Eur Spine J (2019) 28:2873–2933
https://doi.org/10.1007/s00586-019-06102-1

ABSTRACTS

EUROSPINE 2019: ePosters

BASIC SCIENCE, BIOLOGY

P1

ATTENUATION OF INTERVERTEBRAL DISC DEGENERATION AND OSTEOPHYTE FORMATION VIA INHIBITION OF HEDGEHOG SIGNALING

Hokuto Fukuda, Eiichiro Nakamura, Ken Sabanai, Manabu Tsukamoto, Yasuaki Okada, Shinichiro Takada, Akinori Sakai

Dept of Orthopeadic surgery, UOEH, Japan

Purpose: Sonic hedgehog (Shh), secreted by the nucleus pulposus cells, is essential for cell proliferation in the growing disc and for the synthesis of its differentiation in the developmental stage. Indian Hedgehog (Ihh) is expressed at the prehypertrophic chondrocytes in the endplate cartilage of vertebral body. In the process of lumbar spondylosis, however, the expression and the molecular functions of Hedgehog signaling has not been elucidated. In this study, we investigated the effect of Hedgehog on the process of disc degeneration and osteophyte formation by knocking out Smoothened (Smo) which is an essential transducer of Hedgehog signaling, and by administration of an antagonist of Smo.
Methods: We crossed Smo/flox with RosaCreER(T) mice to generate Smo conditional knockout (cKO) mice upon administration of Tamoxifen. To promote intervertebral disc degeneration, we resected bilateral facet joints of 4–5th lumbar vertebra of mice at 8 weeks old. We had kept mice in a climbing cage with 1 m height for 8 weeks from 1 week after the operation. In this cage, mice voluntarily had climbed up and down to get water and feed. We sacrificed mice at 9 weeks after operation and compared Smo cKO group with the control group. We also investigated the effect of Sonidegib, which is an antagonist of Smo, on disc degeneration. Mice were intraperitoneally administered Sonidegib 3 times per week after operation, from 2 weeks after operation, and from 4 weeks after operation. In control group, mice were administered Saline 3 times per week after operation. We sacrificed mice at 10 weeks after operation, and compared among the four groups. By using μCT, we took images of L4–5th intervertebral disc of mice before operation and after sacrifice to calculate disc height reduction rate. To histological evaluation, HE staining, Safranin O staining, and immunohistochemistry were performed. Disc degeneration was evaluated by Masuda classification of intervertebral disc degeneration.
Result: In the control group, disc degeneration and osteophyte formation of vertebra were observed, whereas in the Smo cKO group, those findings were obviously attenuated by the Masuda classification. Disc height reduction was more severe in control group than in Smo cKO group. VEGF positive cells were observed at the anulus fibrosus of the degenerative disc and endplate cartilage in control group, but not observed in Smo cKO group. In comparison between administered Sonidegib groups and Saline group, disc height reduction rate and Masuda classification score were significantly increased in Saline group against the group administered of Sonidegib after operation.
Conclusion: Intervertebral disc degeneration and vertebral osteophyte formation were significantly suppressed in Smo cKO group and the group administered Sonidegib after operation. It was suggested that Hedgehog pathway is significantly associated with intervertebral disc degeneration and osteophyte formation.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none.

P2

CLINICAL TRIAL FOR SPINAL CORD INJURY WITH NEURAL LINEAGE STEM CELL

Keung-Nyun Kim

Dept. of Neurosurgery, Yonsei University, Seoul, Korea

The safety, tolerability, and neurological status were analyzed after transplantation of human neural stem/progenitor cells (hNSPCs) into the injured cord for 19 patients with traumatic sensorimotor complete (n = 17) or motor complete (n = 2) cervical SCI. Participants were 18–57 years of age with no concurrent peripheral nerve or nerve root injury. hNSPCs were derived from the fetal telencephalon at 13 weeks of gestation, grown, and maintained as neurospheres, and transplanted into the injured cord from 2 weeks to 6 months after SCI. In the control group, who did not receive cell implantation, but were otherwise closely matched with the transplantation group, 15 patients with traumatic cervical SCI were included. Assessments included medical and neurological examinations using the American Spinal Injury Association Impairment Scale (AIS), electrophysiological monitoring, and magnetic resonance imaging. At 1 year after cell transplantation, there was no medical or surgical complication to indicate that the procedure was unsafe. There was no evidence of cord damage, syrinx or tumor formation, or deterioration in neurological status. AIS grade improved in 5 of 19 (26.3%) transplanted patients, 2 (A → C), 1 (A → B), and 2 (B → D), but only one in the control group was improved (A → B). In the early subacute treatment group, 30% (3/10) of patients with AIS-A improved to AIS-B or C. Improvements included increased motor scores, recovery of motor levels, and responses to somatosensory (35.3%) and motor evoked potentials (58.8%) in the transplantation group. These results demonstrate that the transplantation of allogeneic fetal hNSPCs into cervical SCI is safe and well-tolerated, and is of some neurological benefit up to 1 year post-implantation. Further long-term, larger-scale, and randomized clinical trials are required to establish evidence of safety and efficacy.
Disclosures: author 1: none.

BASIC SCIENCE, BIOMECHANICS

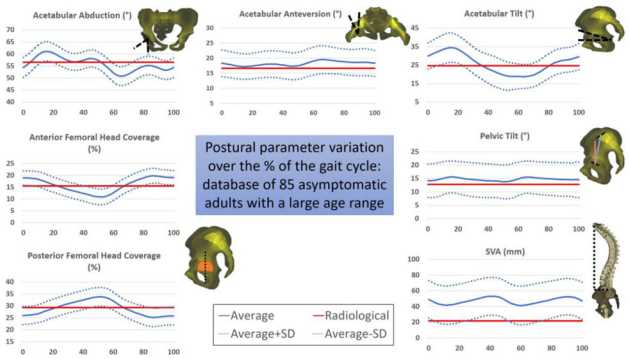
P3

BRIDGING THE GAP BETWEEN STATIC AND DYNAMIC: HOW GLOBAL POSTURAL, SPINO-PELVIC AND HIP ALIGNMENT PARAMETERS PERFORM DURING WALKING?

Ayman Assi, Ziad Bakouny, Fares Yared, Joeffroy Otayek, Aren Joe Bizdikian, Ismat Ghanem, Gaby Kreichati, Helene Pillet, Xavier Bonnet, Virginie Lafage, Wafa Skalli

Faculty of Medicine, University of Saint-Joseph, Beirut, Lebanon; Institut de Biomecanique Humaine Georges Charpak, Arts et Metiers ParisTech, Paris, France; Spine division, Hospital for Special Surgery, New York, USA

Introduction: Alteration of spino-pelvic and global postural alignment affects QoL and activities of daily living, such as walking. Evaluation of gait through motion capture in subjects with spinal deformities is becoming important to assess dynamic stability. Global postural and spino-pelvic alignment parameters are usually assessed on static standing full-body radiographs while hip alignment parameters are assessed on CT-scan supine images. However, while most of these parameters are positional and could vary during gait, there are currently no studies investigating how they are modified during walking.
Purpose: To evaluate the variation of postural alignment parameters during walking.
Methods: 85 asymptomatic adults (age: 30 ± 5 years [18–60]) underwent motion analysis during gait with reflective markers on the lower limbs and C7 spinous process. Subjects then underwent low dose biplanar X-rays in standing position, with the reflective markers still in place. Subject-specific 3D reconstructions of the spine, pelvis, and lower limbs were performed and the following 3D radiological postural parameters were calculated in the static position: pelvic tilt (PT), sagittal vertical axis (SVA), acetabular abduction (Acet_Abduction), anteversion (Acet_Anteversion) and tilt (Acet_Tilt) as well as the anterior (Ant_Cov) and posterior (Post_Cov) coverage of the femoral head by the acetabulum. The 3D bones were registered at each frame of the gait cycle. The postural parameters were then computed during the gait cycle, using the 3D registered bones, at each time frame: means and ranges of motion (ROM) were calculated.
Results: Some of the parameters exhibited large ROM during the gait cycle (Fig. 1) such as: SVA (23 ± 7 mm), Acet_tilt (18 ± 7°), Acet_Abduction (11 ± 3°), and coverage of the femoral head anteriorly and posteriorly (9 ± 1%). During walking, all the parameters varied around their standing posture value, except for the SVA which was shifted anteriorly (25 mm) and PT which was slightly increased by 2°. A minimum of Acet_Abduction (50 ± 3°) was associated with a maximum of Post_Cov (36 ± 4°), both at the beginning of the swing phase of the gait cycle.
Discussion: This is the first study to describe how postural parameters perform during walking. The anterior shift and large ROM of SVA as well as the increase of PT during walking emphasizes the importance of considering the dynamic variation induced by gait when planning surgical re-alignment of the spine. Furthermore, the minimum of acetabular abduction (maximal lateral coverage) associated with a maximal posterior coverage of the acetabulum when subjects start to move their limb forward during walking (swing phase) could lead to a posterior femoro-acetabular conflict. The findings of this study contribute to the understanding of both spine-hip syndrome and normative behavior of postural alignment parameters in the dynamic state, allowing for their better appreciation in subjects with adult spinal deformity.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: grants/research support: ISSG, consultant: Globus, DepuySpine, stock/shareholder: Nemaris; author 11: none.

P4

COMPARISON OF CERVICAL SAGITTAL PARAMETERS AMONG PATIENTS WITH NECK PAIN AND HEALTHY CONTROLS

Morteza Faghihjouybari, Mohsen Rostami, Ramin Kordi

Department of Neurosurgery, Shariati Hospital, Tehran, Iran

Introduction: Previous studies have shown poor health-related outcomes among patients with spinal sagittal malalignment of the thoracolumbar or spinopelvic region and less interest has been paid to the relationship between cervical sagittal balance and functional outcome of the patients. This study aims to compare the cervical sagittal parameters between patients with non-specific neck pain and asymptomatic controls.
Method: Twenty-five patients with non-specific neck pain and 25 age and BMI matched controls participated in the study. Using a standard lateral cervical radiography, the Cobb angle between Occiput–C2, C1–C2, C1–C7, and C2–C7, as well as the thoracic inlet angle (TIA) and C7 and T1 slope angles were measured. Also the Spine cranial angle (SCA) and the C2-SVA (Sacral Vertical Axis) and C1-SVA were measured.
Results: There was no difference in cervical lordosis curvature (measured by C2-C7 and C1–C7 lordosis angle) between patients with non-specific NP and healthy controls. Comparing the cervical sagittal indices between the groups, we found that T1 slope angle was significantly (p Value = 0.02) lower in patients with neck pain. We found no significant differences between the groups, in case of other cervical sagittal parameters.
Conclusion: Our findings showed that the slope of the upper-end plate of T1 vertebrae body (T1 slope) is significantly lower among patient with non-specific neck pain comparing to controls. A compensatory mechanism to bring the center of head gravity back to the spinal axis could be the possible explanation for this difference. This mechanism might be the origin of pain in these patients.
Disclosures: author 1: not indicated; author 2: none; author 3: none.

P5

SACROPELVIC FIXATION: A BIOMECHANICAL COMPARISON BETWEEN DIFFERENT TECHNIQUES ACCOUNTING FOR MICROMOTION AT THE BONE-IMPLANT INTERFACE

Fabio Galbusera, Gloria Casaroli, Matteo Panico, Ruchi Chande, Derek Lindsey, Scott Yerby, Ali Mesiwala, Marco Brayda-Bruno

IRCCS Istituto Ortopedico Galeazzi, Milan, Italy

Introduction: Sacropelvic fixation is frequently used in combination with thoracolumbar instrumentation in select cases of complex spinal deformity correction. Several clinical investigations have demonstrated that pelvic fixation reduces the rate of pseudoarthosis at the lumbosacral junction and increases the stability of the construct, but is also associated with complications such as of implant loosening and failure, especially at the S1 level. This study is aimed at comparing three different sacropelvic fixation techniques in combination with lumbosacral instrumentation, namely iliac screws (IL), S2 alar-iliac screws (S2AI) and laterally placed triangular titanium implants (SI) in terms of resulting stresses on the instrumentation and loads at the bone-implant interface.
Methods: Finite element models of the pelvis, sacrum and L5 vertebra from CT scans of three female patients were built and validated against literature data. For each patient, three models including different sacropelvic fixation solutions, specifically IL, S2AI and SI (iFuse Implant System, SI-Bone Inc., Santa Clara, CA), were derived from the main model. All models also included pedicle screw and posterior rod fixation at the lumbosacral junction. In order to realistically simulate the interaction between the different hardware with the adjacent bone tissue, spring elements with mechanical properties calibrated from experimental tests in synthetic bone were used. A 500 N compressive load in combination with 7.5 Nm moments in flexion, extension, lateral bending and axial rotation were applied to each model.
Results: With respect to lumbosacral fixation only, IL and S2AI induced a reduction of the peak stresses in the S1 pedicle screws (up to 55%), whereas SI had a negligible influence. The stresses in the posterior rods were mostly unaffected by S2AI and SI, but the use of IL resulted in a stress increase up to 48% in extension. S2AI and IL induced a minor decrease of the bone-screw interface force at S1, whereas SI had a negligible effect. In general, IL were subjected to marginally higher pull-out forces than S2AI. The highest pull-out forces were recorded for flexion and axial rotation.
Conclusions: S2AI appeared to have a stronger protective effect on the lumbosacral instrumentation with respect to IL, especially in terms of rod stresses. The triangular titanium implants, being disconnected from the posterior rods, did not have a significant effect on the lumbosacral implants.
Disclosures: author 1: grants/research support: SI-Bone, Santa Clara, CA, USA; author 2: none; author 3: none; author 4: stock/shareholder: SI-BONE, employee: SI-BONE; author 5: stock/shareholder: SI-BONE, employee: SI-BONE; author 6: stock/shareholder: SI-BONE, employee: SI-BONE; author 7: consultant: NuVasive; author 8: grants/research support: Medtronic, Depuy Spine, K2M, consultant: Implanet, K2M, Spineguard.

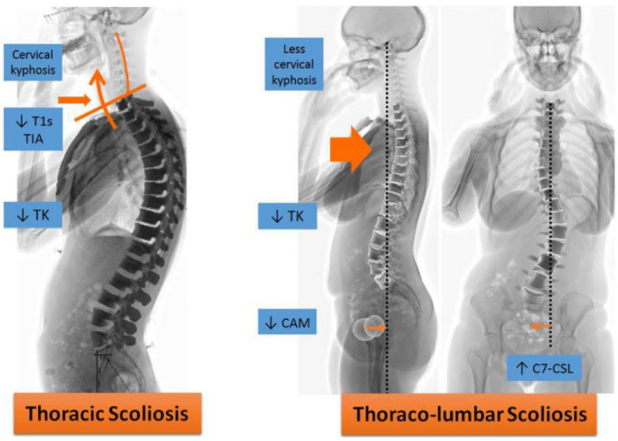
P6

THREE-DIMENSIONAL FULL BODY POSTURAL ALIGNMENT IN SUBJECTS WITH AIS WITH DIFFERENT TYPES OF CURVATURE

Nour Khalil, Mohammad Karam, Ayman Assi, Wafa Skalli, Renee Maria Saliby, Elma Ayoub, Maria Saade, Celine Chaaya, Ali Rteil, Marc Fakhoury, Gaby Kreichati, Khalil Kharrat, Ismat Ghanem

Faculty of Medicine, University of Saint-Joseph, Beirut, Lebanon; Institut de Biomecanique Humaine Georges Charpak, Arts et Metiers ParisTech, Paris, France

Introduction: Scoliosis is a 3D deformity of the spine that can occur at the thoracic (T), thoraco-lumbar (TL) or lumbar (L) segments and affects spino-pelvic alignment. It is still unclear how each type of curvature in adolescent idiopathic scoliosis (AIS) affects full-body postural alignment from head to feet.
Purpose: Compare 3D full-body postural alignment between AIS subjects with different types of curvature and controls.
Methods: This is a cross-sectional study where a group of AIS subjects and a control group (C) underwent full-body low dose biplanar X-rays in standing position with 3D calculation of spino-pelvic (PI, PT, SS, T1T12 kyphosis, L1L5 lordosis), global postural (CAM-HA: distance between center of auditory meatus and hip axis, SVA, C7-CSL: C7 frontal plumbline), cervical (OC2, C0C2, C1C2, C2C7, C2 & T1 slope, cervical SVA, Cranial, neck & cervical tilt, TIA: thoracic inlet angle), gaze (CBVA, SLS) and lower limb (pelvic shift, Knee flexion/extension) parameters. In order to understand how the scoliotic deformity affects full body postural alignment, an ANOVA test was performed on all the aforementioned parameters between T, TL, L and C groups with pairwise comparisons.
Results: 240 AIS (224 F, 14 $\pm$ 3 years) age and sex matched to 60 controls were included. The Cobb angle was significantly higher in the T group compared to TL & L (T: 43° vs TL: 32°, L: 26°). T1T12 was lower in T, TL, L groups compared to controls (T: 31° TL: 33° L: 37° vs C: 42°). In the TL group, CAM-HA was lower (TL: $-$ 30 mm vs C: $-$ 17 mm) and C7-CSL was higher (TL: 14 mm vs C: 7 mm) than controls. At the cervical level, C2C7, T1 s and TIA were lower in the T group than controls (C2C7: $-$ 10° vs $-$ 3°; T1 s: 17° vs 21° and TIA: 63° vs 67°, all $p < 0.05$).
Conclusion: This is the first study to compare the full body postural alignment of AIS subjects with different types of curvatures to controls. No differences were found in pelvic, gaze and lower limb parameters between groups. In the T group the thoracic hypokyphosis was accompanied by a decrease in TIA and T1 s leading to cervical kyphosis. In the TL group, the thoracic hypokyphosis could lead to a backward alignment with a decrease in CAM-HA, accompanied by a less prominent cervical kyphosis than in the T group. Subjects with TL scoliosis showed frontal imbalance. The L group had the lowest frontal deformity, hence lower decrease in TK and no other modifications in global alignment.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: none;.

P7

DOES OVERSTUFFING A TOTAL DISC REPLACEMENT DEVICE LIMIT CERVICAL RANGE OF MOTION?

Kee Kim, Tejas Karnati, Vijay Permeswaran, Amy Claeson, Anup Gandhi

University of California Davis School of Medicine, Sacramento, CA, USA; Zimmer Biomet Spine, Westminster, CO, USA

Background context: Total disc replacement (TDR) is a popular treatment for degeneration of the cervical spine, as it is thought to preserve motion at the index level. However, inappropriate sizing of the height of these devices may increase the stiffness of the cervical spine, decrease range of motion (ROM) at the index level, and increase the likelihood of adjacent level disease. In this study, we tested the effect of overstuffing biomechanically with cadaveric cervical spines and mobile-core TDR devices.
Methods: Eight cervical (C2-T1) cadaveric spinal specimens (average age: 43 ± 12 years) were dissected and prepared for testing. The eight specimens were split into two groups, with three interventions each. For both groups, the first two interventions were the native state, followed by implantation of a mobile-core TDR (Mobi-C, Zimmer Biomet) at both C4-C5 and C5-C6. For the third intervention, the Mobi-C TDR at either C5-C6 (Group A) or C4-C5 (Group B) was replaced with another Mobi-C device with identical footprint but 1 mm taller height core (overstuffed). Optoelectronic markers were attached to each vertebrae of each specimen to allow for motion tracking of segmental and total range of motion (ROM). A servo-hydraulic 6 degree-of-freedom spinal simulator was utilized to test each specimen in three cycles of kinematic, pure moment flexion/extension loading. The last cycle of each test was analyzed to determine the maximum ROM achieved for each segment, intervention and specimen. The maximum overall ROM for the intact state was measured and used as a target to determine what additional moment would be needed to overcome potential drops in ROM at the operated levels. The elastic zone of the ROM curve was used to fit a logarithmic curve, which was extrapolated to find the moment at which the total ROM of the current intervention would reach the intact ROM. The ROM data was normalized to the intact condition, tested with a Shapiro–Wilk test for normality, and the appropriate 1-way repeated measured ANOVA test was performed to assess for statistical significance ($p < .05$).
Results: Overstuffing of the TDR device caused significant decreases in flexion/extension ROM, resulting in a 55% reduction in ROM at C4-C5 and a 53% reduction in ROM at C5-C6 compared to intact. No difference in index level ROM was detected between intact and the 2-level Mobi-C construct at both levels. This reduction in ROM at the index level translated to a significant reduction in total ROM in the overstuffed (↓15%) compared to intact. However, no significant change in compensatory moment was measured between the overstuffed and intact interventions.
Conclusions: Overstuffing of a TDR device by 1 mm reduced flexion/extension ROM by > 50% at the index level (C4-C5 and C5-C6) and 15% for the total cervical spine compared to the native state. Appropriate sizing of a TDR device at two-levels created ROM that were not significantly different from the native state.

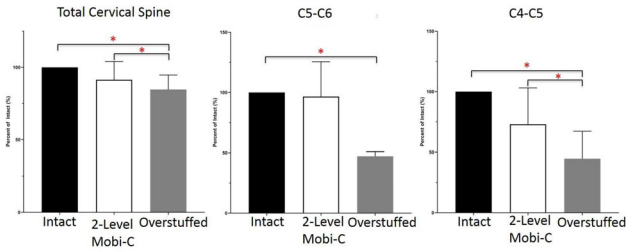


Figure 1: Maximum ROM for the total cervical spine and the index levels (C4-C5 and C5-C6) for intact, 2-level Mobi-C, and 2-level Mobi-C with 1 level overstuffed by 1 mm

Disclosures: author 1: grants/research support: Vertex, InVivo, Medtronic, Mesoblast, Seikagaku, ZimmerBiomet, consultant: Vertex, ZimmerBiomet, stock/shareholder: Moelcular Matrix, royalties: Precision Spine ZimmerBiomet; author 2: none; author 3: employee: Zimmer Biomet Spine; author 4: employee: Zimmer Biomet; author 5: employee: Zimmer Biomet Spine.

P8

DEVELOPMENT OF A BIOMECHANICAL TEST SETUP FOR PEDICLE SCREW INSTRUMENTATIONS REGARDING THE COMPLEX ILIOSACRAL JOINT LOADING

Sven Krüger[1], Jens Beger[1], Bernd Wiedenhöfer[2], Christoph Schilling[1]

[1] Aesculap AG, Tuttlingen, Germany; [2] ATOS Klinik, Heidelberg, Germany

Introduction: The instrumentation of the ilium for additional stability of a spinal pedicle screw construct is common during complex spinal surgeries. This challenging procedure is often accompanied by the usage of rod connectors to bridge the iliosacral joint without fusion. However, those instrumentations are associated to a high rate of mechanical failure. No testing standard exists which covers the complex loading situation these pedicle screw instrumentations are exposed to.
Purpose: A test setup, taking into account the complex loading situation of the iliosacral joint, is evaluated and validated with values available in literature.
Materials and methods: Based on the anatomical situation and the values of the iliosacral joint motion available in literature a biomechanical test setup was developed. This includes test blocks representing the two lower lumbar vertebrae, the sacrum and the two iliac bones (Fig. 1). The L4/L5 and L5/S1 spinal segments are set up as derived from ISO12189:2008 but with a lumbar lordosis. The sacrum offers the possibility to receive S1 as well as S2 screws. The

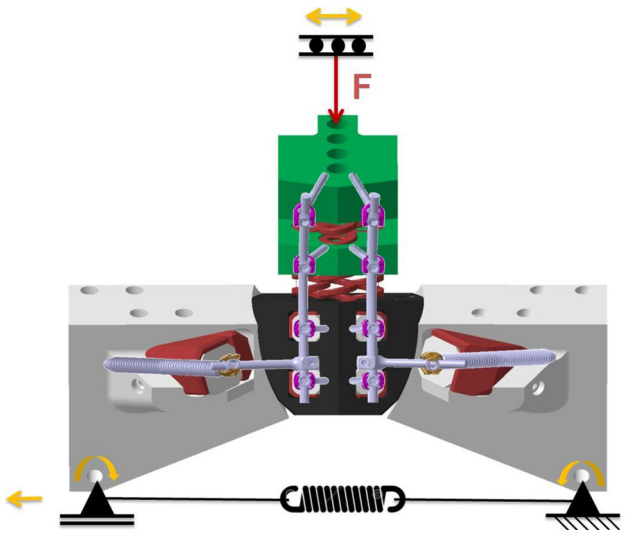
symmetrically arranged ilium test blocks are configured to receive iliac screws with the possibility to vary the position of screw placement. The iliosacral joint is realized by two bilateral, spherical shaped gliding surfaces to allow rotation as well as translational movement. The screws are placed in changeable inlays. Thus, the quality of the screw-bone interfaces can be varied by choosing different fixation materials based on the purpose of a study.

To reflect the loading situation of the iliosacral joint the nutation, a combination of shear and rotational movement was realized with a specific combination of boundary conditions and load application (Fig. 1).

The applied load level is set to achieve a movement of the iliosacral joint which is in a physiological range. This is based on the assumption that due to the high loading within the iliosacral joint its movement in vivo is not fully prohibited by the pedicle screw instrumentation.

Results: The movement of the test blocks relative to each other was evaluated using an optical measurement system. The cranial-caudal translation and the angulation of the sacroiliac joint were chosen as main parameters for validation of the test setup. Both values were in the range of the values given in the literature for compression loading. During a first study with a load increase protocol clinical relevant failure modes as screw, connector and rod failures could be observed.

Conclusion: The described test setup offers the possibility for the investigation of an iliac screw instrumentation under the complex loading situation of the iliosacral joint. In addition to the preclinical evaluation of implants, clinical factors as for example screw loosening topics or different instrumentation techniques can be studied.



Disclosures: author 1: employee: Aesculap AG; author 2: employee: Aesculap AG, Tuttlingen, Germany; author 3: consultant: BBraun Aesculap; author 4: employee: AESCULAP AG.

P9

INCONSISTENCY WITHIN SCOLIOSIS SURGEONS TREATING THE SAME AIS-CASES. AN EVALUATION OF A MULTI-CENTRE-SURVEY

Benedikt Schlager, Michael Ruf, Michael Akbar, Frank Niemeyer, Fabio Galbusera, Hans-Joachim Wilke, Bernd Wiedenhöfer

Institute of Orthopaedic Research and Biomechanics, Ulm, Germamy

Introduction: Surgical treatment of adolescent idiopathic scoliosis (AIS) is very complex and modern instrumentation techniques offer multiple possibilities. Despite numerous publications, there is no clear consensus on the optimal strategy for the correction of this spinal deformity.

The goal of this study was to document and analyse the surgeon variability in surgical treatments of patients with AIS.

Method: Eight experienced surgeons from different hospitals were asked to plan surgeries on twelve patients with AIS, two for each Lenke-type. The surgical planning was based on the patients' radiographs and was documented using a questionnaire. The patients' data were acquired retrospectively and included radiographs of the lateral and frontal planes, as well as lateral bending to the left and right. The angles of the main spinal curvatures were specified in the questionnaire. The surgeons were asked to specify the Lenke-type, their surgical approach, the planned fusion length, the type of implant and the resection steps.

The data were analysed with respect to the inter-rater variability which was quantified using the Fleiss-Kappa Method.

Results: In choosing the surgical approach, the surgeons concurred most with Lenke-curve-types 2 ($\kappa = 0.88$) and 4 (0.75). The largest differences were shown for Lenke 1 (0.39) and 5 (0.32). Anterior approaches were selected in the majority of cases for Lenke types 5, with a frequency of 50%. The surgeons who chose an anterior approach had a shorter fusion length, with 4 levels in average, than those who used posterior approaches. The strongest deviation in fusion length was documented at Lenke-curve type 6. Mono- and polyaxial screws were nearly exclusively used for the posterior instrumentation; hooks, however, seldom.

Conclusions: With this survey, the instrumentation technique of surgeons could be documented. The results indicate that the differences in the surgical approach particularly depend on the Lenke-curve-type. The variation in the fusion length depends on the direction of the surgical approach and the consideration of the secondary (contralateral) curvature.

The documented discrepancies indicate the lack of scientific evidence for the optimal treatment and biomechanical understanding of AIS. The result of this survey can be used as basis for further biomechanical studies.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: not indicated; author 5: none; author 7: grants/research support: Signus, Neos, ApiFix, Spinol, 3D Matrix.

P10

SPINAL ALIGNMENT DURING MOTION AND ITS RELATION TO BALANCE CONTROL IN ADULT SPINAL DEFORMITY

Pieter Severijns, Thomas Overbergh, Kaat Desloovere, Lieven Moke, Lennart Scheys

Institute for Orthopaedic Research and Training; KU Leuven, Belgium

Hypothesis: Dynamic spinal alignment in adult spinal deformity differs from controls and relates to balance control.

Introduction: Adult spinal deformity (ASD) patients show decreased function in terms of balance control. Surprisingly this decrease did so far not show any relation with 2D static spinopelvic parameters. (1) This study explores if instead a relation exists between balance and dynamic spinal alignment, using an innovative method to assess 2D spinal parameters during dynamic conditions.

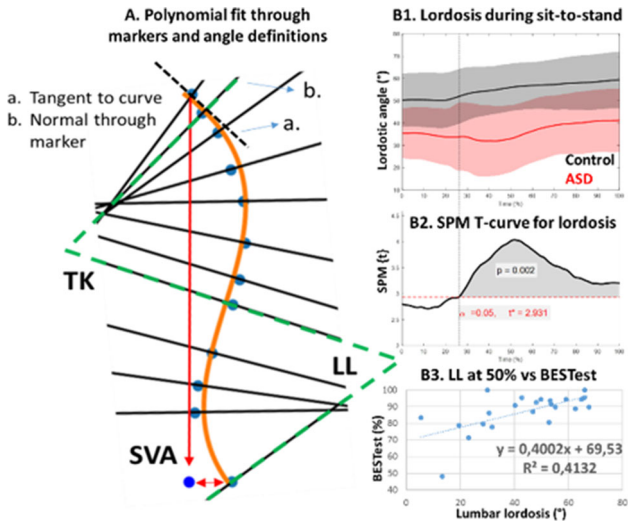
Methods: 12 sagittal ASD patients and 12 controls performed a sit-to-stand (STS) task in a motion lab. 12 markers were placed on the

spinous process of C7, T1, T3, T5, T7, T9, T11, T12, L2, L3, L4 and S2. To link the markers to the true anatomy of the subject the markers were corrected to the 3D positions of the vertebral bodies based on biplanar X-rays. Then a 3rd order polynomial (2) was fitted through the markers' 3D trajectories. Angles were defined by the normals through the markers (Fig 1. Ab) on the polynomial's tangents (Fig 1 Aa). Dynamic thoracic kyphosis (TK) and lumbar lordosis (LL) were measured from T1-T12 and T12-S2. Dynamic sagittal vertical axis (SVA) was defined by the distance between the S2 marker and the projection of the C7 marker on the S2 transverse plane. A Statistical Parametric Mapping (SPM) unpaired *t* test was used to compare time-normalized dynamic spinal parameters. Balance control was assessed using the Balance Evaluation Systems Test (BESTest). To explore the relation between spinal motion and balance control SPM regression analysis was performed.

Results: LL was significantly lower during STS in ASD patients (27–100% of STS cycle) with a clearly decreasing LL from 27 to 50%, which is not observed in control subjects. A significant relation between LL and BESTest (max r = 0.64 at 50% of the motion curve; p = 0.004) revealed that the use of more LL during STS was associated with better balance performance measured with the BESTest. No differences were found between ASD patients and controls for TK and SVA motion curves.

Conclusion: ASD patients use more lumbar flexion during STS indicated by a decrease in lumbar lordosis, compared to controls who increase their lordosis through the whole movement suggesting the use of pelvic anteversion. Decreased dynamic lumbar lordosis might be an underlying mechanism of decreased functionality in ASD, since it shows a significant relation with balance control.

(1) Moke et al. Spine. 2018 May 1;43(9):637–646.; (2) Ignasiak et al. Hum Mov Sci. 2017 Aug;54:230–239.



Disclosures: author 1: grants/research support: Medtronic; Research Foundation Flanders (FWO); author 2: grants/research support: Medtronic; author 3: none; author 4: grants/research support: KU Leuven Medtronic Educational Chair for Spinal Deformity Research 2013–2017, consultant: KU Leuven C2 grant Advanced Spinal Evaluation and Surgical Planning Platform (ASESP-P); author 5: grants/research support: Medtronic, Depuy-Synthes, Zimmer-Biomet, Smith&Nephew, Arthrex, V!GO.

P11

HUMAN RECOMBINANT ERYTHROPOIETIN IMPROVES MOTOR FUNCTION IN CHRONIC CERVICAL COMPRESSION MYELOPATHY RAT MODEL

Takahiro Tanaka, Hidetoshi Murata

Department of Neurosurgery, Yokohama City University, Yokohama, Kanagawa, Japan

Objective: Erythropoietin (EPO) is a hematopoietic cytokine for red blood cell production in the bone marrow, and clinically used to treat chronic anemia. Recently, the neuroprotective effects of EPO have been reported in cerebral infarction, brain contusion and acute spinal cord injury. Here, we assessed neuroprotective effect of EPO in a rat chronic spinal cord compression model to explore the potential as a pharmacological treatment for cervical spondylotic myelopathy.

Methods: Male Wistar rats were used to produce chronic cervical compression model, a sheet of gradually expandable urethane compound polymer (size 2 × 6 × 0.7 mm) was inserted into sublaminar space of C5-C6. The motor functions (rotarod performance and grip strength) were evaluated once a week. In preliminary experiment, motor functions significantly declined 7 weeks after surgery, so recombinant human EPO (rhEPO) 5000 IU/kg, 500 IU/kg or normal saline (NS) was administered subcutaneously from 8 to 16 weeks after surgery two times a week. 16 weeks after surgery, cervical spinal cords were evaluated histopahologically. In another experiment, terminal deoxynucleotidyl transferase-mediated deoxyuridine triphosphate-biotin nick and labeling (TUNEL) stein was made to analyze apoptotic cell death and microvascular remodeling at 10 weeks after surgery.

Results: In high dose rhEPO group, rotarod performance was improved from 9 to 15 weeks and grip strength was improved from 9 to 16 weeks after surgery significantly compared with low dose rhEPO group and NS group. Motor neurons in anterior horn were also preserved significantly in high dose rhEPO group. Apoptotic cells were significantly lower than another two groups.

Conclusions: EPO preserves motor functions and anterior horn motor neurons in the rat chronic spinal cord compression model. EPO also improves motor function even in the progressive phase of compression myelopathy.

Disclosures: author 1: none; author 2: grants/research support: The General Insurance Association of Japan and a Grant-in-Aid for Scientific Research of Japan (17K10903).

P12

EARLY DETECTION OF PROGRESSIVE IDIOPATHIC SCOLIOSIS THROUGH THE QUASI-AUTOMATIC 3D RECONSTRUCTION OF THE SPINE FROM BIPLANAR RADIOGRAPHY

Claudio Vergari, Laurent Gajny, Eric Ebermeyer, Kariman Abelin-Genevois, Raphael Vialle, Ayman Assi, Ismat Ghanem, Jean Dubousset, Wafa Skalli

Institut de Biomecanique Humaine Georges Charpak, Paris, France

Adolescent idiopathic scoliosis (AIS) is a deformity of the spine and the rib cage. Conservative treatment aims at slowing down or stopping the progression of the deformity to avoid the need for surgery; it is more efficient when started early. A severity index (s-index) for scoliosis was recently described in the literature: it was preliminary

validated on 65 AIS patients, out of which 89% of progressive cases were correctly detected. However, the calculation of the s-index was based on the 3D reconstruction of the spine from biplanar radiography, a time-consuming method which relies on the operator's experience. The aim of this work was to test a novel quasi-automatic reconstruction method to calculate the severity index.

Fifty-five patients were collected prospectively after approval of the ethical committee. Patients were diagnosed with AIS, and had a Cobb angle between 10° and 25°, and Risser sign < 3. Patients were followed until prescription of bracing, and considered progressive, or until skeletal maturity with no progression (Risser ≥ 3 and Cob angle ≤ 25°) and considered as stable. Bracing was based on a 5° increase of Cobb angle in six months or less, together with a worsening of the clinical appearance.

All patients underwent biplanar radiography in free-standing position at their first exam, and a quasi-automatic 3D reconstruction of the spine was performed. The reconstruction started with the digitization of few anatomical landmarks in the two radiological views. An initial 3D solution was automatically computed from statistical inference and projected on the frontal radiography: the user could then adjust the horizontal position and axial rotation of 7 key vertebrae (apex, junctions and adjacent). The s-index was then calculated automatically, and it was compared to the outcome of patients. Moreover, three operators (with reconstruction experience between same-day and five-years) repeated the reconstruction twice on a subset of 30 patients. Intraclass Correlation Coefficient (ICC) was calculated to determine inter-operator reproducibility.

Overall, 85% of the patients were correctly classified with a sensitivity of 92% and specificity of 74%. „Good"inter-operator agreement was observed (ICC = 0.63), with percentage agreement higher than 80%. In the reproducibility study, 80% of the reconstructions yielding s-index indicating progression, were correct.

Although fifty-five patients are still a small cohort, this preliminary study shows promising results, by detecting 80% of the progressive patients, even when reconstructions were performed by an operator with same-day training. Furthermore, the manual labor for the method's initialization and adjustments took less than 4 min. Data collection for the s-index's extensive validation is under way; such index could allow very early initiation of conservative treatment for progressive patients, thus increasing treatment efficacy and therefore reducing the need for surgery.

Disclosures: author 1: grants/research support: ParisTech BiomecAM chair program on subject-specific musculoskeletal modelling (with the support of ParisTech and Yves Cotrel Foundations, Société Générale, Proteor and Covea); author 2: none; author 3: none; author 4: consultant: Medicrea; author 5: consultant: Stryker spine; Eos imaging; Spineguard; Nuvasive; author 6: none; author 7: none; author 8: none; author 9: none;.

P13

SPINE SLENDERNESS IN ADOLESCENT IDIOPATHIC SCOLIOSIS

Claudio Vergari, Mohammad Karam, Raphael Pietton, Raphael Vialle, Ismat Ghanem, Wafa Skalli, Ayman Assi

Arts et Métiers ParisTech, Paris, France

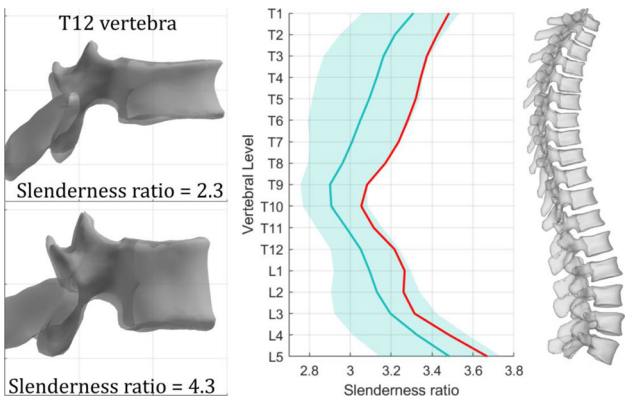
Adolescent idiopathic scoliosis (AIS) is a spinal deformity that induces a lateral displacement of the apical vertebra and a torsion of the vertebral column. It was shown that girls, who are more affected by AIS than boys, tend to have slenderer spines than boys. Moreover, AIS patients tend to be taller than healthy adolescents of the same age. It is still unknown if the 3D shape of the spine and its slenderness are different between AIS patients and controls. The aim of this study was to characterize disc and vertebral slenderness of AIS patients with different type of curvatures, relative to healthy controls.

321 AIS patients (272 girls, 14 ± 2 years, Cobb angle 35 ± 18°) and 83 control subjects (56 girls, 14 ± 3 years) were retrospectively included. Subjects underwent standing biplanar radiographs with 3D reconstruction of the spine. Patients were grouped according to the type of curvature (T: thoracic, TL: thoraco-lumbar, L: lumbar). Width, depth, height and slenderness ratio were calculated for all vertebrae and discs; slenderness ratio was calculated as the ratio of transverse diameters to vertebral (or disc) height. Correlations were analyzed with Spearman's rank test and differences between groups with Kruskal–Wallis tests ($\alpha = 0.05$).

Results showed that AIS patients had significantly smaller vertebrae (width and depth) than controls at all vertebral levels ($p < 0.05$). Vertebrae were significantly slenderer in patients with TL curves (N = 101) than in controls at all levels ($p < 0.001$), while T curves (N = 159) were slenderer than controls at all levels except for T7 and T8 ($p < 0.05$). L curves (N = 61) had slenderer vertebrae than controls between T5 and L5 ($p < 0.05$; Figure 1a).

Figure 1 shows an example of high and low slenderness ratio of T12 vertebrae in AIS and controls, as well as a comparison of slenderness ratios along the spine of the two groups: AIS patients had slenderer spines than about 75% of controls. Vertebral slenderness, width and height of the apex were inversely correlated to Cobb angle ($p < 0.01$). Width and depth of upper and lower junctional vertebrae were also inversely correlated to Cobb angle ($p < 0.01$). Cobb angle was also inversely correlated to apex intervertebral disc slenderness and height, and to disc width and depth at the junctional levels ($p < 0.001$).

Slenderness ratio, which could be a factor of spinal geometrical instability, appears to be altered in scoliotic spines, independently of curve topology. Vertebral slenderness increased with aged and did not seem to be affected by severity, while disc slenderness increased with severity and decreased with age. Longitudinal follow-up of patients could help determine if slenderness is an early phenomenon that could facilitate the onset of the deformity.



Disclosures: author 1: grants/research support: ParisTech BiomecAM chair program on subject-specific musculoskeletal modelling (with the support of ParisTech and Yves Cotrel Foundations, Société Générale, Proteor and Covea); author 2: none; author 3: none; author 4: consultant: Stryker Spine, Eos-Imaging, Spineguard, Nuvasive; author 5: none; author 6: none; author 7: none.

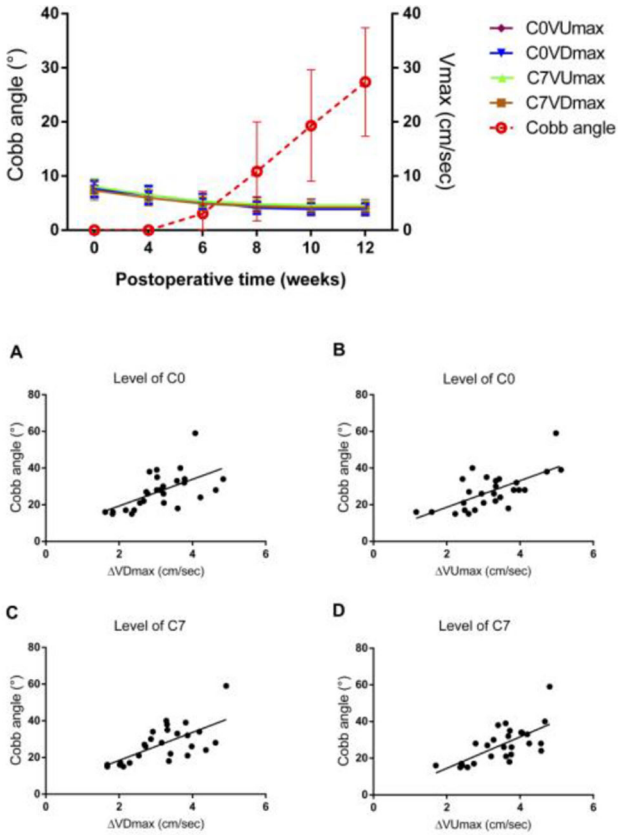
P14

HYDRODYNAMIC CHANGE OF CEREBROSPINAL FLUID FLOW WORKS FOR SCOLIOSIS FORMATION IN A KAOLIN-INDUCED RABBIT MODEL

Zhi Zhao, Yingsong Wang, Jingming Xie, Zhiyue Shi, Qiuan Lu, Ying Zhang, Ni Bi, Quan Li, Tao Li

Department of Orthopedics, the 2nd Affiliated Hospital of Kunming Medical University, Kunming, China

Background: Syringomyelia (SM) is often found in the patient of scoliosis, but the relationship between them is still obscure. The hydrodynamic change of cerebrospinal fluid (CSF) flow has been believed as an important reason of SM. The changes of CSF flow should be included in the researches of scoliosis and associated-SM.
Objective: Based on a kaolin-induced SM-associated scoliosis rabbit model, the potential relationship between cerebrospinal fluid flow (CSF) flow and scoliosis was explored through magnetic resonance image (MRI) analysis and radiography.
Methods: In 40 rabbits, before and after injecting kaolin into C7 spinal cord, through phase contrast-cine MRI (PC-cine MRI) and radiography, CSF flow and spinal curve formation were recorded at consecutive phases. Other 10 rabbits were selected randomly as the control (the same surgical process but using the 0.9% saline to instead of kaolin injection). According to the final formation of scoliosis, the rabbits were divided into 2 groups: scoliosis (group S) and non-scoliosis (group Non-S). The peak velocities of CSF flow, including up-flow (VUmax) and down-flow (VDmax) were measured. Then the relationship between the changes of CSF flow velocity and scoliosis formation were analyzed.
Results: In the 37 survived rabbits after kaolin-induction, spinal curve and/or syrinx were observed from week 6. At postoperative 12 weeks, scoliosis was observed in 73.0% animals and involved in group S and the mean final Cobb angle was 27.4°, and the other 10 without scoliosis were involved in group Non-S. In the control, either scoliosis or SM was observed in none. From the comparison between the 2 groups, the differences of the velocities of CSF flow were more obviously from week 4 to 12 after induction, especially at week 6. In the group S, the peak velocity of CSF flow was diseased gradually after induction. Moreover, the changes of VDmax and VUmax from preoperation to postoperative 12 weeks positively correlated to the final Cobb angle ($P < 0.01$). (Fig.).
Conclusion: The SM-associated scoliosis can be induced by kaolin injection into rabbit cervical spinal cord. In this model, the formation of scoliosis is correlated to the hydrodynamic status of CSF flow. The change of CSF flow could be an important potential factor working for the formation of scoliosis.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none.

CRANIOCERVICAL JUNCTION (ALL PATHOLOGIES)

P15

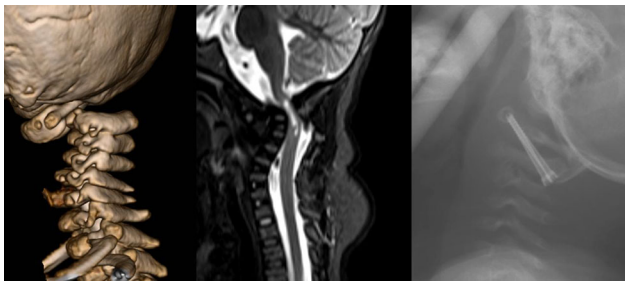
UPPER CERVICAL FUSION SURGERY FOR OS ODONTOIDEUM WITH CHONDRODYSPLASIA PUNCTATA IN PEDIATRIC PATIENTS INCLUDING INFANTS

Yujiro Takeshita, Kota Miyoshi

Dept of Spine Surgery, Yokohama Rosai Hospital, Kanagawa, Japan

Background: Chondrodysplasia punctata (CDP) is a rare skeletal dysplasia characterized by punctate calcification of epiphyseal ossification center. Upper cervical myelopathy due to os odontoideum is known as one of the severe complications with CDP, and sometimes it occurs in early infancy causing life-threatening condition. However, there have been few reports on surgery for this pathology, especially in early infantile cases.
Objectives: To investigate the surgical results of upper cervical fusion surgery for os odontoideum with CDP especially in pediatric patients including infants.
Materials and methods: Retrospective cohort study. 5 consecutive pediatric CDP patients who underwent upper cervical fusion surgery in our single institute between 2007 and 2018 were enrolled in this study. The demographics, radiological and neurological findings,

surgical methods, bony fusion rate and perioperative complications were investigated.
Results: A total of 7 surgeries were done for 5 cases including 3 males and 2 female. The ages at the first visit were 7, 10, 22 months, 3 and 9 years old respectively. The ages at surgery were 8, 12, 14, 18, 22 months, 3 and 14 years old. Atlantoaxial instability due to os odontoideum, significant failure of ossification and punctate calcification of mid-lower cervical vertebrae were seen in all cases. The instability was marked in the 3 infantile cases (7, 10 and 22 months old at first visit). The younger 2 cases had severe quadriplesia with respiratory failure in need of ventilator support. The case of 22 months old at first visit had severe quadriplesia without apparent respiratory failure. These 3 infantile cases showed almost no voluntary movement in the extremities. The elder 2 cases had no apparent neurological deficit. All 7 surgeries were posterior fusion with Halo fixation. 5 surgeries were atlantoaxial and 2 were occipitocervical fusion. Graft bone were iliac autograft in 6 surgeries, rib autograft in 1 surgery and allograft in 3 surgeries. Metal instruments were used in 4 surgeries. However, in 2 surgeries which performed at the age of 14 and 22 months, the too small size of vertebrae did not allow the usage of commercially available spinal instruments (minimum diameter of screw is 3.5 mm). So that instruments designed for hand surgery (the diameter were 2.4–2.7 mm) were utilized as Magerl screw for atlantoaxial fusion. In 3 cases with quadriplesia, 2 case achieved a dramatic neurological recovery postoperatively, while the other showed no significant change. 3 surgeries resulted in pseudoarthrosis, and 4 surgeries (57%) achieved solid bony fusion. As a rare complication, depressed skull fracture occurred in the middle of Halo fixation for 8 month-old case.
Conclusions: Os odontoideum with CDP causes severe myelopathy even in very early infancy. Whereas timely surgical intervention with optimum method could result in good neurological prognosis and bony fusion, surgery for this pathology is still challenging.



Disclosures: author 1: none; author 2: none.

P16

THE POSITION OF THE VERTEBRAL ARTERY V1 SEGMENT RELATIVE TO THE C7 VERTEBRA

Chikara Ushiku, Shigeru Soshi, Takeshi Inoue, Akira Shinohara, Kei Shinohara, Anri Ohkawa, Takayoshi Kajiwara, Yoshiharu Nakajima, Shunsuke Katsumi, Keishi Marumo

Dept of Orthopaedic Surgery, The Jikei University Kashiwa Hospital, Chiba, Japan

Background: The vertebral artery (VA) usually enters the transverse foramen at the C6 level. Thus, surgeons prefer to insert pedicle screws (PSs) at C7, but this does not eliminate the risk of VA injury, one of the most serious complications of cervical surgery. We aimed to clarify anatomical features of the VA V1 segment at the C7 pedicle level, based on computed tomographic angiography (CTA) of 81 consecutive patients.
Methods: We examined the course of the VA V1 segment on axial CTA images to determine the level at which the VA entered the transverse foramen and to detect hypoplastic VA (HVA), defined as a lumen diameter $\leq$ 2.2 mm. VA position was classified according to its alignment with the anterior (A), middle (M), or posterior (P) third of the C7 vertebral body at the pedicle level. We also assessed the contralateral side for HVA. We measured the distance (VED) from the optimum C7 PS entry point (Ep) to the center of the VA. We also measured the angles formed by the vertebral midline and a line from the inner edge of the VA to the Ep (the VEA), and by the vertebral midline and a line from the inner edge of the pedicle to the Ep (the PEA).
Results: This study included 81 subjects (52 male and 29 female) with a mean age of 69 years. Of these, 68 subjects underwent cerebral vascular screening that included the cervical spine, and 13 underwent VA screening prior to cervical surgery. We examined 160 VA courses except for 2 cases with VA absence, of which 149 (93.1%) entered the transverse foramen at C6. The VA entry level was abnormal in 11 (6.9%) cases, in which the VA entered the transverse foramen at C4 (0.6%), C5 (5.0%), or C7 (1.3%). We observed HVA in 16 patients (19.8%): on the right side in 10 (12.3%), on the left in 5 (6.2%), and on both sides in one patient (1.2%). The variant location of the VA to the C7 vertebra was A in 13 courses (8.1%), M in 127 (79.4%), and P in 20 (12.5%). HVA was present in the contralateral side in 7 of 20 courses (35%) in the P group, and in 8 of 127 courses (6.3%) in the M group ($p < 0.05$). The VED was 14.8–24.7 mm (mean 20.2 mm), the VEA angle was $-11°$ to 19° (mean 6.9°), and the PEA angle was 25° to 50° (mean 36.3°).
Conclusion: The VA location at the C7 vertebra was A in 8.1% of the courses, M in 79.4%, and P in 12.5%, and the P group had the highest rate of HVA on the contralateral side. In this study of VA anatomy at the C7 pedicle level, 7 of the 160 VA courses we examined (4.4%) were particularly vulnerable to injury during PS insertion, and any injury would have a high probability of serious complications. The mean VED for all VA courses was 20.2 mm, and the mean VEA angle was 6.9°, and the mean PEA angle was 36.3°.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: none;.

DEGENERATIVE (CERVICAL)

P17

RISK FACTORS FOR HOSPITAL READMISSION AND EXTENDED LENGTH OF STAY FOLLOWING ACDF

Brian Dial, Valentine Esposito, Melissa Erickson

Duke University, Dept Orthopaedic Surgery, Durham, USA

Objective: Identify patient risk factors for extended length of stay (LOS) and 90-day hospital readmissions following elective ACDF.
Methods: Included ACDF patients from 2013 to 2017 at a single institution. Eligible patients were subset into LOS < 2 and LOS ≥ 2 days, and no 90-day hospital readmission and yes 90-day hospital readmission. Patient and surgical factors were compared between the LOS and readmission groups. Multivariable logistic regression analysis was utilized to determine the association of independent factors with LOS and 90-day readmission rates.
Results: Our sample included 1896 patients; 265 (14%) had LOS ≥ 2 days, and 121 (6.4%) had a readmission within 90 days of

surgery. Patient and surgical factors associated with LOS included patient age 65 (OR 1.72, CI 1.15–2.56), marriage (OR 0.57, CI 0.43–0.79), private health insurance (OR 0.28, CI 0.15–0.50), ASA score (OR 1.52, CI 1.12–1.86), African American race (OR 1.95, CI 1.38–2.72), and harvesting iliac crest autograft (OR 4.94, CI 2.31–10.8). Patient and surgical factors associated with 90-day hospital readmission included ASA score (OR 1.81, CI 1.32–2.49), length of surgery (OR 1.002, CI 1.001–1.004), and radiculopathy as indication for surgery (OR 0.60, CI 0.39–0.96).

Conclusions: Extended LOS and 90-day hospital readmissions may lead to poorer patient outcomes and increased episode of care costs. Our study identified patient and surgical factors associated with extended LOS and 90-day readmission rates. In general, pre-operative patient factors impacted these outcomes more than surgical factors.

Figure 1: Multivariate analysis for extended length of stay

Patient Factor	OR (95% CI)	p-value
Patient Demographics		
Age (yr):		
48-64	Reference	
0-48	0.69 (0.43-1.02)	0.090
>65	1.72 (1.15-2.56)	0.007*
Male gender	0.75 (0.55-1.01)	0.058
BMI (kg/m^2) (18.5-24.5 reference group)		
Normal weight (18.5-24.5)	Reference	
Underweight (<18.5)	1.61 (0.27-5.7)	0.520
Overweight (24.5-29.9)	1.05 (0.70-1.60)	0.790
Obese (30-34.9)	1.03 (0.68-1.66)	0.860
Severe Obesity (>35)	1.39 (0.91-2.26)	0.140
Race		
Caucasian	Reference	
African American	1.95 (1.38-2.72)	<0.001*
Asian	0.79 (0.04-4.39)	0.82
Social History		
Marital Status: married vs single	0.57 (0.43-0.79)	<0.001*
Payor Status		
Medicaid Insurance	Reference	
Medicare Insurance	0.44 (0.23-0.83)	0.01*
Private Insurance	0.28 (0.15-0.50)	<0.001*
No insurance	0.33 (0.11-0.82)	0.02*
Medical Comorbidities		
ASA score	1.52 (1.12-1.86)	0.001*
Surgical Factors		
Graft type: Iliac crest autograft vs. allograft	4.94 (2.31-10.8)	<0.001*
EBL	1.003 (1.001-1.005)	0.001*
Intra-operative steroids: Yes	0.72 (0.49-1.07)	0.10
Surgery Length	1.001 (0.99-1.002)	0.08

*statistical significance

Disclosures: author 1: none; author 2: none; author 3: none.

P18

CROWNED DENS: NORMAL FINDING IN OLD PEOPLE, RADIOLOGICAL DEGENERATIVE SIGN OR CLINICAL SYNDROME? REFLECTION ON FOUR CASES AND A PREVALENCE STUDY ON 843 PATIENTS

Rafael Llombart Blanco, Carlos Villas, Mariana Elorz, Matías Alfonso, Jesús Payo, Álvaro Suárez, Jorge Gómez, Jesús Dámaso Aquerreta

Clínica Universidad de Navarra, Pamploa, Spain

Introduction: Knowledge about the so-called crowned dens syndrome (CDS) is reduced to the seldom published reports on one or a few cases. These authors state that this entity would not be a very rare condition but mentions some doubts on the possibility of being also an eventual radiological finding.

Objective: The objective of this study was to search a possible distinction of ossifications around the apex of the odontoid process as early as degeneration signs, normal findings in old people and the so-called crowned dens syndrome (CDS).

Patients and methods: For this preliminary study, we reviewed retrospectively 843 consecutive CT studies of the upper cervical spine. Four out of these studies were indicated by CDS suspicion, 18 in patients with sub-axial neck pain, 43 in general medical checking in patients with no cervical pain, 144 in studies of the facial bones, 292 in studies of neck structures and cavum and 348 in studies of the brain. Data about age, sex, nuchal pain and fever were taken on every patient as well as the presence of lumpy or lineal calcifications in the CT, associated or not to degenerative signs at disc spaces or zygapophyseal joints.

Results: Twenty-seven (3.2%) out of the 843 CT scan studies disclose some kind of calcification around the odontoid process. The average age was 80.4 (57 to 98); 59% were men and 41% were women. No patient had fever and only the four under suspicion of having a CDS, complained of suboccipital pain. Two of these patients were finally diagnosed of CDS and 2 had degenerative signs -simple arthritis—at C1C2 level. Only two 2 of the 27 patients had chondrocalcinosis in other locations.

Conclusions: The so-called CDS has to be better defined. Nuchal pain may be caused by C1C2 arthritis and similar images may be found in asymptomatic people over fifty years. This study is the largest study conducted on the prevalence of periodontoid calcifications and will continue in order to better define the options for diagnosis in case of facing patients with suboccipital pain.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P19

FUSION RATES IN ACDF FOR SMOKERS WHEN USING TITANIUM NANO-COATED PEEK CAGES

Geert Mahieu, Frederique Van Ermen

Orthopedic Center of Antwerp, Orthoca, Belgium

Introduction: Peek cages coated with Titanium are believed to increase and accelerate fusion rates in Anterior Cervical Discectomy and Fusion (ACDF). Based on literature data, smoking is associated with an increased rate of pseudarthrosis following anterior cervical discectomy and fusion (acdf). In this prospective study we evaluated if cervical PEEK cages with a Titanium Nano-coating could increase the fusion rate in smokers to the same rate as in non-smokers.

Materials and methods: 63 patients underwent a cervical fusion for radiculopathy or myelopathy by one single surgeon. Titanium Nano-coated PEEK cages were used in all patients. Cages were filled with a fully resorbable paste made of magnesium substituted hydroxyapatite Nano-crystals. A plate with screws was used in every patient. Flexion/extension X-rays were taken three months postoperatively. A CT scan was taken after 6 months. When the interspinous distance at the fused level did not change $>$ 2 mm in flexion extension x-rays, the level was considered fused at three months. (Group I) When there was bone bridging fusion on CT scan, fusion was confirmed. When there was no bone bridging fusion they were considered to be in Group II. Patients where no fusion was achieved were in Group III.

Results: 63 patients (M/F = 35/28) with a mean age of 51.3 years old were evaluated. 24 patients were smokers, 39 non-smokers. 100 cages were placed with a smoker/non-smoker ratio of 65/35. In the smoking group, 12 patients were operated at 1-, 11 patients at 2- and 1 at 3 levels. In the non-smoking group it was 20 (1 level),15 (2 level) and 4 (3 level). 18 smokers (75%) and 29 non-smokers (74.4%) were in Group I. 4 smokers (16.7%) and 8 non-smokers (20.51%) were in Group II. 2 smokers (8.4%) and 2 non-smokers (5.1%) were in Group III. We did not see any case of cage subsidence or any other hardware failure.
Conclusion: Fusion rates are excellent when Titanium Nano-coated cages are used in the cervical spine. (91.7% in smokers, 94.91% in non-smokers). There seems to be a trend towards more comparable fusion rates for smokers and non-smokers when using Titanium Nano-coated PEEK cages. More studies however are needed to confirm this trend.
Disclosures: author 1: not indicated; author 2: none.

P20

COMPARISON OF CLINICAL OUTCOMES AFTER LAMINOPLASTY IN PATIENTS WITH PREOPERATIVE CERVICAL KYPHOSIS VERSUS LORDOSIS

Atsunori Ohnishi, Akira Yamagishi, Masayoshi Ishii, Tetsuo Ohwada

Dept of Orthopaedic surgery, Amagasaki, Japan

Objective: Several studies demonstrated that patients with cervical kyphosis had poor clinical outcomes after laminoplasty (LP). However, there has been few reports to compare clinical outcomes in patients with cervical kyphosis with those with lordosis. The aim of this study was thus to compare clinical outcomes after LP in patients with kyphosis with those with lordosis.
Methods: 153 consecutive patients who underwent LP for cervical spondylotic myelopathy since January 2010 and were followed for at least 2 years after surgery were included in this study. The patients were divided into kyphotic group (C2-C7 angle $< 0°$, mean $-4.5 \pm 3.8°$; n = 21) and lordotic group (C2-C7 angle $\geq 0°$, mean $12.4 \pm 8.6°$; n = 132). Age at the time of surgery and gender showed no significant differences between the 2 groups. Neurological outcome was assessed using JOA score before surgery and at 2-year follow-up. The presence of postoperative axial neck pain was also examined. Cervical lateral X-ray images were evaluated preoperatively and at 2-year follow-up. The radiographic measurements included C2-C7 angle and C1-C7 sagittal vertical axis (SVA).
Results: The mean JOA score improved significantly from 12.0 points before surgery to 14.9 points at 2-year after surgery in the kyphotic group (mean recovery rate 55.5%), and from 10.9 points to 13.6 points in the lordotic group (mean recovery rate 43.2%). Recovery rate of the JOA score showed no significant difference between the 2 groups. Additionally, no difference was found for the presence of postoperative axial neck pain. The mean C2-C7 angle decreased from $-4.5°$ before surgery to $-5.8°$ at 2-year after surgery in the kyphotic group (p = 0.32), and from 12.4° to 10.5° in the lordotic group (p = 0.0018). The mean change in C2-C7 angle showed no significant difference between the 2 groups. The mean C1-C7 SVA decreased from 35.3 mm preoperatively to 32.7 mm at 2-year after surgery in the kyphotic group (p = 0.35), on the other hand, it increased significantly from 28.5 mm to 33.8 mm in the lordotic group ($p < 0.01$). Neither pre- nor post-operative C1-C7 SVA showed significant differences between the 2 groups.
Conclusions: Although both groups showed a trend towards kyphotic increase or lordotic decrease, the mean JOA score improved significantly after surgery and recovery rate of the JOA score showed no significant difference between the 2 groups. The mean C1-C7 SVA was not deteriorated in the kyphotic group. Laminoplasty is considered as one of the surgical options for myelopathy in patients with cervical kyphosis.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P21

PATTERNS AND PREDICTORS OF RETURN TO WORK AFTER SURGICAL MANAGEMENT OF CERVICAL SPONDYLOTIC MYELOPATHY

Arun John Paul, Rohit Amritanand

Christian Medical College, Vellore, India

Background: Return to work is arguably the most important outcome following spine surgery from a patient's perspective. It has been well described following lumbar spine surgeries and cervical discectomy. Cervical spondylotic myelopathy (CSM) is the most common cause of cervical spine dysfunction. Yet, to the best of our knowledge, there have been no reports in the English literature describing return to work amongst patients undergoing surgery for CSM.
Purpose of the study: In developing nations, where patients have less social support especially the elderly, return to work is the vastly important factor that determines the quality of life of an individual. This study was conducted to determine the patterns and predictors of return to work following surgical management of CSM.
Methods: This is a cross-sectional cohort study of patients who underwent surgery for CSM at a University hospital from January 2012 to December 2017. We included adult patients with Nurick grade ≥ 3. Clinical details were obtained from their electronic medical records. The patients were divided into two groups-those who returned to work within 6 months of surgery (Group 1) and those who did not (Group 2). The pre and post operative functional status were assessed using Nurick grade and modified Japanese Orthopaedic Association (mJOA) score. The patients were asked about their preoperative and present occupation details. Data collected from these patients and their records were subjected to statistical analysis. The study received clearance from the institutional review board.
Results: A total of 34 patients with CSM who underwent surgery were included. At a mean follow-up of 32 months (SD 20.1),52.9% returned to work by 6 months. Baseline characteristics were comparable. Better functional outcomes were seen in patients who returned to work at 6 months (Nurick grade (p = 0.000), mJOA score (p = 0.001)). The nature of work had statistically significant association with return to work by 6 months (p = 0.005) with poorer outcomes seen in manual labourers and better outcomes in service group patients and home makers. All patients who returned to work and 75% of patients who did not return to work were satisfied with the outcome of surgery (p = 0.039). Age, body mass index, duration of symptoms, preoperative absenteeism, smoking, diabetes, number of levels operated, surgical approach, post operative complications and cord signal changes did not appear to have any association with postoperative return to work.
Conclusion: Inspite of functional improvement, CSM is associated with poor return to work with manual labourers being the most vulneratble group. Though the functional outcome was better in patients who return to work by 6 months, majority of the patients even in the non return to work category were satisfied with the outcome of surgery. This study will help surgeons modulate patient expectations as well as provide a platform for counseling them.

Comparison of type of occupational profile among the two groups

S.No.	Type of profession	Group I (Return to work) (N=18) n (%)	Group 2 (Non return to work) (N=16) n (%)	Total (N=34) n (%)	p value
1.	Service	9 (50)	3 (18.7)	12 (38.2)	0.005
2.	Self-employed	3 (16.6)	4 (25)	7 (20.5)	
3.	Manual labourer	1 (5.5)	8 (50)	9 (26.3)	
4.	Home maker	5 (27.7)	1 (6.2)	6 (14.7)	

Disclosures: author 1: none; author 2: none.

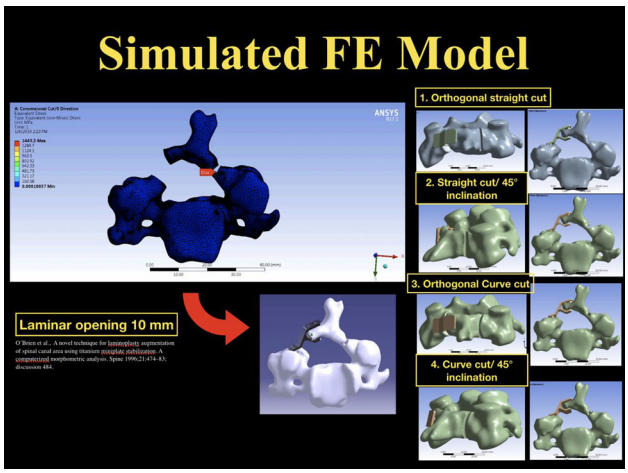
P22

BIOMECHANICAL STUDY OF CURVE-CUTTING VERSUS STRAIGHT-CUTTING ON HINGE SIDE LAMINOPLASTY: A FINITE ELEMENT STUDY

Weerasak Singhatanadgige, worawat limthongkul, Terdpong Chancharoenchai, Tawechai Tejapongvorachai

Chulalongkorn University and King Chulalongkorn Memorial Hospital, Bangkok, Thailand

Background: Cervical open-door laminoplasty is standard treatment for multi-level canal stenosis. Displaced lamina fractures have been found in several cases. These so-called hinge fractures (HFs) can cause axial neck pain and spinal cord compression. The purpose of this study was to compare the stress distribution comparing curve-cutting versus conventional straight-cutting on the hinge side during open-door laminoplasty, by using finite element model.
Study design: A Finite element study.
Materials and methods: CT scan data was obtained from a 53 years old male. the C3-C7 data, saved in Dicom format and then imported into the 3D slicer software. The intact model was modified to simulate the surgical procedure of laminoplasty. Four techniques of hinge site cutting including orthogonal straight cutting (conventional cutting), orthogonal curve cutting, 45 degree inclination-straight cutting and 45 degree inclination-curve cutting were performed.
Finally, the models were imported into the Ansys Finite Element software with the compressive and shearing forces applied at the spinous process. The stress distribution of the four techniques at hinge site were evaluated by comparing the maximum von Mises stress.
Results: The maximal stress distribution on each hinge sites including orthogonal straight cutting (conventional cutting), 45 degree inclination-straight cutting, orthogonal curve cutting, and 45 degree inclination-curve cutting techniques under compressive and shearing forces were 41.7, 23.63, 45.12, 24.19 and 112.31, 74.97, 136.16, 46.17 MPa respectively. The more stress concentration were seen in inferior 1/3 of lamina in compressive forces and superior 1/3 of lamina in shearing forces.
Under compressive force, the cutting with 45 degree inclination technique can reduce maximum stress at the hinge site from conventional cutting by 40%. Under shearing force, curve cutting with 45 degree inclination technique can reduce maximum stress from conventional cutting by 58.89%. Post-operative sagittal canal diameter and surface did not differ in each groups.
Conclusions: the stress distribution was more dispersive and the maximum von Mises stress levels were lower in the curve-cutting with 45o inclination group for the more shearing loading conditions. Especially in the open-door laminoplasty patients with neutral or kyphotic alignment (< 15o), this curve-cutting with 45o inclination technique was potentially lower risk of the hinge fracture. On the other hand, the patients with lordotic cervical alignment that had the more compressive stress than shearing stress. So, cutting with 45o inclination technique was enough to decrease the risk of the hinge fracture.



Disclosures: author 1: grants/research support: Metronic; author 2: consultant: Medtronic; author 3: none; author 4: none.

P23

SKIP-LEVEL CERVICAL DISC ARTHROPLASTY VERSUS SKIP-LEVEL CERVICAL DISCECTOMY AND FUSION: A COMPARATION BASED ON FINITE ELEMENT ANALYSIS

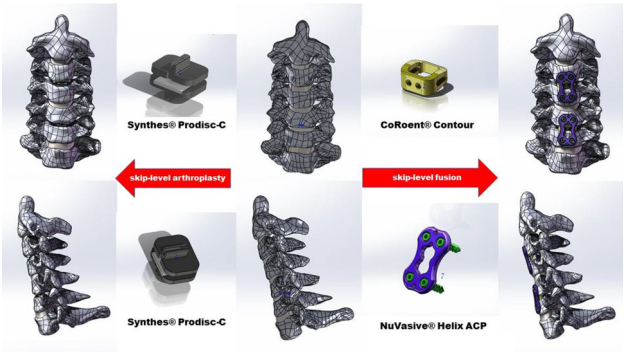
Xiang-Yao Sun, Chao Kong, Shi-Bao Lu

Department of Orthopedics, Xuanwu Hospital Capital Medical University, China

Purpose: To investigate the kinematic and biomechanical changes at the cervical intermediate segment (IS) after skip-level fusion and skip-level arthroplasty constructs.
Methods: Twenty-four cervical (C2-C7) finite element models (FEMs) were constructed. One intact FEMs group (intact group) and two surgical FEMs groups were developed. Two surgical FEMs group included: skip-level fusion (CoRoent® Contour and NuVasive® Helix ACP) at C3/4 and C5/6 (fusion group); skip-level arthroplasty (Synthes® Prodisc-C) at C3/4 and C5/6 (arthroplasty group). Each of the groups included 8 FEMs. 75 N follower loads and 1.0 N·m moments were applied to C2 vertebras in order to produce motion in these FEMs.
The end-points in each direction corresponding to the intact model were applied to the surgical models under displacement-control protocols. Statistical analyses were performed using STATA version 14.0 (Stata Corp LP, College Station, Texas, USA). Statistical significance was set at $P < 0.05$.
Results: In fusion group, the range of motions (ROMs) were significantly decreased at the operated levels compared with the intact group ($P < 0.05$); the ROMs of IS (C4/5) significantly increased in all directions compared with intact group and arthroplasty group

($P < 0.01$). However, the corresponding ROMs of the arthroplasty group were similar to the intact group in all directions except flexion at C4/5 (arthroplasty group > intact group, $P = 0.032$) and C5/6 (arthroplasty group > intact group, $P = 0.013$) as well as lateral bending at C5/6 (arthroplasty group > intact group, $P = 0.014$). The intradiscal pressure and facet contact force at C4/5 significantly increased in fusion group compared with intact group ($P < 0.01$) and arthropathy group ($P < 0.01$). However, the IS did not experience additive stress in arthroplasty group compare with intact group ($P > 0.05$).

Conclusion: Theoretically, CDA maintains motion at a decompressed interspace resulting in improved load transfer and reduced stress on the adjacent intervertebral discs. Although previous cadaveric biomechanical studies and FE studies have demonstrated superior kinematics and biomechanical effects after a CDA construct, most studies investigated one-level or contiguous two-level CDA. As the mechanism of skip-level arthroplasty is different from contiguous two-level CDA, conclusions related to the biomechanical effects based on contiguous two-level CDA may not be applicable to skip-level CDA. Skip-level arthroplasty does not cause additive ROM or stress in the intervertebral disc or facet joints at IS. This technique has fewer biomechanical effects on the IS than skip-level fusion. The biomechanical principles of skip-level arthroplasty in treating patients with skip-level cervical degenerative disc disease have been proved in this study.



Disclosures: author 1: none; author 2: none; author 3: none.

DEGENERATIVE (THORACOLUMBAR)

P24

REDUCTION OF COMPENSATORY HYPERLORDOSIS IN THE ADJACENT SEGMENT: THE BIOMECHANICAL EFFECT OF LORDOSIS RESTORATION IN L5/S1 WITH TLIF

Peter Ferlic, Michael Götzen

Department of Orthopaedic Surgery - Medical University of Innsbruck, Austria

Background/introduction: Degenerative changes in the lumbar spine can lead to a loss of lordosis. Hyperlordosis of an adjacent segment is one compensatory mechanism that can help to maintain global sagittal alignment. This mechanism however, can lead to altered of biomechanics and loads in the intervertebral disc and may contribute to the development of adjacent segment disorders. The immediate effect of restoring lordosis in a fused segment on the compensatory hyperlordosis in the adjacent segment has not yet been studied in detail. We hypothesized that restoration of segmental lordosis with lumbar interbody fusion diminishes the compensatory hyperlordosis in the adjacent segment.

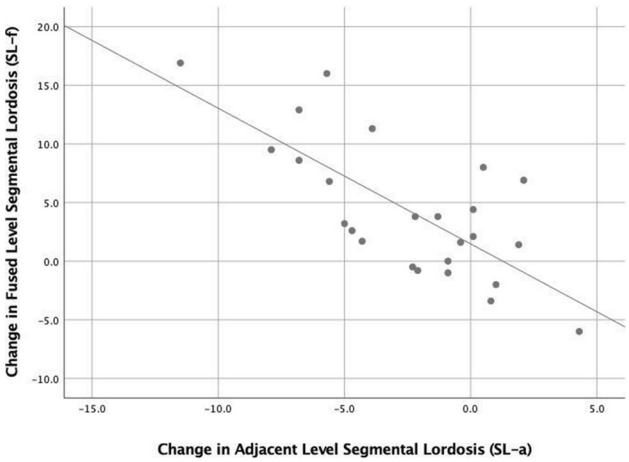
Purpose of the study: The present study aimed to determine how the restoration of segmental lordosis in L5/S1 with TLIF correlates with the segmental lordosis in the adjacent segment.

Materials and methods: Twenty-five consecutive patients undergoing lumbar interbody fusion together with segmental pedicle screw instrumentation were retrospectively analyzed. Segmental lordosis in the fused segment L5/S1 (SL-f) and the adjacent segment (SL-a) were measured in lateral standing x-rays before and 2 months after surgery. Furthermore, lumbar lordosis (LL) and lordosis of the two segments L4-S1 (SL-2) were recorded.

Spearman correlation coefficient was calculated to evaluate the correlation between the changes in the segmental lordosis in the fused segment and the adjacent segment. Wilcoxon Rank Test was used to compare pre- and postoperative parameters. The level of significance is set at $p < 0.05$.

Results: We found significant strong negative correlation ($p < 0.01$ $r = -0.638$) between the change in SL-f and SL-a, i.e. better restoration of lordosis in L5/S1 resulted in a decrease of compensatory hyperlordosis in the adjacent segment (Figure). Failure to restore lordosis with TLIF caused persistent hyperlordosis in L4/5. Mean SL-f significantly increased after surgery from $10.5° \pm 6.6$ to $14.8° \pm 5.0$, whereas SL-a significantly decreased from $18.3° \pm 6.0$ to $15.9° \pm 5.1$ ($p < 0.01$). Mean LL showed a slight but significant increase after surgery from $48.8° \pm 14.7$ to $52.4° \pm 13.1$ ($p < 0.01$). No significant change was observed in SL-2 ($28.7° \pm 8.6$ vs. $30.5° \pm 7.0$, $p = 0.08$).

Conclusion: Restoring lordosis with TLIF has an immediate effect on the compensatory hyperlordosis in the adjacent segment. Recreation of lordosis in L5/S1 reduces compensatory mechanisms in L4/L5. This study highlights the importance of reestablishing lordosis when performing lumbar interbody fusion. An increase in lordosis after TLIF can positively influence the biomechanics and stress in the adjacent disc, leading to a more physiological segmental lordosis.



Disclosures: author 1: grants/research support: DepuySynthes; author 2: none.

P25

IMPACT OF S2-ALAR ILIAC SCREW PLACEMENT ON SACRO-ILIAC JOINT-CLINICAL AND RADIOLOGICAL ASSESSMENT OF 100 JOINTS -

Shunsuke Fujibayashi, Bungo Otsuki, Kazutaka Masamoto, Takayoshi Shimizu, Koichi Murata, Shuichi Matsuda

Dept of Orthopedic Surgery, Kyoto Univ, Japan

Introduction: S2-alar iliac screw (S2AIS) fixation is one of the effective surgical procedures as caudal anchor for the correction and fixation of adult spinal deformity or other unstable lumbosacral disorders due to its strong stability. S2AIS usually penetrates the sacro-iliac joint (SIJ) to achieve the sufficient stability. However, the impact of penetration and fixation of SIJ on the morphological change and pain at SIJ has not been understood. The purpose of this study is to elucidate the impact of S2AIS placement on SIJ clinically and radiologically.
Materials and methods: 100 SIJs in 50 cases were evaluated using CT axial images at minimum 1 year after surgery. 47 cases of adult spinal deformity, 2 pyogenic spondylitis, and 1 pelvic fracture were included. All S2AISs were placed under fluoroscopy. Morphological change of SIJ such as progression of osteoarthritis (OA) change or bony union were evaluated radiologically using preoperative and 1-year postoperative CT by two spine surgeons independently. Inter-rater reliability was assessed statistically. OA change of SIJ was diagnosed according to the Elgafy's classification (Clin Orthop Relat Res 2001). The accuracy of S2AIS placement, S2AIS loosening, implant failure, and bony union at L5-S1 level were also assessed. SIJ pain was extracted from medical chart retrospectively.
Results: The accuracy of S2AIS was 97% and bony union at L5-S1 was achieved in 84% cases. The rates of bony union at L5-S1 were 88.9% in cases of interbody fusion and 40% in cases of posterolateral fusion. S2AIS loosening was observed in 15% screws and among them 80% occurred in cases of nonunion at L5-S1. Progression of OA change and bony union at SIJ appeared at 8% and 6%, respectively. Inter-rater reliability was 0.846 for OA change and 0.94 for bony union. Only one case (2%) complained SIJ pain after surgery.
Discussion and conclusion: The results of this study indicated S2AIS placement was safe and effective procedure to achieve a rigid fixation of unstable lumbosacral spine. The high relevance between S2AIS loosening and nonunion at L5-S1 indicated stronger fixation of S2AIS was desirable in cases of posterolateral fusion. The rates of morphological change and pain at SIJ were negligible. Further studies are needed to elucidate the longer-term impact of S2AIS placement on SIJ.
Disclosures: author 1: none; author 2: none; author 3: not indicated; author 4: none; author 5: none; author 6: none.

P26

IMPACT OF PVM ON OSTEOPOROTIC VERTEBRAL FRACTURE: A MULTICENTER COHORT STUDY

Hasibullah Habibi, Shinji Takahashi, Masatoshi Hoshino, Hiroaki Nakamura

Dept of Orthopedic Surgery, Osaka, Japan

Background: Osteoporotic vertebral fracture (OVF) has been increasing as elderly people increase. Recently, sarcopenia has become a problem in elderly people, but there are few reports on the relationship between paravertebral muscle (PVM) and OVF. Therefore, the decrease of the PVM may affect on the healthy process and subsequent vertebral fracture.
Purpose: The purpose of this study was to clarify the effect of PVM on poor prognosis in OVF.
Method: This is multicenter prospective cohort study from 2012 to 2015. Subjects $\geq$ 65 years old within 2-weeks after fracture onset followed up for 6 months. PVM were measured at the upper edge of the L1 and L5 vertebral body at the MRI T2- axial position at registration. Cross sectional area (CSA), relative CSA (RCSA) and fat infiltration (% FI) were measured. As a poor prognosis, severe vertebral body crushing (height reduction of vertebral body $\geq$ 40%), nonunion, new vertebral body fracture (new fracture during chase period), lumbago remnant (VAS $\geq$ 40) were taken. The comparison adjusted sex and age by analysis of covariance analysis.
Results: Among 153 patients who were followed for 6 months, 117 cases whose PVM could be measured were analyzed. The average age was 78.8 years, 94 women (80%). Severe vertebral compression: 48 cases, delayed union: 37 cases, new OVF: 11 cases, and lumbago remnant: 27 cases. We found the the Fat infiltration of PVM was associated both with the new OVF ($p = 0.035$) in the thoracolumber level and remnant lumbago ($p = 0.051$) in the lower lumber level but PVM fat infiltration had no any correlation with the sever vertebral compression and delayed union. Comparison of paraspinal muscles is as shown in the table.
Conclusions: Fat infiltration in PVM at the thoracolumbar transition may be related to the occurrence of additional OVF. In addition, it was suggested that fatty degeneration of PVM at the lower lumbar level may be related to residual lumbago. Physicians can be aware that is, patients with such fatty degeneration in acute MRI may require stronger treatment.

Impact of PVM on osteoporotic vertebral fracture: a multicenter cohort study

		Severe compression		P	Delayed union		P	New OVF		P	Lumbago remnant		P
		+	-		+	-		+	-		+	-	
L1	CSA	12.2	13.1	0.131	12.2	12.9	0.345	12.5	13.5	0.221	13	12.6	0.362
	RCSA	1.15	1.21	0.354	1.13	1.2	0.572	1.17	1.18	0.962	1.19	1.17	0.741
	%FI	39.6	41.4	0.289	40.7	40.2	0.983	46.1	39.8	0.035	42.7	39.7	0.367
L5	CSA	16,3	17	0.233	17.3	16.4	0.159	17.5	16.5	0.263	17.2	16.5	0.232
	RCSA	1.27	1.27	0.483	1.34	1.23	0.464	1.3	1.26	0.733	1.35	1.23	0.085
	%FI	49.1	50.5	0.402	51.9	49.1	0.252	52.5	49.7	0.455	53.4	48.9	0.051

Disclosures: author 1: none; author 2: not indicated; author 3: none; author 4: none.

P27

SPINAL CORD STIMULATION FOR FAILED BACK THERAPY SYNDROME

Jukka Huttunen, Henna-Kaisa Jyrkkänen, Mette Nissen, Tiina-Mari Ikäheimo, Nils Danner, Mikael von und zu Fraunberg

Dept of Neurosurgery, Kuopio, Finland

Background: Spinal cord stimulation (SCS) is used for patients suffering from failed back therapy syndrome (FBTS) and is commonly done after other forms of treatment are already exhausted.
Method: We performed an analysis of consecutive patients with spinal cord stimulation treatment for FBTS from prospectively acquired data

from the Kuopio Neuromodulation Database. The follow-up visits were 6 and 12 months after the implantation. The outcomes were determined using a self-completed Oswestry Disability Index. Pain relief after the SCS was evaluated using the Numerical Rating Scale (NRS). Becks Depression Inventory (BDI) was used to evaluate the symptoms of depression. Patients reported Global Perceived Effect (GPE) after SCS at twelve months using a 7-point scale including categories: completely recovered, substantial improvement, little improvement, no change, little decline, substantial decline, and totally failed.

Results: Between January 1, 2015 and January 31, 2018, 88 FBTS patients underwent SCS. Eight patients did not receive SCS treatment after one-week trial period and seven patients underwent multiple revision and could not be evaluated at follow-ups. We removed 10 spinal cord stimulation devices during follow up. In total, 63 FBTS patients had 6-month and 12-month follow-ups. Mean age for the study cohort was 53 years (median 54, range from 24 to 84 years). Out of 63 patients 34 (54%) were females. Mean BDI score for 62 patients before SCS was 13 (Median 12, SD 7, 5).

In total 57 (90%) of the 63 patients had had at least one spinal surgery before spinal cord stimulation, 75% of 57 patients had two or less spinal operations. The first spinal operation was at lumbar spine in 51 (89%) patients out of 57 patients. Most common indications for first lumbar surgery were herniated disc and lumbar stenosis or both, 26 (51%), 14 (27%) and five (10%) respectively. Out of 57 patients 20 (35%) had lumbar postero-lateral instrumented fusion procedure before SCS.

A repeated measure ANOVA showed a significant decrease in the pain intensity as measured with NRS. The average pain within the last 30 days decreased from NRS 7 (SD 1,3) to NRS 5 (SD 2,3) at 6 months and NRS 5 (SD 2,2) at twelve months, after SCS. The worst pain within the last 30 days decreased from NRS 9 (SD 1, 0) to NRS 7 (SD 2,5) at 6 months and NRS 7 (SD2,2) at twelve months, after SCS. In addition, there was significant improvement when measuring the degree of disability using the Oswestry Disability Index. The Oswestry disability index score decreased from 48% (SD 13, 3) to 40% (SD 15, 2) at 6 months and to 41% (SD 17, 1) at 12 months.

Out of 63 patients, 32 (54%) patients reported substantial improvement and 20 (34%) patients reported little improvement after spinal cord stimulation for FBTS. Two (3%) patients reported little decline after SCS for FBTS.

Conclusions: Spinal cord stimulation is an effective treatment for failed back therapy syndrome.

Disclosures: author 1: grants/research support: Medtronic; author 2: none; author 3: employee: Kuopio University Hospital; author 4: other financial report: Abbott (speakers honoraria and travel funds), Medtronic (travel funds); author 5: none; author 6: grants/research support: Medtronic, Abbott.

P28

DOES PREVIOUS FLATBACK FUSION DETERIORATE OUTCOMES AND SATISFACTION WITH TREATMENT OF ADULT SPINAL DEFORMITY?

Kati Kyrölä, Liisa Pekkanen, Pirkka Mäkelä, Arja Häkkinen

Department of Orthopaedics and Traumatology, Jyväskylä, Finland

Introduction: Fixed iatrogenic lumbar flatback (LF) may derive from lumbar fusion where the pelvic incidence (PI) minus lumbar lordosis (LL) mismatch remains and proportional elliptical LL is missing. There are few studies about the impact of LF and sagittal imbalance on ASD surgery outcome and patient satisfaction. Good clinical and patient reported outcomes (PROM) have been reported after previous LF when the mismatch between pelvic incidence (PI) and lumbar lordosis (LL) is corrected and the sagittal global balance is returned neutral. However, the three column osteotomy of the spine through the previous fusion mass is challenging and includes technical risks. Inferior outcomes and patient satisfaction have been reported after ASD surgery with LF.

Purpose of the study: We aimed to analyse if the previous failed lumbar fusion (LF) deteriorates the outcome and patient satisfaction with adult spinal deformity (ASD) surgery compared to primary spinal deformity surgery (PF).

Materials and methods: 79 patients operated for ASD in our institution had their baseline and 1–9 years follow-up radiographs and PROMs (ODI, VAS, SRS-30) analysed in two groups: PF and LF with sagittal imbalance. Sagittal deformity correction was made with osteotomies or ALIF and posterior surgery. The outcome of PF was compared to LF revision surgery in ASD correction.

Results: Althogether 28(35.4%) had previous LF before ASD surgery. Mean (SD) age 64.3(10.3) (p = 0.064), gender; female 57(72.2%) (p = 0.248), body mass index (BMI) 27.0(4.4) (p = 0.074), Oswestry Disability Index 51.2(12.1) (p = 0.056), radiographic parameters (SVA, PI-LL, LL, TPA, PT, T1Slope) and prevalence of spinal stenosis were not significantly different between PF and LF groups. Before ASD surgery the LF group had more back pain VAS 80.1(13.3) than the PF group, VAS 66.9(24.1), (p = 0.021). The LF group had more co-morbidities (p = 0.002), neuropathic pain (p = 0.005) and rheumatic inflammatory diseases (p = 0.041) than the PF-group. After the follow-up period of 1–9 years there was no statistically significant difference in PROMs, surgical approach, fusion length, complications or the radiographic result of the ASD correction between the groups (Table 1).

Conclusion: Patients with previous failed LF and ASD reached the same outcome and satisfaction with treatment than ASD patients with PF, though their baseline status was inferior to PF patients. The good

Table 1 Clinical and radiographic postoperative parameters between LF and PF patients after ASD surgery at 1.5–9 years follow-up. Mean (SD) or count (%)

Parameter	LF n = 28	PF n = 51	p-value
ODI	35.9(18.2)	33.9(21.2)	0.674
VAS back	32.4(25.5)	27.7(27.3)	0.460
VAS leg	33.9(31.3)	36.5(29.4)	0.711
SRS-30 total	3.14(0.77)	3.33(0.74)	0.299
Satisfied with management SRS-30	3.49(1.19)	3.65(1.02)	0.517
Reoperated patients	8(29%)	18(35%)	0.543
Neural injury	3(11%)	12(24%)	0.165
Dural lesion	11(39%)	11(22%)	0.093
Infection	2(7%)	5(2%)	0.691
Rod breakage	2(7%)	8(16%)	0.275
PJF	3(11%)	5(2%)	0.898
ΔSVA mm	55.2(51.6)	45.1(61.2)	0.486
ΔLL°	23.9(17.7)	23.3(19.3)	0.898
ΔPI-LL°	22.5(18.0)	21.4(18.5)	0.796
ΔTPA°	11.0(8.6)	11.0(11.4)	0.995
Fused levels	8.4(3.9)	9.0(3.8)	0.512
LIV S1-ilium	28(100%)	47(92%)	0.677
ALIF/Osteotomy	11/17	20/31	0.677
Osteotomy level L3–5	13/15(87%)	23/25(92%)	0.424

LF Patients with adult spinal deformity and previous failed lumbar fusion

PF Patients with adult spinal deformity without previous spinal fusion surgery

result may be explained with correction to the previous fusion mass to create proportional lordosis of the lumbar spine and fusion to pelvis, which were both well tolerated when the sagittal alignment was neutral and postural back pain was relieved.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P29

MODIC TYPE 2 CHANGES ARE ASSOCIATED WITH LOWER RISK FOR SEVERE CAGE SUBSIDENCE AMONG STANDALONE LATERAL LUMBAR INTERBODY FUSION PATIENTS

Ichiro Okano, Colleen Rentenberger, Stephan Salzmann, Oliver Sax, Fabian Winter, John Carrino, Andrew Sama, Frank Cammisa, Federico Girardi, Alexander Hughes

Spine Service, Hospital for Special Surgery, New York, USA

Introduction: It has been reported that certain DDD radiologic factors are associated with higher regional bone mineral density (BMD) in the adjacent vertebral bodies. However, it remains unclear whether these DDD changes have protective effects against osteoporotic complications such as cage subsidence after lumbar surgery. Standalone lateral lumber interbody fusion (SA-LLIF) is used for various lumbar spinal conditions. Since the contact surfaces between implant and bone only includes the cage and endplates in SA-LLIF, it is suitable to assess the effect of DDD factors on the risk of cage subsidence in this construct type.
Purpose of the study: To investigate the effect of DDD-associated findings on the risk of severe subsidence after SA-LLIF.
Materials and methods: We reviewed the data of consecutive patients undergoing SA-LLIF from 2007 to 2016. Patients who had over 6 months of follow-up and radiological imaging between 6 to 12 months after surgery were included. As the outcome measure, cage subsidence was assessed utilizing the grading system by Marchi et al. and severe subsidence was defined as grade 2 or 3 subsidence. As potential DDD-related risk factors, we assessed vacuum phenomenon (VP) on CT, as well as the 5-grade Pfirrmann grade (PG) and 3-type Modic changes (MC) on MRI. Univariate and multivariate logistic regression analyses with a generalized mixed model were conducted. Severe subsidence at each SA-LLIF level was set as the response variable and adjusted with demographic factors and regional trabecular BMD in the vertebral bodies by quantitative CT (vBMD). The statistical significance level was set at $p < 0.05$.
Results: Of 279 SA-LLIF levels in 130 patients, 277 levels in 128 patients were available for subsidence assessment. Mean age (± SD) was 66.8 ± 10.5. 62.5% of the patients were female. Severe subsidence was observed in 80 levels (28.9%). Univariate analyses demonstrated that only number of LLIF levels was associated with severe subsidence (OR 1.82, $p = 0.03$). Other factors, including spondylolisthesis, or previous surgery, showed no significant association with severe subsidence. After adjusting with age, gender, regional vBMD, and number of LLIF levels, VP and PG were not independent contributors of severe subsidence (VP: $p = 0.78$;PG 5 vs 4, $p = 0.51$; vs 3, $p = 0.96$), but the presence of MC (any type: OR (95% CI) 0.35 (0.13–0.95), $p = 0.04$; type 2 OR (95% CI) 0.28 (0.09–0.89), $p = 0.03$) was shown to be associated with a lower risk of severe subsidence.
Conclusions: Our results demonstrate that the presence of a Modic type 2 change was significantly associated with a lower risk of severe subsidence after SA-LLIF, but no significant association was observed for VP or PG. Also, this significant association was independent from regional trabecular vBMD values. This finding suggests that microstructure and/or material property alterations associated with Modic type 2 changes might have a protective effect in this patient population.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: consultant: Pfizer, Spreemo, other financial report: Image Analysis Group, Carestream; author 7: grants/research support: AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution)AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution), consultant: DePuy Orthopaedics Inc, Ortho Development, Clariance Inc, 4WEB Inc, Kuros Biosciences AG, Sentio LLC, stock/shareholder: Paradigm Spine LLC, royalties: Ortho Development Corp, other financial report: Scientific Advisory Board – Clariance Inc, Strategic Advisory Board – Kuros Biosciences AG; author 8: grants/research support: Spinal Kinetics, Inc.; Ivy Healthcare Capital Partners, LLC; ISPH II, LLC; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Centinel Spine, Inc. (fka Raymedica, LLC); Beatrice & Samuel A. Seaver Foundation; 4WEB Medical; Woven Orthopedic Technologies; Depuy Synthes; Orthobond Corporation; Pfizer, Inc.; Paradigm Spine, LLC; 7D Surgical, Inc., consultant: Vertical Spine, LLC; 4WEB Medical, stock/shareholder: VBVP VI, LLC, royalties: NuVasive, Inc., other financial report: Spinal Kinetics, Inc.; Vertical Spine, LLC; Bonovo Orthopedics, Inc.; Viscogliosi Brothers, LLC; Liventa Bioscience (fka AF Cell Medical) Woven Orthopedic Technologies; Healthpoint Capital Partners, LP; Paradigm Spine, LLC; Tissue Differentiation Intelligence, LLC; author 9: grants/research support: Aesculap (Paid to Institution); MiMedx Group Inc (Paid to Institution); Nuvasive, Inc. (Paid to Institution), consultant: Ortho Development Corp; SPINEART USA; Nuvasive, Inc; DePuy Synthes Spine; Lanx, Inc; EIT Emerging Implant Technologies, stock/shareholder: Healthpoint Capital Partners; Paradigm Spine, LLC; Centinel Spine, Inc.; Spinal Kinetics, Inc.; Liventa Bioscience, royalties: Lanx, Inc; DePuy Synthes Spine; Nuvasive, Inc; Ortho Development Corp.; author 10: grants/research support: 4WEB Medical; NuVasive, Inc.; Pfizer, Inc.

P30

CHANGES IN THE VERTEBRAL-PELVIC BALANCE AFTER HIP REPLACEMENT IN PATIENTS WITH CONGENITAL HIP DISLOCATION

Alexey Peleganchuk, Alexander Krutko, Vitaliy Pavlov, Lev Schneider, Evgeniy Baykov

Dept of Orthopedics, Novosibirsk, Russia

Patients with congenital hip dislocation (CHD), appealing for medical aid, complain of pain in the lumbar spine, which is the basis for hip replacement (HR). In 2004, Y. Matsuyama described changes spinal pelvic balance in patients with bilateral congenital hip dislocation with the presence of pain, and evaluate changes occurring in patients over a long period of time (20–30 years.). We are unaware of reverse changes spinal-pelvic balance in patients with CHD after total recovery from the rotation center of TBS, and we can not predict the effects of changes in the spine in the planning of the operation.
Objective: To determine the features of the formation of the pelvic sagittal spinal balance in patients with congenital hip dislocation and its changes after total hip replacement with the restoration of the rotation center.
Materials and methods: a retrospective analysis of the medical documentation of 48 patients with CHD was performed, 62 operations were performed in the volume of endoprosthetics of HR. The average age of the patients was 42.4 years (from 19 to 74 years), of which 5 men and 42 women. Patients are divided into 2 groups: DTBS1—patients with unilateral CHD n = 26 and DTBS2—patients with

bilateral CHD n = 21. The processing and study of the statistical correlation was performed using the Spermana method at $p \leq 0.05$ with SPSS 12.0.2.
Results: Prior to surgery, the mean GLL = 64.1°, these patients also had an excess value of the angle SS = 46.4°, which leads to hyperlordosis. After operation, the average GLL = 57.2°, SS = 41.5° There is a close relationship between these parameters r = 0.787.
Conclusions: Restoring the center of rotation of HR in patients with congenital hip dislocation contributes to a decrease in the incidence of the sacrum, a decrease in pelvic anteversion, and as a consequence, a decrease in lordosis.
Disclosures: author 1: none; author 2: none; author 3: not indicated; author 4: not indicated; author 5: none.

P31

ABDOMINAL AORTIC CALCIFICATION HAS SIGNIFICANTLY NEGATIVE IMPACTS ON SURGICAL OUTCOMES AFTER DECOMPRESSION SURGERY FOR LUMBAR SPINAL CANAL STENOSIS

Hironobu Sakaura, Daisuke Ikegami, Takahito Fujimori, Tsuyoshi Sugiura, Yoshihiro Mukai, Noboru Hosono, Takeshi Fuji

Dept of Orthopaedic Surgery, JCHO Osaka Hospital, Osaka, Japan

Objective: We have recently reported that the presence of chronic kidney disease (CKD), a risk factor for both poor bone quality and systemic atherosclerosis, significantly affects surgical outcomes after PLIF and that systemic atherosclerosis is a significant poor prognostic factor for surgical outcomes after both PLIF and cervical laminoplasty. Impaired blood flow due to atherosclerosis could aggravate degeneration of the lumbar spine and neural tissue. However, there has been no report of a study evaluating the deleterious effects of CKD and atherosclerosis on the outcomes after decompression surgery for lumbar spinal canal stenosis (LSCS). The purpose of this study was thus to examine whether CKD and systemic atherosclerosis negatively affect surgical outcomes after decompressive laminotomy for LSCS.
Methods: Of consecutive 214 patients who underwent decompressive laminotomy for LSCS between January 2014 and December 2015, one patient died during postoperative follow-up, one patient was lost to follow-up due to unknown reason and 69 patients with a history of previous spine surgery, peripheral artery disease, rheumatoid arthritis, and/or undergoing hemodialysis were excluded in this study. The subjects thus comprised 143 patients who were followed for ≥ 2 years after surgery. Fifty-five patients had CKD (Stage 3–4). Clinical outcome was assessed using the Japanese Orthopaedic Association (JOA) score before surgery and at 2-year postoperatively. According to the scoring system by Kauppila et al., the abdominal aortic calcification score (AAC score: a surrogate marker of systemic atherosclerosis) was assessed using preoperative lateral radiographs of the lumbar spine.
Results: Patient age had weak but significantly negative correlations with the preoperative JOA score and the JOA score at 2-year after surgery ($p < 0.01$, $r = -0.380$; $p < 0.01$, $r = -0.217$), but did not have a significant correlation with the recovery rate of the JOA score at 2-year postoperatively ($p = 0.32$). None of the JOA score before surgery, the JOA score at postoperative 2-year and its recovery rate was not significantly deteriorated by the presence of CKD. On the contrary, the AAC score had a weak but significantly negative correlation with the preoperative JOA score ($p < 0.01$, $r = -0.280$), and had relatively strong and significantly negative correlations with the JOA score at 2-year after surgery and its recovery rate ($p < 0.01$, $r = -0.587$; $p < 0.01$, $r = -0.520$).
Conclusions: At 2-year after surgery, the advanced AAC, a surrogate marker of systemic atherosclerosis, was a significant poor prognostic factor for surgical outcomes after decompressive laminotomy for LSCS.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: consultant: Jansen Pharma, Daiichi-Sankyo, royalties: United Biomech Japan, Nakashima Medical, Mizuho Ika-Kogyo.

P32

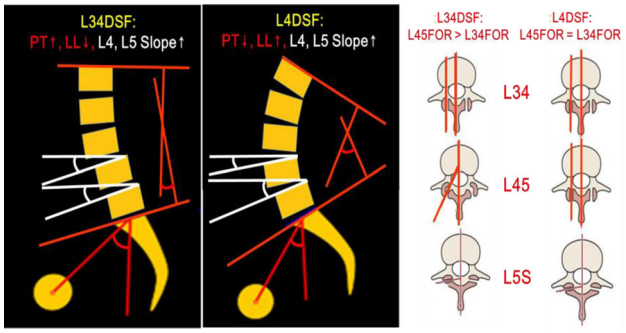
THE MORPHOMETRIC DIFFERENCE OF L4 SINGLE-LEVEL AND L3–4 MULTI-LEVEL DEGENERATIVE SPONDYLOLISTHESIS; FOCUSED ON SAGITTAL SPINOPELVIC MORPHOLOGY AND GENDER DIFFERENCE

Issei Senoo, Tetsuya Kobayashi, Mutsuya Shimizu, Shizuo Jimbo, Hiroshi Ito

Dept of Orthopaedic surgery, Asahikawa, Japan

Introduction: Degenerative spondylolisthesis (DS) is a common especially among female. There have been limited studies about gender difference of spinopelvic morphology related to the development of DS, as well as morphometric differences between L4 single-level (L4DS) and L3–4 multi-level degenerative spondylolisthesis (L34DS). The purpose is to clarify the radiographic factors of DS with focus on gender- and level-specific differences in spinal sagittal alignment and lumbopelvic morphology.
Methods: 451 patients who underwent medical check-up for spinal disease with upright whole spine x-ray and CT between 2012 and 2018 were reviewed. After excluded patients with previous spinal surgery, vertebral fracture, or additional deformity other than DS, a final total of 126 subjects were included. L34DS were found in 25; 19 females (L34DSF, mean 71.7 yrs.) and 6 males (L34DSM, 75.3 yrs.), L4DS was found in 53; 33 females (L4DSF, 70.9 yrs.) and 20 males (L4DSM, 68.6 yrs.), and lumbar spinal stenosis without DS (LSS) was found in 48; 14 females (LSSF, 74.4 yrs.) and 34 males (LSSM, 70.1 yrs.). Radiographic measurement included L4, L5 and S1 slope, LL, PI, PT, SVA, L3/4 and L4/5 facet orientation (FOR; the angle between bilateral facet) and facet sagittalization angle was calculated (L45FOR–L34FOR). ANOVA was used for statistical analyses.
Results: In female subjects, the following parameters showed significant differences; L4 slope (L34DSF 11.5 ± 2.0, L4DSF 7.7 ± 1.6, LSSF 0.6 ± 2.6, L4DSF > LSSF $p = 0.001$, L4DSF > LSSF $p = 0.019$), L5 slope (L4DSF 16.4 ± 1.1 LSSF 13.1 ± 1.2, L4DSF > LSSF $p = 0.043$), PI (L34DSF 56.6 ± 2.6, L4DSF 54.6 ± 1.9, LSSF 48.5 ± 2.6, L34DSF > L4LSSF $p = 0.034$), PT (L34DSF 27.7 ± 2.4, L4DSF 22.2 ± 1.5, LSSF 18.6 ± 2.4, L34DSF > L4DSF $p = 0.043$, L34DSF > LSSF $p = 0.006$), LL (L34DSF 35.1 ± 3.4, L4DSF 42.2 ± 2.0, LSSF 33.1 ± 2.8, L34DSF < L4DSF $p = 0.049$, L4DSF > LSSF $p = 0.023$), L34FOR (L34DSF 54.7 ± 3.6, L4DSF 55.8 ± 2.1, LSSF 64.9 ± 3.2, L34DSF < LSSF $p = 0.031$, L4DSF < LSSF $p = 0.032$), L45FOR (L34DSF 67.7 ± 3.7, L4DSF 58.9 ± 2.5, LSSF 86.7 ± 3.7, L34DSF > L4DSF $p = 0.043$, L34DSF < LSSF $p < 0.001$, L4DSF < LSSF $p < 0.001$) and L45FOR-L34FOR (L34DSF 12.7 ± 2.0, L4DSF 4.6 ± 2.2, LSSF 21.3 ± 2.1, L34DSF > L4DSF $p = 0.023$, L34DSF < LSSF $p = 0.017$, L4DSF < LSSF $p < 0.001$). In male subjects, there were no significant differences in any spinal sagittal alignment parameter except for L45FOR (L34DSM 59.3 ± 6.8, L4DSM 65.7 ± 4.3, LSSM 79.5 ± 2.5, L34DSM < LSSM $p = 0.008$, L4DSM < LSSM $p = 0.005$).

Discussion: It was suggested that both inappropriate sagittal spinal alignment and facet sagittalization was associated with DS in female subjects, while only facet sagittalization was related in male subjects. Regarding the difference between L34DS and L4DS in female subjects, our results indicated that increased PT affected both L34DS and L4DS, while LL affected only L4DS, and subjects with greater L45FOR-L34FOR angle was associated with the development of L34DS.
The lumbar spinal sagittal alignment and spinopelvic morphology may affect the incidence of L4DS and L34DS.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none.

P33

ADULT IDIOPATHIC COMPARED TO DEGENERATIVE SCOLIOSIS HAVE DIFFERENT PEDICLE MORPHOLOGIES

Maksim A. Shlykov, Mostafa H. El Dafrawy, Owoicho Adogwa, Travis S. CreveCoeur, Munish C. Gupta

Washington University in St. Louis, St. Louis, USA

Summary: Deformities in adult idiopathic (AI) and degenerative (DS) scoliosis have different etiologies, clinical and radiographic features. Anatomical differences in pedicle osteology can help determine scoliosis etiology, which is sometimes difficult to discern radiographically. Unlike AI, DS pedicles are formed before any deformity occurs. We compared pedicle widths in AI and DS pts. Concave AI (AIc) pedicles were significantly smaller than concave DS (DSc) pedicles. We found a similar, but less robust pattern for convex AI (AIv) and DS (DSv) pedicles.
Hypothesis: AIc pedicles have smaller widths compared to DSc pedicles and AI pts have greater differences between concave and convex pedicles.
Design: Retrospective cohort study.
Introduction: Concave pedicles are smaller than convex pedicles in adolescent idiopathic scoliosis. The question of whether AIc are significantly smaller than DSc pedicles and whether concave and convex AI pedicles differ remains unanswered.
Methods: Single surgeon database with 22 AI and 14 DS pts. was reviewed. Only primary surgeries with preoperative CT imaging were included. Pts. were asked whether they had scoliosis in childhood. Measurements of pedicle widths of involved segments between T12-L5 (typical location of DS), apical rotation and lateral translation were performed. Inter- and intraobserver reliability for measurements has been previously demonstrated. Apical asymmetry was defined as >1 SD from the mean concave pedicle width at that level. The primary outcome of interest was pedicle width and comparison of the concave and convex side of scoliosis curves.
Results: At baseline, there were no significant differences in age ($p = .34$), BMI ($p = .21$), but AI pts were lighter (73 ± 13 vs 84 ± 18 kg; $p = .01$) and shorter (163 ± 7 vs 170 ± 12 cm; $p = .03$) than DS pts. AI curves were larger (48.5 ± 17.4 vs $36.1 \pm 18.6°$; $p = .02$). 70 AI and 57 DS pedicle pairs were measured. AIc pedicles were 14.5% smaller than DSc pedicles (6.09 ± 2.55 vs 7.13 ± 2.55 mm; $p = .004$). AIv pedicles were 9.4% smaller than DSv pedicles (6.37 ± 2.37 vs 7.03 ± 2.48 mm; $p = .045$). The AI pts had apical asymmetry between the concave compared to the convex pedicles in 50% of pts whereas 0% asymmetry was noted in DS pts. The largest difference in concave pedicle size was at the T12 level, with AIc pedicles being 31% smaller. 52% of AI and 87% of DS curves had apices about L2-L3. Apical rotation and lateral translation were not significantly different ($p = .09$, $p = .43$).
Conclusion: Pedicle morphology of pts with adult idiopathic scoliosis was different from degenerative scoliosis pts. Concave pedicles are smaller in AI pts and asymmetric compared to the convex pedicles. This difference can help in determining etiology as well as in operative planning.
Take Home Message: Besides curve pattern, magnitude, location and number of segments involved, concave pedicle size may be useful in determining the etiology of thoracolumbar scoliosis and for operative planning purposes.

Level	AI Concave	AI Convex	DS Concave	DS Convex
T12	4.86±1.37	5.34±1.60	7.03±2.26	6.62±2.16
L1	4.54±1.72	4.83±1.87	5.17±2.14	5.61±2.20
L2	5.59±1.85	6.22±1.78	6.04±1.50	6.04±1.48
L3	7.09±1.87	7.45±2.44	8.26±1.92	7.96±1.79
L4	9.78±3.03	8.91±2.11	9.70±2.12	9.41±3.03
L5	Not involved in curves			

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: grants/research support: AOSpine & OMeGA grants for fellowship paid directly to institution, consultant: Medtronic, DePuy, stock/shareholder: J&J, P&G, perForm Biologics, royalties: Innomed, DePuy.

P34

THE BONE UNION RATE AT 2 YEARS AFTER OBLIQUE LATERAL INTERBODY FUSION; COMPARISON WITH THAT OF TANSFORAMINAL LUMBAR INTERBODY FUSION

Shimei Tanida, Shunsuke Fujibayashi, Bungo Otsuki, Shuichi Matsuda

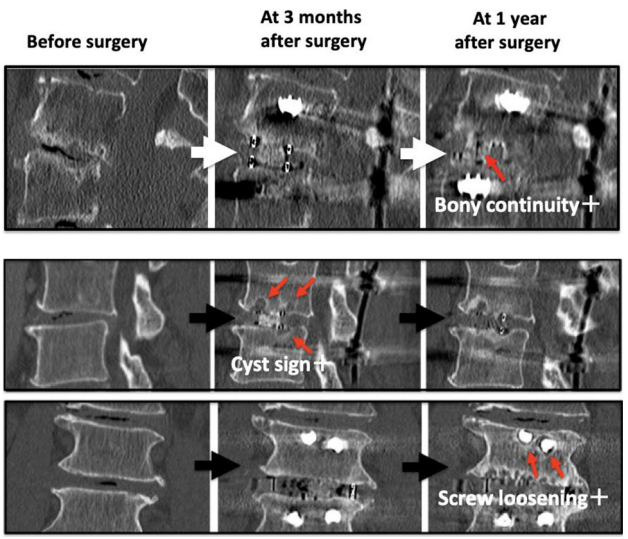
Dept of Orthopedic surgery, Shiga, Japan

Purpose: The bone union rate at 2 years after Oblique Lateral Interbody Fusion (OLIF) was investigated, and compared with that of Transforaminal Lumbar Interbody Fusion (TLIF).
Materials and methods: The inclusion criteria were (1) OLIF performed between 2012 and 2017, (2) computed tomography (CT) images at 1 year and 2 years after surgery. Ninety-seven patients (39 men and 58 women) and 167 levels were included. The number of patients with CT images at both 1 year and 2 years after surgery was 90 (155 levels). Their mean age was 69.1 years (range 16–87 years). In all the cases, the posterior fusion with pedicle screws was also performed, and hydroxyapatite/collagen composite was added in the OLIF cage, if the autologous bone harvested from the anterior iliac crest was not enough. The bone union rate was evaluated with CT images at 1 year and 2 years after surgery, and the three groups were categorized as follows: (1) union group (bony continuity with adjacent vertebral body through graft bone, fused facet joints or bridging osteophytes, was confirmed, (2) stable group (no bony continuity with adjacent vertebral body, and no "cyst sign" or screw loosening), (3)

non-union group (except for union and stable). (Figure 1) "Cyst sign" suggested micro-motion of the intervertebral cage (S. Fujibayashi et al.: Spine 2012) (S. Tanida et al.: Spine 2016). The result of the bone union rate after TLIF between 2005 and 2011 in our institution was applied (144 levels). The result of bone union rate of L5/S level was excluded in this study.

Result: The bone union rate at 1 year after OLIF was 81.3%(126/155 levels). At 1 year after OLIF, stable group was 13.0% (20/155 levels). Among stable group at 1 year, 90% (18/20 levels) converted to union group at 2 years. Among nonunion group at 1 year, only 56% (5/9 levels) converted to union group at 2 years. The bone union rate at 2 years after OLIF was 96.1%(149/155 levels). Just for the single level fusion surgery, in comparison to the bone union rate after TLIF, that of OLIF was not significantly different at both 1 year ($p = 0.16$, OLIF (O); 87.8%, TLIF (T); 76.1%) and 2 years ($p = 0.086$, O; 97.8%, T; 87.3%). Just for multiple levels fusion surgery, the bone union rate was not significantly different between the two groups at 1 year after surgery ($p = 0.41$, O; 72.6%, T; 80.0%), but was significantly higher after OLIF at 2 years after surgery ($p = 0.0012$(O; 96.3%, T; 80.0%).

Discussion and conclusion: From the progress of CT images, the bone union was sufficiently expected even at more than 1 year after OLIF, if the fixation of both cage and pedicle screws was retained. From the comparison of the bone union rate between OLIF and TLIF, just for the single level fusion surgery, the bone union rate after OLIF was comparable to that of TLIF, but the bone union rate after OLIF was superior for the multiple levels fusion surgery.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P35

TEST-TO-RETEST REPRODUCIBILITY OF THE WALKING TEST FOR INTERMITTENT CLAUDICATION ASSOCIATED WITH LUMBAR SPINAL STENOSIS

Shinji Tanishima, Li Shugang, Li Weishi, Sun Tiansheng, Yang Huilin, Hu Jianzhong, Zheng Yanping, Luo Zhuojing, Jie Zhao, Bingqiang Wang, Hideki Nagashima, Qiu Guixing

Department of Orthopedic Surgery, Tottori-University Hospital, Yonago, Japan

Introduction: The walking test is a useful procedure for evaluating cauda equina symptoms in patients with lumbar spinal stenosis. However, reports on the reproducibility of the walking test are lacking.

Objective: The present study aimed to evaluate the reproducibility of the walking test in patients with lumbar spinal stenosis.

Material: Seventy patients with lumbar spinal stenosis who had presented with symptoms affecting both lower limbs at a multicenter outpatient clinic were examined prospectively.

Method: A walking test was conducted at the initial visit and at 4 weeks. Study variables were walking distance and pain and numbness in the lower limbs. Pain and numbness were evaluated using visual analog scale (VAS) immediately following the walking test; these variables were reported in the hip and outside, inside, front, and posterior sides of the lower legs. Reproducibility of each evaluation variable of the walking test at initial visit and at 4 weeks was evaluated using Cohen's kappa analysis and interphase correlation coefficients (ICC). The Swiss Spinal Stenosis Questionnaire (SSS) was used for evaluation of stenosis severity.

Result: Mean SSS was 30.2 ± 5.5 at initial visit and 29.2 ± 5.2 at 4 weeks, with no significant difference in severity ($P = 0.10$). Walking distance of ICC between baseline and 4 weeks was 0.67. The analysis of interobserver reproducibility or the part of ache of lower limb revealed values (Cohens κ) of 0.470, 0.204, 0.480, 0.485 and 0.580 for in front of legs, back of leg, outside of leg inner of leg and hip with right side leg. Cohens κwere 0.550, 0.446, 0.208, 0.660 and 0.558 for in front of legs, back of leg, outside of leg inner of leg and hip left side.

The analysis of interobserver reproducibility for the part of numbness of lower limb revealed values (Cohens κ) of 0.325, 0.639, 0.530, 0.480 and 0.400 for in front of legs, back of leg, outside of leg inner of leg and hip with right side. Cohensκ were 0.339, 0.533, 0.433, 0.478 and − 0.027 for in front of legs, back of leg, outside of leg inner of leg and hip with left side.

The average VAS of lower leg pain was 23.2 ± 25.2 mm at baseline and 27.4 ± 28.8 mm at 4 weeks. ICC was 0.668. The average VAS of leg numbness was 23.4 ± 26.7 mm at baseline and 24.8 ± 25.2 mm at 4 weeks. ICC was 0.683.

Discussion: The symptoms of LSS are often affected by standing and walking posture or other factors, not all of which are known. Considering the diurnal variation of the disease, the reproducibility of the walking test to assess magnitude and location of leg pain and numbness caused by LSS seems to be acceptable. It is possible to derive the symptoms experienced by the patient to a certain extent by conducting the walking load test at any time when clinical symptoms do not improve.

Conclusion: The walking test showed acceptable reproducibility of the walking distance and lower leg symptomatic sites.

Disclosures: author 1: other financial report: ONO PHARMACEUTICAL CO., LTD.; author 2: not indicated; author 3: grants/research support: ONO PHARMACEUTICAL.CO., LTD; author 4: none; author 5: none; author 6: grants/research support:; author 7: grants/research support:; author 8: none; author 9: other financial report: ONO PHARMACEUTICAL CO., LTD (Except Dr Hideki Nagashima); author 10: not indicated; author 11: Research grants: Grants-in-Aid for Scientific Research (16K10820), Simizu Hospital, Motomachi Hospital, Misasa Onsen Hospital, Tsuyama Daiichi Hospital, Chugai Pharmaceutical Co., Ltd, Asahi Kasei Pharma Co., Kaken Phrmaceutical Co., Ltd, Taisho Toyama Pharmaceutical Co. Ltd. Pfizer Japan Inc, MSD, K. K. Shionogi & Co., Ltd, Eisai Co., Ltd., Nippon Zoki Pharmaceutical Co., Ltd. Astellas Phrma Inc. Teijin Pharma Ltd., Takeda Pharmaceutical Co., Ltd., Daiichi Sankyo Co., Ltd., Ono Pharmaceutical Co., Ltd., Stryker Japan K.K.; author 12: none.

P36

PATIENT SATISFACTION AFTER INITIAL SURGERY AND SECONDARY FUSION RATES IN PATIENTS WITH SYMPTOMATIC LUMBAR STENOSIS DUE TO DEGENERATIVE SPONDYLOLISTHESIS

Judith van Grafhorst, Manon Dijkerman, Wilco Peul, Carmen Vleggeert-Lankamp

Dept of Neurosurgery, Leiden, Netherlands

Background: It has been proven that surgical treatment is more effective than non-surgical treatment, but there has not yet been consensus about which technique leads to better clinical outcomes (1–3). Decompression is the generally accepted treatment for patients with lumbar stenosis. However, additional degenerative spondylolisthesis indicates severe degeneration of the facet joint and intervertebral disc, and this may fit to increased instability of the spine (4). There is discussion whether or not concomitant fusion is necessary in case of decompression in degenerative spondylolisthesis.
Objective: To evaluate the reoperation rate and clinical outcome between decompression versus fusion, in patients with or without spondylolisthesis in patients with lumbar stenosis.
Methods: The clinical outcome of surgery of lumbar spinal stenosis with or without degenerative spondylolisthesis was analysed by evaluating all medical files between 2007 and 2013 in the Spaarne Hospital (Hoofddorp, The Netherlands) and the Alrijne Hospital (Leiderdorp, The Netherlands). The following items were extracted from the medical files: demographic characteristics, pre-operative radiological characteristics (level of stenosis, presence of spondylolisthesis, grade of spondylolisthesis) and surgical technique. For the clinical evaluation, the notes written in the file by the neurosurgeon were evaluated. Patient satisfaction was classified as 'satisfied 'or 'not satisfied'. Clinical outcome after initial surgery, reoperation rates and secondary fusion rates were compared between the stenosis and the spondylolisthesis group. Finally, the patient satisfaction rates after secondary decompression and secondary fusion were compared.
Results: A total number of 932 patients was included. Of those, 683 stenosis patients and 250 spondylolisthesis patients. The spondylolisthesis group consisted mostly of women (p = . 000). The stenosis group had a greater initial satisfaction rate at 2 months compared with the spondylolisthesis group (80% vs. 75%, p = 0.110). Of the 682-stenosis patients, 86 underwent a reoperation (13%) and 43 of the spondylolisthesis (17%) patients underwent a reoperation (p = . 069). Most of the patients had a secondary decompression, 77 (90%) of the stenosis patients and 31 (72%) of the spondylolisthesis patients (p = . 019). After secondary surgery the satisfaction rate was 65% in the stenosis group and 75% in the spondylolisthesis group (p = . 171). Of those with a decompression on a different level than the initial decompression, the satisfaction rate is 80% regardless of spondylolisthesis or not.
Conclusions: Lumbar stenosis with and without (low-grade) degenerative spondylolisthesis can effectively be treated with solely decompression, leaving the majority of patients satisfied after initial surgery. Most patients with degenerative spondylolisthesis can be treated with another decompression in case of persisting symptoms.
Disclosures: author 1: not indicated; author 2: none; author 3: grants/research support: Medtronc, Paradigm Spine, Braun; author 4: grants/research support: Covidien sponsors a trial on legpumps in neurosurgical surgery. Ynske Meyes Fund sponsors a trial on epidural injections in sciatica. These are all investigator initiated trials. The payment is not made to my own account but to our research department. Board of CSRS Europe, faculty for EANS, CSRS, Eurospine and webinar for AO spine.

P37

DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS EXTENDED TO THE LUMBAR SEGMENTS INCREASE FURTHER SURGERY AFTER SURGERY FOR LUMBAR SPINAL STENOSIS

Kentaro Yamada, Yuichiro Abe, Hiroaki Nakamura

Dept of Orthopaedic surgery, Osaka City University, Japan

Introduction: A lot of studies have indicated that diffuse idiopathic skeletal hyperostosis (DISH) has negative impact on clinical outcomes of spinal fractures due to increased mechanical loading by ossified segments. DISH also may affect negatively on the clinical outcomes of surgeries for degenerative lumbar disorders as well as spinal fracture. However, few studies focused DISH as a potential risk factor on the treatment of lumbar spinal stenosis (LSS). The purpose of this study was to investigate whether DISH affected on the reoperation for LSS in long-term results.
Materials and methods: This study included 1063 responders to a postal surveillance out of 2363 consecutive patients who were over 50 years-old and underwent surgery for LSS in one institution between 2002 and 2010. The surveillance included further lumbar surgery at another hospital and the patient-reported outcomes. DISH was diagnosed according to Resnick criteria using preoperative standing whole spine radiograph.
First, risk factors for reoperation were investigated. Potential confounders for reoperation included not only DISH but also patients' characteristics, concomitant pathology (spondylolisthesis and scoliosis), preoperative symptom severity, and procedure (fusion procedure, multilevel surgery, attending surgeon, and surgical period). Second, detail analyses of reoperations were performed from medical records.
Results: Further lumbar surgeries were performed in 115 patients (10.8%) within mean follow-up period of 8.6 years. Patients who only had DISH were not associated with reoperation, however, further surgeries were significantly more often performed in patients with DISH extended to the lumbar segment (L-DISH) than those without (22% and 7.3%, $p < 0.001$). Kaplan–Meier survival analysis showed surgery-free survival in patients with L-DISH were significantly shorter than those without L-DISH (p = 0.005). Cox analysis showed that L-DISH was one of the independent predictors of further surgery (hazard ratio 2.05, p = 0.009). The cause of further surgery did not differ between patients with and without L-DISH. The patients with stenosis adjacent to the caudal end of DISH showed a high reoperation rate (3 of 7 patients, 42.9%). The latest EQ5D, ZCQ, and ODI did not differ between patients with and without L-DISH.
Conclusions: The result indicated L-DISH independently associated with further surgery for LSS. DISH reportedly begin most frequently in the lower thoracic spinal segments, and later extend into the upper thoracic segments and lumbar spine. Decreased number of lumbar mobile segments due to L-DISH might increase mechanical loading to residual mobile segments and lead to unfavorable outcomes. Patients with L-DISH should be taken special attention after surgery for LSS.
Disclosures: author 1: none; author 2: none; author 3: none.

P38

COMPLICATIONS IN THE UPPER INSTRUMENTED VERTEBRAE FROM THE COMBINED USE OF SACRAL ALAR ILIAC SCREWS FOR LUMBOSACRAL FUSION WITH A MINIMUM OF 4 LEVELS FUSED

Makoto Yoshida, Yasuo Ohori

Dept of Orthopedics, Tokyo Japan

Background/introduction: In the fusion of the upper lumbar and sacral spine for lumbar canal stenosis (LCS), complications that surround the sacrum are common; thus, the addition of sacral alar iliac (SAI) screws to the lower instrumented vertebra (LIV) may reduce complications that surround the sacrum (Ohori, JPSTSS 2017). However, like adult spinal deformity (ASD), the use of SAI screws in multi-level lumbosacral spinal fusion may pose the risk of complications to the upper instrumented vertebrae (UIV).
Purpose of the study: The aim of this study was to evaluate the short-term postoperative outcomes following lumbosacral fusion with a minimum 4 levels fused.
Materials and methods: After June of 2016, 24 patients (male, 10; female, 14; mean age at surgery, 74.6 ± 6.4 years) underwent lumbosacral fusion with a minimum of 4 levels fused. The mean follow-up period was 15.9 ± 9.4 months. UIV was at L1 in 2 patients and at L2 in 22 patients, and lateral interbody fusion (LIF) was performed at the L1 or L2-L5 level, while transforaminal lumbar interbody fusion (TLIF) was performed after bilateral facetectomy at the L5-S1 level. Percutaneous pedicle screws (PPS) were used for posterior fixation at the L1 or L2-S1 level, and SAI screws were added to prevent complications in the LIV. Proximal junctional kyphosis (PJK) was defined as a postoperative increase of 10° or more in the sagittal Cobb angle between the lower endplate of the UIV and upper endplate of the two supra-adjacent UIV. We evaluated the incidence of postoperative PJK, proximal complications, and surgical revision rates. In addition, pre- and post-operative spinopelvic parameters (PT, PI, LL, TK, SVA) were measured, and risk factors for the onset of proximal complications were compared between groups with and without proximal complications.
Results: The incidence of PJK was 3/24 (12.5%), of which 2 patients had each resulted in either a UIV fracture or adjacent vertebral fracture, and the 1 remaining patient resulted in a cephalad pedicle screw back-out. In patients without PJK, 4 patients exhibited loosening of UIV screws. In terms of revision surgery, cephalad fixation was prolonged in one patient that experienced a screw back-out. The surgical revision rate was 1/24 (4.2%). Compared to the group without complications, the group with proximal complications demonstrated significantly greater pre- to post-operative changes in LL.
Conclusion: Although the incidence of PJK due to ASD has been reported to be between 20 and 40%, the incidence was not as high in lumbosacral fusion using SAI screws. In cases with greater pre- to post-operative lordotic changes, the reciprocal changes in the post-operative thoracolumbar spine may induce proximal complications.
Disclosures: author 1: none; author 2: none.

TRAUMA (WHOLE SPINE)

P39

SUBAXIAL CERVICAL TRANSLATION FRACTURES - AN ANALYSIS OF 102 CONSECUTIVE OPERATED CASES

Nils Danner, Joel Alve, Henna-Kaisa Jyrkkänen, Ville Leinonen, Jukka Huttunen

Neurocenter/Neurosurgery, Kuopio, Finland

Subaxial cervical translation fractures - an analysis of 102 consecutive operated cases.
Background: Subaxial cervical fractures carry a remarkable risk of spinal cord injury with devastating consequences. The range of severity spans from stable isolated vertebral body fractures to highly unstable translation fractures with associated facet joint injuries. The optimal method of treatment has been under debate. We report a consecutive series of patients operated at Kuopio University Hospital (KUH) for subaxial cervical fractures with associated facet injuries.
Materials and Methods: KUH neurosurgery is a tertiary referral hospital with a catchment population of over 813 000 and is responsible for the operative treatment of cervical spinal trauma in Eastern Finland. We performed a retrospective analysis of patients operated for subaxial cervical injuries between the years 2002–2017. The charts and imaging findings were re-evaluated. The injuries were categorized according to the AOspine subaxial classification system and the severity of spinal cord injuries was determined by the AIS-classification. Outcome data was collected at three months. Patients were identified by the ICD-10 diagnostic codes S12.x, S13.x, S14.x and procedure codes NAJxx and NAGxx.
Results: A total number of 212 patients were operated. Patients with ankylosing spondylitis (n = 31) were excluded. AO type A injuries were observed in 37 patients and B type injuries in 38 patients. Four patients had isolated facet injuries. The final study population consisted of 102 patients with AO type C injuries including 80 males and 22 females with a median age of 49.5 years (range 12–90).
35 patients had spinal cord injuries, which were divided in different AIS classes as follows: D (n = 11), C (n = 10), B (n = 2) and A (n = 12). A postoperative improvement in the AIS class was observed in 5 patients and a deterioration in one patient due to postoperative failure of the fixation. Four patients died within 3 months after the surgery due to causes unrelated to the procedure.

Bilateral facet joint injuries (n = 64): 47 patients were operated with anterior fixation, 15 with posterior fixation and primary 360-degree fixation was performed in 2 patients. Failure of the fixation was observed in 4 patients, two of whom were initially operated with anterior fixation (failure rate 4%) and two of whom were operated with posterior fixation (failure rate 13%).

Unilateral facet joint injuries (n = 38): 34 of these patients had a subluxation or dislocation of the facet joint (AO F4). 36 patients were operated with anterior fixation and two with posterior fixation. No failures in the fixation were observed.
Conclusion: Anterior fixation seems to be a suitable treatment modality for patients with a subaxial translation fracture and an associated unilateral facet joint injury, whereas a 360-degree fixation should be considered as an option for patients with a bilateral facet joint injury.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: grants/research support: Medtronic.

P40

COMPLICATIONS OF ANTICOAGULATION THERAPY IN PATIENTS WITH CERVICAL SPINE FRACTURES

Michael Faloon, Conor Dunn, Jennifer Kurowicki, Kimona Issa, Stuart Changoor, Kumar Sinha, Ki Soo Hwang, Arash Emami

St. Joseph's University Medical Center, Department of Orthopaedics, Paterson, NJ, USA

Introduction: The role and timing of anticoagulation (AC) therapy in patients with cervical fractures is an ongoing debate in the literature with poor evidence dictating guidelines specific to these injuries. The risk of pulmonary embolism (PE) must be weighed against the risk of bleeding complications from the therapy itself. Patients with cervical fractures may be at greater risk of devastating bleeding complications, particularly after surgical decompression. The goal of this database study was to provide an accurate estimate to serve as reference in the literature for the incidence of thromboembolic events (TE) in these patients.
Purpose: The purpose of this study was to (1) evaluate comorbidity burden, (2) rate of thromboembolic events, (3) rate of anemia and transfusion events, and (4) evaluate utilization rates of various forms of pharmacologic prophylaxis following cervical spine fracture.
Methods: A retrospective review of the Humana insurance database from 2007 to 2016 was performed to identify patients with cervical spine fractures. Patients were subdivided by AC therapy prescribed within 6 months of cervical spine fracture: aspirin/anti platelet therapy, warfarin, heparin/low molecular weight heparin (LMWH), or factor Xa inhibitors. Each cohort was longitudinally tracked for incidence of deep venous thrombosis (DVT), PE, stroke, anemia, or transfusion at 2 weeks, 4 weeks, 12 weeks, and 6 months following cervical fracture. Demographics including age, gender, race, geographic location, and Charleston Comorbidity Index (CCI) was recorded. Sub-analysis by specific comorbidity was performed between cohorts. Chi squared test was used to determine significance and compound annual growth rate was used to analyze utilization.
Results: 5871 patients were identified as having AC therapy with aspirin/anti-platelet, heparin/LMWH, warfarin or factor Xa inhibitors within 6 months of cervical spine fracture. Demographics of cohorts were similar. Patients on aspirin/anti-platelet therapy were the least likely cohort to have any TE (2.1%, $p < 0.5$), particularly DVT (1.3%) and PE (0.6%). There was no difference found between cohorts in regards to proportion of transfusion and anemia reported.
Conclusion: Aspirin and anti-platelet anticoagulation therapy after cervical fracture had the least number of thromboembolic events when used within 6 months compared to other common forms of anticoagulation. Further research is needed to better understand the relationship between timing of specific anticoagulation therapy with the risks of the specific patient (cervical fracture pattern, medical comorbidities, etc.) and these devastating complications to create a more individualized protocol.
Disclosures: author 1: grants/research support: K2M; author 2: none; author 3: none; author 4: not indicated; author 5: none; author 6: none; author 7: none; author 8: none.

P41

MANIPULATIVE REDUCTION COMBINED WITH CONCAVE SIDE PKP FOR TREATMENT OF KYPHOSCOLIOSIS DEFORMITY CAUSED BY THORACOLUMBAR OSTEOPOROTIC VERTEBRAL COMPRESSION FRACTURE

Chaoyuan Ge, Dingjun Hao, Lequn Shan, Qinpeng Zhao

Department of Spine Surgery, Honghui Hospital, Xi'an Jiaotong University College of Medicine, Xi'an, China

Objective: To evaluate the efficacy and safety of manipulative reduction combined with concave side PKP in the treatment of kyphoscoliosis deformity caused by thoracolumbar osteoporotic vertebral compression fractures (OVCF).
Methods: A retrospective analysis of 28 thoracolumbar OVCF patients with coronal asymmetric compression fractures admitted to our hospital from January 2016 to January 2017 was conducted, including 10 male and 18 female patients, with an average age of 68.3 ± 5.5 years. Preoperative CT or X-ray confirmed lateral and anterior compression fracture of vertebral body, and MRI suggested fresh vertebral fracture. All patients underwent extension and reverse lateral flexion position to reduce preoperatively, and concave side PKP under local anesthesia. The Visual Analogue Score (VAS), Oswestry disability index (ODI), Cobb angle of local kyphosis and scoliosis were recorded before the surgery, at 1 day after operation and at the last follow-up.
Results: Surgery of all patients went successfully, with an average follow-up of 16.1 ± 3.4 months. Before and 1 day after surgery, and at the last follow-up, the patient's VAS scores were 8.3 ± 0.6, 2.5 ± 0.6, and 2.2 ± 0.4, respectively, and the ODI scores were 48.5 ± 8.7, 20.2 ± 5.6, and 18.6 ± 5.5, respectively. The VAS and ODI score were significantly improved at 1 day after surgery and at the last follow-up ($P < 0.05$), and there was no significant difference between the scores at 1 day after surgery and at the last follow-up ($P > 0.05$). Before and 1 day after surgery, and at the last follow-up, the Cobb angles of local kyphosis of the injured vertebrae were $23.4 \pm 2.3°$, $10.7 \pm .1.8°$, and $11 \pm 2.5°$, and the Cobb angles of the scoliosis were $10.5 \pm 1.7°$ and $3.2 \pm 2.2°$, and $4.1 \pm 2.4°$, respectively. The kyphosis and scoliosis Cobb angle were significantly improved at 1 day after the surgery and at the last follow-up ($P < 0.05$), but there was no difference between the values at 1 day after surgery and at the last follow-up ($P > 0.05$). During the operation, one case occured cement leakage in front of vertebral body, and 2 cases had concave side cement leakage, all of which did not lead to any clinical symptom. No new vertebral fractures occurred during the follow-up period.
Conclusion: Manipulative reduction combined with concave side PKP is a safe and effective method for the treatment of kyphoscoliosis deformity caused by thoracolumbar OVCF. It can effectively relieve pain, improve the quality of life and improve local kyphoscoliosis deformity of local spine.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P42

THE VALIDITY OF THE THORACOLUMBAR INJURY CLASSIFICATION SYSTEM IN THORACOLUMBAR SPINE INJURIES

Sung Kyu Kim, So Hyun Moon

Department of Orthopedic Surgery, Chonnam National University Medical School & Hospital

Department of Nursing, Chosun University, Gwangju, South Korea.
Introduction: Although there were many studies about the application of the TLICS classification to thoracolumbar spine injuries, large-scale studies of efficacy in treated patients were rarely investigated.
Purpose of the study: This study aimed to assess the efficacy of TLICS classification in the selection of treatment methods for patients with thoracolumbar spine injury.
Materials and methods: From 2000 to 2016, we retrospectively studied 330 patients who were treated for thoracolumbar spine injuries. Clinical results and radiological data were studied and analyzed using ASIA scale, Magerl/AO classification and TLICS classification.
Results: Among 330 patients, 139 patients (42.1%) received conservative treatment and 191 patients (57.9%) received surgical treatment. Of the 139 patients who underwent conservative treatment, 128 patients (92.1%) were consistent with the recommended treatment in TLICS. Of the patients who underwent conservative treatment, 10 patients (7.2%) failed conservative treatment and required surgical treatment. On the other hand, out of a total of 191 patients who underwent surgical treatment, 160 patients (83.8%) were consistent with the recommended treatment in TLICS.
Conclusion: The TLICS classification is highly effective in the conservative treatment of thoracolumbar junction injury. In addition, it has relatively good efficacy in surgical treatment.
Disclosures: author 1: none; author 2: none.

P43

RISK FACTORS FOR CORRECTION LOSS AFTER POSTERIOR FIXATION FOR SINGLE-LEVEL THORACOLUMBAR OSTEOPOROTIC VERTEBRAL BURST FRACTURES

Hiroyuki Nakarai, Akiro Higashikawa, Kenichi Watanabe

Department of Spine Surgery, Kanto Rosai Hospital, Kawasaki, Japan

Introduction: Osteoporotic vertebral burst fractures (OVBFs) are common in elderly, and surgical intervention is sometimes required due to neurologic deficits and persistent back pain. Treating fragile fractures is challenging, and only a few reports have been published. Our aim was to investigate the risk factors for correction loss (CL) after posterior fixation for single-level thoracolumbar OVBFs.
Methods: We retrospectively reviewed 38 elderly patients (age, 62–88 years; mean, 77.8 years) with single-level thoracolumbar (T12 or L1) OVBFs treated with posterior fixations, which were indicated because of neurologic deficits and/or refractory back pain. The follow-up period was at least 1 year (range 12–89 months). We evaluated the recollapsing angle, measuring the postoperative local kyphotic angle (LKA) using lateral radiographs taken immediately after surgery and the final LKA at the latest presentation. We defined recollapse more than 10 degrees as CL, and the patients were divided into CL (n = 17) and non-CL (n = 20) groups. Additional radiographical assessments were performed, including pre-existing osteoporotic vertebral fracture, the type of anterior column reconstruction, number of instrumented levels, and the preoperative LKA in a supine and sitting position. The reduction angle was calculated by subtracting preoperative LKA in a supine position from postoperative LKA. Postoperative complications, the functional and neurologic outcomes were also recorded.
Results: The number of instrumented levels was significantly longer in non-CL group, though no significant difference was found in the other factors as summarized in Table 1. Logistic regression analysis also showed that the number of instrumented levels (OR, 8.6; 95% CI 2.3–33) was the independent predictors of CL. The postoperative complications were as follows (CL, non-CL group); surgical site infection, (2, 1); cage subsidence, (1, 3); adjacent segmental degeneration, (1, 0); proximal junctional kyphosis/fracture, (1, 3); distal junctional kyphosis/fracture, (3, 2). The functional and neurologic outcome was not significantly different between the groups.
Conclusion: Our findings show that the number of instrumented levels in OVBFs is significantly correlates to CL, though around one-fourth of patients, whose instrumented levels were more than above-2 or below-2, still may experience CL after posterior fixation.

Table 1. Factors associated with correction loss after posterior instrumentation in patients with single-level thoracolumbar osteoporotic vertebral burst fracture.

		CL group (N=17)	non-CL group (N=20)	P value*
Mean recollapsing angle(°)		18 ± 6.2	3.9 ± 4.1	-
Age (years)		79.1 ± 5.7	78.1 ± 5.5	0.61
Sex (Male: Female)		4: 13	7: 13	0.50
Pre-existing OVF		9 (52%)	10 (50%)	1.00
Anterior column supports	Mesh or expandable cage	13	12	0.29
	Kyphoplasty (PMMA)	3	7	
	No support	1	1	
No. of instrumented levels		3.5 ± 0.8	5.6 ± 1.1	<0.0001
No. of patients (UIV)	above 4	1 (14.3%)	6 (85.7%)	-
	above 3	1 (20%)	4 (80%)	
	above 2	3 (25%)	9 (75%)	
	above 1	12 (92.3%)	1 (7.7%)	
No. of patients (LIV)	below 3	0 (0%)	7 (100%)	-
	below 2	6 (33.3%)	12 (66.7%)	
	below 1	11 (91.7%)	1 (8.3%)	
Preoperative LKA, sitting (°)		29.1 ± 7.7	32.8 ± 14.6	0.33
Preoperative LKA, supine (°)		17.5 ± 8.2	23.2 ± 14.7	0.16
Postoperative LKA (°)		11.7 ± 9.2	10.6 ± 5.8	0.69
Reduction angle (°)†		6.8 ± 6.7	11.6 ± 9.6	0.09

CL indicates correction loss; N, number; OVF, osteoporotic vertebral fracture; PMMA, Polymethyl methacrylate; UIV, upper instrumented vertebra; LIV, lower instrumented vertebra; LKA, local kyphotic angle

*Student's t-test was used for measurement data, and chi-square test for dichotomous nominal data
†Calculated by subtracting preoperative LKA in a supine position from postoperative LKA

Disclosures: author 1: none; author 2: none; author 3: none.

P44

REHABILITATION OF THE PATIENT IN IN CHRONIC SPINAL CORD INJURY: A BLACK BOX, A RUSSIAN DOLL OR SYSTEMATICAL COMBINED APPROACH?

Oxana Prudnikova, Anastasia Kachesova, Irina Nesterova

Russian Ilizarov Scientific Center

Department of Spinal surgery, Kurgan, Russia.

Currently the paradigm shift is going on in the rehabilitation of patients with spinal cord injury (CSI). Robot-assisted devices and additive technologies replace compensatory strategies and neuromuscular technologies. Anyway, there are still no common approaches in the assessment of condition, care and rehabilitation of the patients. For many years the „rehabilitation"term includes any technique without evaluation of its efficacy and in the most of the cases represents a „black box"or „Russian doll"(Whyte J., Hart T., 2003).

Purpose is to study the approaches to the rehabilitation of the patients in chronic CSI and define main trends of complex rehabilitation system basing on the literature data and our own clinical data.
Materials and methods: databases of PubMed, Web of Sciences, Scorpus, CrossRef, AO Spine resources, Eurospine resources, Researchgate resources, eLIBRARY and MEDLINE. Clinical material: analysis of treatment results of 265 cases in chronic CSI: ASIA,

Beck Depression Inventory (BDI), Spinal Cord Independence Measure (CSIM).
Results: Mean age of the patients was 35.7 ± 8.7. In 23.5% of the cases 1–2 years passed after injury and more than 2 years in 76.5%. Cervical spine injury was diagnosed in 27.4%, the same of the thoracic spine was observed in 41.2% and the lumbar spine was damaged in 31.4% of the cases. Distribution by ASIA scale was as follows: type A—7%, type B—55%, type C—25.5%, type D—12.5%. Mean BDI depression value was 11.9 ± 6.7.
157 patients underwent restorative treatment using the techniques of epidural electrical stimulation and the courses of locomotor training. The selection of rehabilitation techniques was done by the principle „let's try—it might be effective"and outcomes were evaluated by increase of tolerance to the physical weight-bearing or increase of certain muscles force.

The analysis of the current literature data allowed us to define main trends of rehabilitation as follows: 1. Adaptation to changed functional status (exercises to increase the volume and force of the muscles of the paralytic limbs, adaptive training, additive training, orthoses); 2. Stimulation of conductive and segmental conductivity of the spinal cord (epidural electrostimulation, cell therapy); 3. Training of the feedback mechanisms and compensatory potentials of the nerve system (robotic exercise equipment); 4. Prevention of secondary diseases (respiratory and trophic disorders, uro-infection, stool disorders); 5. Diagnostics and correction of psychological status disorders.

Application of systematical rehabilitation program in 138 patients gave the possibility to improve the functional status (SCIM), achieve the regress of neurological disorders (ASIA) and reduce the depression level. It was the combination of aimed rehabilitation with consideration of neurological and functional status that was the optimal variant of rehabilitation program for the patients with CSI consequences.
Disclosures: author 1: none; author 2: none; author 3: none.

P45

COCCYDYNIA, OUTCOME 1 YEAR AFTER SURGICAL TREATMENT OF 138 CONSECUTIVE PATIENTS

Ane Simony, Mikkel Osterheden Andersen

Sector for Spine Surgery & Research, Lillebelt Hospital, Middelfart, Denmark

Summary: Patients suffering from coccydynia caused by trauma, are reporting severe pain and reduced Health related quality of life. This study reports the outcome, after surgical removal of the coccyx in 138 consecutive patients.
Hypothesis: Surgical removal of the coccyx bone, can relieve persistent pain in patients suffering from coccydynia.
Design: A prospective cohort study.
Introduction: Coccydynia caused by trauma or giving birth is mostly reported in females in the age 30–60 years. Many treatment modalities have been suggested including special pillows, steroid injections, special physiotherapy and pain medication. Patients suffering from coccydynia are suffering, due to the severity of pain in sitting position which often causes problems working and disruption of family activities. The purpose of this study is to report the outcome and rate of complications, 1 year after surgery with partial or complete removal of the coccyx.
Methods: Patients are evaluated by examination bimanual palpation of the coccyx, and examination of the pelvic ligaments. If abnormal movement is present and the pain mechanism can be activated during examination of the coccyx, surgery with full or partially removal of the coccyx bone is suggested. All patients are treated with steroid injections prior to surgery, with only short term relief.
Results: 138 consecutive patients was treated at the Sector for Spine Surgery, Middelfart Hospital and evaluated 3 and 12 months after surgery. 3 months after surgery, 40% of the patients are pain free in sitting position, 47% of the patients are experiencing some degree of discomfort in sitting position but are improved and 13% of the patients are still experiencing pain while sitting. 99 patients are satisfied, 1 year after the surgery. 22 patients have hoped to have a bigger improvement and 17 patients are not satisfied. 32 patients developed infections after surgery and received antibiotics, 5 reoperations was performed, 3 due to infections and 2 due to rupture of the skin after return to normal daily living 3 months after surgery.
Conclusion: Pain in the coccyx after trauma or birth, are a quite common condition in women. Patients with severe symptoms and a history of pain duration of more than 12–18 months, should be referred for spine surgical evaluation. Partial or complete resection of the coccyx, is a safe procedure with in most patients will relieve the pain and restore the ability to sit.

	Mean pre [95%]	Mean 1 year [95%]	p-value
VAS Back	41.12 [35.41–46.83]	24.63 [17.29–31.97]	0.0006
VAS Leg	65.23 [59.39–71.07]	40.1 [31.39–48.81]	< 0.0001
EQ5D Index	0.59 [0.54–0.64]	0.73 [0.72–0.74]	0.0005
EQ5D Health	50.1[45.31–54.89]	67.1[60.95–73.25]	< 0.0001
ODI	33.97 [31.14–36.8]	21.79 [16.94–26.64]	< 0.0001
SF36 PCS	36.78 [34.96–38.6]	42.67 [39.43–45.91]	0.0002
SF36 MCS	44.57 [42.27–46.87]	43.95 [40.51–47.39]	0.96.

Disclosures: author 1: none; author 2: none.

TUMOR (WHOLE SPINE)

P46

COMPARISON OF OPEN AND MINIMALLY INVASIVE TECHNIQUES IN THE SURGICAL TREATMENT OF INTRADURAL EXTRAMEDULLARY SPINAL TUMORS IN ELDERLY AND SENILE PATIENTS

Vadim A. Byvaltsev, Ivan A. Stepanov, Andrei A. Kalinin, Evgenii G. Belykh, Roman A. Polkin, Sergei V. Ochkal

Department of Neurosurgery and Innovative Medicine, Irkutsk, Russia

The purpose: With an increase in the average life expectancy of the population, some histological types of symptomatic intradural extramedullary spinal tumors (IEMT) are more common in elderly and senile patients.
Methods: Of the 45 patients included in the study, 27 (60%) patients underwent a microneurosurgical resection of the tumor tissue using minimally invasive techniques (minimally invasive group) and 18 (40%) to patients using the classical open method (open group).
Results: The duration of operative intervention in both cohorts of respondents is comparable and is 245.4 ± 117.1 min and 261.1 ± 108.6 min for open and minimally invasive groups,

respectively (p = 0.71). The volume of blood loss in the minimally invasive group of patients (139.6 ± 44.6 ml) was statistically significantly lower than in the open technique group (539.2 ± 127.5 ml) (p < 0.01). The total degree of resection of tumor tissue was achieved in 97.4% of patients in the open group and 92.8% in the minimally invasive group (p = 0.81). The incidence of recurrence of IEMT in the study cohort of patients was 6.6%. At the same time, in 1 case the relapse of IEMT was verified in an open group of patients and in 2 cases in patients of the minimally invasive group. The average duration of hospitalization of patients of the minimally invasive group was 9.6 ± 2.7 days, and the open group 13.5 ± 3.1 (p < 0.01). The comparison of the incidence of adverse events between the two groups of patients did not show significant differences (p = 0.61).
Conclusions: The data obtained suggest that microsurgical resection of symptomatic intradural extramedullary spinal tumors in elderly and senile patients is possible using both classical open and minimally invasive techniques. When performing minimally invasive techniques, there is less blood loss, early activation of patients and a short duration of hospitalization. Of course, further development and improvement of surgical methods for treating spinal cord tumors of different localization is necessary.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none.

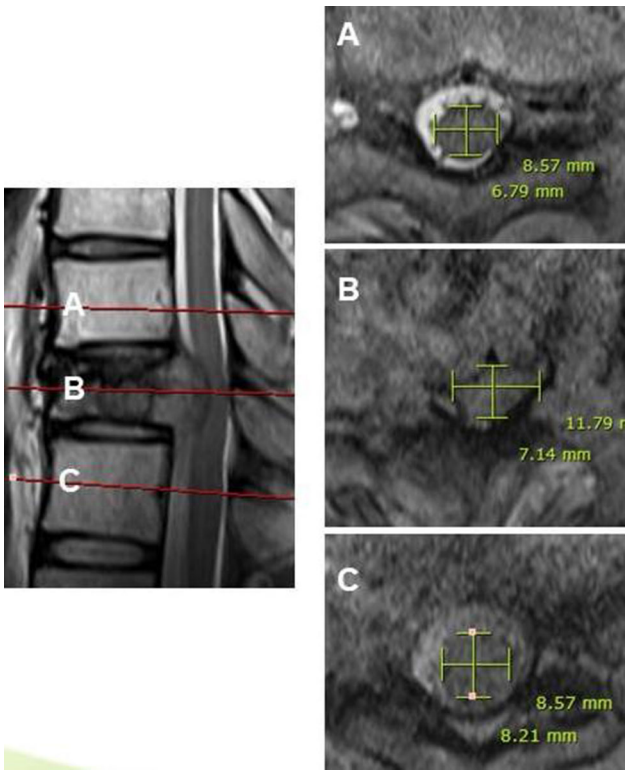
P47

SIMPLE PREDICTOR OF POSTOPERATIVE NEUROLOGIC STATUS IN PATIENTS WITH METASTATIC SPINAL CORD COMPRESSION - CORD COMPRESSION RATIO ON MRI

Sang-Il Kim, Young-Hoon Kim, Kee-Yong Ha, Hyung-Youl Park, Woong-Ki Jeon, Joon-Hyung Cho, In-Soo Oh

Dept of Orthopedic surgery, Seoul St. Mary's Hospital, The Catholic University of Korea, Seoul, South Korea

Introduction: Previous studies have reported several clinical predictors for postoperative ambulatory function in patients with metastatic spinal cord compression (MSCC). However, few studies demonstrated the relationship between preoperative magnetic resonance imaging (MRI) findings and postoperative ambulatory status. The purpose of this study is to identify MRI parameters to predict postoperative ambulatory status.
Methods: We retrospectively investigated 63 patients who underwent surgeries for their metastatic spinal cord compression in a single institute between Jan. 2011 and Jun. 2017. On preoperative MRI, the change in signal intensity (SI) of the spinal cord on sagittal T2 images was recorded, and anteroposterior (AP) diameter and width of the spinal cord at maximal compression lesion and two adjacent levels above and below were measured on axial T2 images. The mean value of two products of AP diameter and width at two adjacent levels was compared with the product of AP diameter and width at the lesion. The compression ratio was calculated by division of the value of the lesion by the mean values of two adjacent levels. The parameters mentioned above were analyzed statistically regarding the postoperative ambulatory status at the postoperative 1 month as the endpoint.
Results: Preoperatively, 33.3% of the patients (n = 21) were non-ambulatory, whereas 77.8% of the patients (n = 49) were ambulatory at the postoperative 1 month. The difference between the value of the lesion and the mean value of adjacent levels showed a prognostic relationship for the postoperative ambulatory status (P = 0.011). In 23 patients, the difference between the products of AP diameter and width at the lesion and the adjacent levels was over zero. The compression ratio showed a significant correlation with postoperative ambulatory status (P = 0.002). Receiver operating characteristic (ROC) curve analysis demonstrated that the optimal ratio cutoff value for postoperative ambulatory status at 1 month was 0.82. Both inter-observer and intra-observer reliability were over 0.80. When the high SI of the cord on T2 images determined by both examiners was positive, it was also a significant predictive factor (P = 0.017. However, the Cohen's kappa regarding the change of signal intensity of the spinal cord on sagittal T2 images was 0.416.
Conclusion: The compression ratio may help spine surgeons to predict the postoperative ambulatory function. The change of SI of the spinal cord on sagittal T2 images showed poor interobserver agreement. Although some imaging features have proposed for prediction of postoperative functional prognosis, the compression ratio is considered simple and reliable.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none.

P48

NEW POSTERIOR COLUMN RECONSTRUCTION USING TITANIUM LAMINA MESH AFTER TOTAL EN BLOC SPONDYLECTOMY OF SPINAL TUMOUR

Sung Kyu Kim, So Hyun Moon

Department of Orthopedic Surgery, Chonnam National University Medical School & Hospital Department of Nursing, Chosun University, Gwangju, South Korea

Introduction: There have been few reports about posterior column reconstruction to reinforce the stability by maintenance of the posterior structure and provision of the posterior fusion bed, and to protect the neural structures such as the spinal cord.
Purpose of the study: To investigate the usefulness of titanium lamina mesh for posterior column reconstruction after total en bloc

spondylectomy in patients with spinal tumour and evaluate the radiographic outcomes of this method.
Materials and methods: Eight patients who underwent total en bloc spondylectomy with posterior column reconstruction using titanium lamina mesh and bone graft to treat a spinal tumour were included in this study. The mean age at the time of surgery was 50.6 years (range 16.5–70.9 years) and the mean follow-up duration was 50.2 months (range 28.1–68.7 months). The pathological lesions were located from the T2 to L1 vertebrae. There were four patients in each primary and metastatic tumour group. For the posterior column reconstruction, titanium lamina mesh was used and bone graft was applied over the lamina mesh. Radiographic evaluation was used to investigate the displacement of lamina mesh and union of the grafted bone above lamina mesh.
Results: At the postoperative six month follow-up, a bony bridge on the titanium mesh between upper and lower adjacent lamina was observed in all cases, except for one with infection. On the last follow-up, there was no collapse or displacement of titanium lamina mesh, and there was no instability or malalignment of the spinal column.
Conclusions: Posterior column reconstruction using titanium lamina mesh during total en bloc spondylectomy for spinal tumour was a useful surgical option that provided new lamina reconstruction for stability of spinal column and protection of the neural elements.
Disclosures: author 1: none; author 2: none.

P49

INTRA-OPERATIVE NEUROMONITORING (IONM): IS THERE A ROLE IN METASTATIC SPINE TUMOUR SURGERY (MSTS)?

Naresh Kumar, Vijayaraghavan G, Nivetha Ravikumar, May Lin Yin, Ravish Patel, Nandika Naresh, Hwee Weng Dennis Hey, Leok-Lim Lau, Gabriel Liu

Department of Orthopaedic Surgery, National University Health System (NUHS), Singapore

Introduction: Multimodal IONM is standard of care in spinal deformity surgeries but limited data exist about its role in MSTS. We hypothesize that multimodal IONM has a place in the operative management of patients undergoing MSTS. We aim to report our experience with IONM in MSTS.
Methods: This is a retrospective analysis of prospectively collected data of 128 patients from 2010 to 2017 who underwent MSTS with IONM at our institute, after excluding 7 patients with no baseline signals. Data collected included demographics, details of tumour involvement, pre-operative neurological status and surgical details (MIS/Open, levels instrumented and decompressed). Patients with postoperative neurological deficit were followed up for 12 months or until their demise, whichever earlier. All patients had 20–32 channel multimodal IONM [SSEP, tcMEP and free running EMG].
Results: The 128 patients (61 males and 67 females) had a mean age of 61 years. 116 had posterior procedures; 9 anterior and 3 both. Preoperative ASIA Grades were A = 0, B = 0, C = 10, D = 44 and E = 74 patients. Fifty-four patients underwent MSTS for neurological deficit, 66 for instability pain and 8 for intractable pain. A total of 116 patients had undergone posterior procedure, 9 anterior and 3 a combination of both. Of 128 patients, 13 (10.2%) had significant IONM alerts (true positives); 114 were true negatives, 1 false negative & no false positives. Among the 13 true positives, 4 (30%) underwent MIS and 9 (70%) underwent open procedures. Eight (69.2%) patients had undergone surgery with a posterior approach. Seven (53.84%) true positive alerts occurred during decompression, which resolved upon completion of decompression; 5 (38.46%) occurred during instrumentation, which recovered after adjusting/downsizing instrumentation; and 1 (8.3%) during lateral approach which reversed after changing the plane of dissection. Among the 13 true positives, 1 alert was of all three modalities, 5 were of MEP & SSEP, 2 were of MEP & EMG and 5 alerts were of MEP alone. Of the 7 patients without baseline, 5 were ASIA-A and 2 ASIA-C. Sensitivity, specificity, positive and negative predictive values were 99.1%, 100%, 100% and 92.9% respectively.
Conclusions: Multimodal IONM prevented post-operative neurological deficit in 9.4% of MSTS patients. It's high sensitivity and specificity to detect intraoperative neurological events envisages its use in ASIA-grade D/E patients.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: not indicated.

P50

ASYMPTOMATIC CONSTRUCT FAILURE (ASCF) AFTER METASTATIC SPINE TUMOUR SURGERY (MSTS): A NEW ENTITY OR A CONTINUUM WITH SYMPTOMATIC FAILURE?

Naresh Kumar, Ravish Patel, Barry WL Tan, Nivetha Ravikumar, Helena Milavec, Aravind Kumar, Hwee Weng Dennis Hey, Leok-Lim Lau, Joseph Thambiah, Gabriel Liu

Department of Orthopaedic Surgery, National University Health System (NUHS), Singapore

Introduction: The reported incidence rates of construct failures (CF) in metastatic spine tumour surgery (MSTS). (1.9–16%) are based on revisions for symptomatic failures (SF). The phenomenon of asymptomatic construct failure (AsCF) after MSTS has not been described in literature.
We hypothesize that most radiological failures must be symptomatic, as is the case in degenerative spine diseases. AsCF is a condition that behaves much differently in patients who undergo MSTS, as compared to those undergoing degenerative/deformity correction surgeries.

We aim to study the incidence, onset, underlying mechanism, natural history and factors leading to AsCF after MSTS.
Methods: We retrospectively reviewed prospectively collected data of 288 patients who underwent MSTS at a single tertiary care institute from 2005 to 2015. Data collected included demographics, oncological, and operative and postoperative details. Radiological evidence of CF was identified using the available serial radiographs. Patients with AsCF were analysed for risk factors and duration of survival. Competing risk regression analyses were done with AsCF as the event of interest and SF and death as competing events. Kaplan–Meier survival curves were obtained for patients with AsCF, SF and no failures.
Results: In our study, AsCF was observed in 16.7% (41/246) patients with an average onset of 2 (1–9) months after MSTS. However, symptomatic construct failures were observed in only 5.7% (14/246) of our patients, a subset of which were revised. 80.5% of our patients experienced early AsCF (< 3 months from index surgery) and 19.5% had late AsCF (> 3 months). Early AsCF was due to: 1) reduction in the height of vertebral body within the construct in patients who underwent posterior instrumentation only (n = 22) and 2) cage subsidence/tilting in anterior column reconstruction (n = 11). Increasing age ($p < 0.02$) and primary breast (13/41 = 31.7%) ($p < 0.01$) tumours were associated with higher AsCF rates. The most common radiologically detectable AsCF mechanism was increase in kyphosis (29 patients) (Fig. 1), followed by screw ploughing (15 patients) and

screw loosening (15 patients). A trend towards AsCF was observed in patients with SINS $\geq$ 7, instrumentation across junctional regions and a construct length of 6–9 levels. Median survival was 20 (3–95) months in early and 41 (11–92) months in late AsCF. Average follow-up duration was 20 months. None of the AsCF patients underwent revision.

Conclusions: 1. The majority of early AsCF were clinically inconsequential and required no intervention.

2. Late failure was seen in patients surviving longer and in those who maintained ambulation for longer periods. This could be attributed to late tumour recurrence.

3. AsCF is not an urgent indication for any intervention; however, we recommend frequent follow-up and periodic investigations in order to detect progressive CF.

4. Increasing age and primary breast tumour patients are prone to AsCF after MSTS.

Figure 1: (A) Spinal metastases to T12 from lungs(56 yrs/female). (B & C) Anterior decompression&reconstruction(cage);anterior fixation(T11-L1). (D & E) Early failure with increase in kyphosis(10°), cage sinkage(7 mm)(<1 month) (Total survival-38 months)

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: grants/research support: Swissorthopaedics research grant, other financial report: Icotec AG: softsponsoring fellowship; author 6: none; author 7: none; author 8: none; author 9: none; author 10: other financial report: DePuy Spine.

P51

FACTORS INFLUENCING EXTENDED HOSPITAL STAY IN PATIENTS UNDERGOING METASTATIC SPINE TUMOUR SURGERY AND ITS IMPACT ON SURVIVAL

Naresh Kumar, Ravish Patel, Samuel Wang, Joel Yong Hao Tan, Zhaojin Chen, Nivetha Ravikumar, Nandika Kumar, Hwee Weng Dennis Hey, Balamurugan Vellayappan

Department of Orthopaedic Surgery, National University Health System (NUHS), Singapore

Introduction: Metastatic spine tumour surgeries (MSTS) are indicated for preservation/restoration of neurological function in order to provide mechanical stability and for pain alleviation. MSTS aims to improve the quality of life of patients with metastatic spine disease (MSD) and to aid oncological control, which is usually achieved by adjuvant therapies. Outcome measures such as length of stay (LOS) and rate of complications after MSTS are important indicators of quality of the medical/surgical management provided, but limited literature evidence exists for the same. We aimed to determine the incidence and factors influencing normal (nLOS) and extended length of stay (eLOS) after MSTS.

Methods: We present a retrospective analysis of prospectively collected data of 220 patients undergoing MSTS from 2005 to 2015 at a single tertiary care institution. Data was collected on the preoperative, intraoperative and postoperative variables, discharge destinations and socioeconomic factors and were analysed. The key outcome indicator was eLOS, which was defined to be positive when LOS exceeded the 75th percentile for this cohort. Univariate and multivariate logistic regression analyses were performed to determine the predictive factors of eLOS.

Results: Overall median LOS was 7(1–30) days. The 75th percentile LOS in our cohort was 10.5 days and hence an LOS of $\geq$ 11 days was considered as eLOS, which was observed in 55 patients. The mean age was 60(25–87) years with gender distribution of 111 males (50.4%) and 109 females (49.5%). The most common primary tumour was lung (27%). Thirty-seven percent of patients had no comorbidities prior to surgery, 16% had one and 46.3% had 2 or more. The major comorbidities noted were diabetes, hypertension and heart diseases. Multivariate analysis revealed that significant variables independently associated with eLOS were instrumentation $>$ 9 spinal segmental levels (OR 2.89; 95% CI 1.1–7.5; p = 0.032) and the presence of postoperative complications (OR 3.68; 95% CI 1.85–7.30; $p < 0.001$). The LOS in patients without post-operative complications was 7.5 ± 3.6 days and for those with complications was 9.7 ± 5.5 days. Metastatic tumours other than breast, prostate and lung had a lesser risk of eLOS (OR 0.31; 95% CI 0.14–0.70; p = 0.004). The median survival of the whole cohort was 13-months (1–129 months), of patients with eLOS was 9-months (1–95 months) and of those with nLOS was 15-months (1–129 months). Survival estimates showed that patients with eLOS had shorter survival than those with nLOS (Crude HR 1.81; 95% CI 1.13–2.89; p = 0.003) (Fig. 1).

Conclusions: Our study showed that instrumentation levels $>$ 9, metastases from lung, breast & prostate, and the presence of major postoperative complications were the factors influencing eLOS. A reduction of LOS will assist health care providers in better resource allocation and will enable MSTS patients to spend a larger proportion of their limited life span in their home or preferred environment.

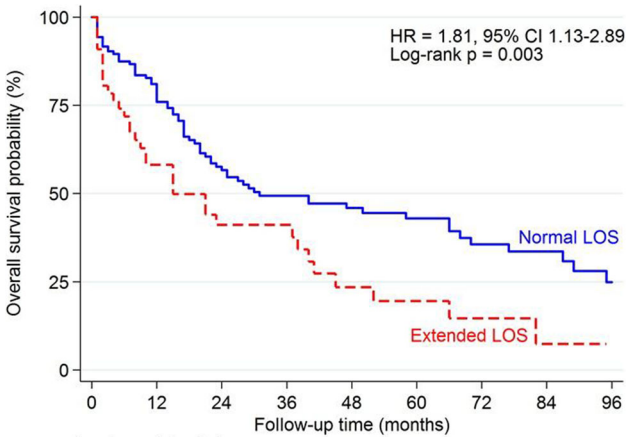


Fig. 1 Kaplan-Meier analysis showing probability of survival with respect to length of stay categories (eLOS-Extended Length of Stay and nLOS-Normal Length of Stay)

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10:.

P52

THE CLINICAL AND FUNCTIONAL OUTCOMES OF ELDERLY PATIENTS FOLLOWING DECOMPRESSIVE SURGERY FOR METASTATIC EPIDURAL CORD COMPRESSION ARE NOT INFERIOR TO THEIR YOUNGER COUNTERPARTS

Stacy Ng, Wee Lim Loo, Shree Kumar Dinesh

Department of Orthopaedic Surgery, Changi General Hospital, Singapore

Introduction: Advancements in cancer treatments have resulted in longer survival. An increasing number of patients who present with metastatic epidural cord compression (MECC) are elderly. The mainstay of management of patients with symptomatic MECC is palliative surgery. Age has been proposed to be a risk factor for poorer outcomes and some physicians may be deterred from offering older patients definitive management to reduce post-operative complications. Our aim was to determine if older patients had worse clinical and functional outcomes following decompressive surgery for MECC compared to their younger counterparts.
Methods: The clinical records of all patients who presented with neurological and/or radiological evidence of cord compression from spinal metastases who underwent surgery from January 2013-October 2017 were reviewed. The pre and post-operative Eastern Cooperative Oncology Group (ECOG) scores up to 24 months and American Spinal Injury Association (ASIA) scores were recorded. These patients were divided into two groups: group 1 (< 60 years old) and group 2 (60 years old). A p-value of < 0.05 was considered statistically significant.
Results: There were 14 and 19 patients in group 1 and 2 respectively. The pre-operative ECOG score was higher in the older group compared to the younger group (2.53 ± 0.70 and 1.93 ± 0.92 respectively, $p = 0.041$). There was no significant difference between gender, race, ASA score, location of metastases and number of levels operated between the two groups. Improvement in ASIA scores were seen in both groups after surgery; 78.6% from group 1 and 68.4% from group 2 achieved at least 1 grade improvement in ASIA score after surgery ($p = 0.864$). Group 1 patients had 1 grade higher post op ECOG at 3 months compared to group 2 ($p = 0.024$). There were no significant differences between the two age groups at 6, 12 and 24 months. There was no statistically significant difference between both groups for length of survival; the median survival time for group 1 and 2 were 317 and 518 days respectively ($p = 0.440$). Group 2 patients were 5.4 (OR 95% CI 0.94–31.0) times more likely to have a post-operative complication compared to group 1 but this association did not reach statistical significance ($p = 0.067$).
Conclusion: In our study, those aged 60 years did not have significantly poorer outcomes compared to those < 60 years old. $> 65\%$ of patients in both groups showed at least 1 grade improvement in post-op ASIA score. There was no difference in survival and post-op complications between both groups. The patient's age alone should not be the sole determinant of whether to offer surgery in MECC when clinically indicated.
Disclosures: author 1: none; author 2: none; author 3: none.

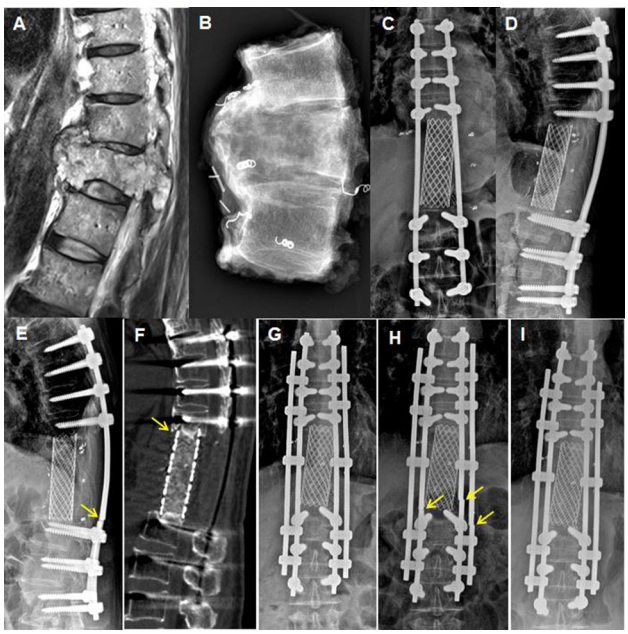
P53

ROD FRACTURE AND RELATED FACTORS AFTER TOTAL EN BLOC SPONDYLECTOMY

Se-Jun Park, Chong-Suh Lee, Tae-Hoon Yum, Yun-Jin Nam, Jin-Sung Park

Department of orthopedic surgery, Samsung medical center, Seoul, Korea

Background context: Several studies have reported favorable oncosurgical outcomes after total en bloc spondylectomy (TES) for treatment of primary malignant tumors or oligometastatic tumors. Considering that TES is indicated for patients with longer life expectancy, long-term instrumentation-related issues such as rod fracture needs to be addressed.
Purpose: To investigate delayed rod fracture and related factors after TES.
Study design: Multicenter, retrospective study.
Patient sample: Thirty-two patients who survived for more than 2 years after TES consisted of 18 men and 14 women, with a mean age of 49.0 years. Twenty patients had primary tumors and 12 patients had metastatic tumors.
Outcome measures: Rod fracture and related factors.
Methods: The relationships between rod fracture and related factors were investigated using Kaplan–Meier survivorship analysis with log-rank test. The analyzed factors were sex, age (< 60 or ≥ 60), tumor histology (primary or metastatic), location of resected tumor (thoracic [above T11], thoracolumbar [cases including T12-L1], or lumbar [below L2]), number of resected vertebrae (1, 2, or 3), anterior support method (expandable cage, mesh cage, or strut bone graft), rod diameter (5.5 mm or 6.0 mm), and history of radiotherapy including preoperative or postoperative radiotherapy.
Results: The mean follow-up duration was 49.8 months (range 24–166 months). Twelve of 32 patients (37.5%) experienced rod fractures at an average of 29.2 months (range 8–93 months) after TES. Of these 12 patients, 8 underwent revision surgery due to back pain aggravation (n = 7) or nonunion on CT scan (n = 4). Location of resected tumor and history of radiotherapy were significantly associated with rod fracture ($p = 0.004$ and $p = 0.019$, respectively).
Conclusion: Rod fracture was not a rare complication after TES surgery. History of radiotherapy and TES at lumbar level were significant risk factors related to rod fracture. A robust strategy to obtain solid osseous fusion should be considered when planning TES.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none.

P54

RATE OF IMPLANT FAILURE AND SPONTANEOUS FUSION IN MISS FIXATION OF METASTATIC SPINE: IS THE FUSION NECESSARY?

Alvaro Silva, Oscar Bravo, Manuel Valencia, Ratko Yurac, Bartolomé Marré

Clínica Alemana - Universidad del Desarrollo, Santiago, Chile

Introduction: Surgical treatment goals for spinal metastasis are focused on improving quality of life, always considering the potential damage of the surgery with patient's life expectancy.
There is growing literature supporting that minimally invasive surgery (MIS) can help us achieve adequate spinal stabilization for pain control and neural decompression for cord or root impairment, with lower surgery-related complications, faster postoperative recovery time, timely access the radiotherapy or radiosurgery.

Since 2007 our group started to apply MIS techniques to stabilize and decompress the metastatic spine, watching in that time a very low incidence of complications. Considering the state of the art at that moment, and the medium to low survival expectancy of the patients, our group also started to do percutaneous pedicle stabilization without fusion, associated with radiotherapy.

The aim of this work is to evaluate the radiological findings like implant loosening and spontaneous fusion in a series of patient with metastasis of the spine treated with MIS stabilization (with or without decompression) but without fusion.
Materials and methods: This is a retrospective case series of patients operated by the same surgical team between January 2007 and June 2018 in two private centers in Santiago, Chile.
Medical records were reviewed to obtain: age, sex, primary tumor, spinal location, surgical decision, postoperative complications, access time to radiotherapy and patient survival.

Pre and postoperative computed tomography (axial, sagittal and coronal reconstructions) were reviewed looking for implant loosening and spinal spontaneous fusion.
Results: 27 patients were reviewed, average age 64.3 years old (34–90), 9 women and 18 men.
Primary tumor: Lung 40.7%, renal 18.5%.
Spinal Location: thoracic 29.6%, Thoraco-lumbar: 33.3%, Lumbar: 33.3%.
Surgical decision: Mechanical pain 17, Cord compression 6, 4 lumbar root compression.
Surgical complications: 1 dural tear and 2 epidural hematomas solved with decompression.
No postoperative infections were observed.

81.5% of the patients went to radiotherapy; average 30.8 days (5–256).
Patient survival: 621.6 days (median 376).
There were no implant failures, like loosening, migration, screw or rod breakage.

Spontaneous fusion was observed at all the facet joint within the construction in 8 of the patients (29.7%). No preoperative spontaneous fusion was observed.
Discussion: MIS decompression and stabilization without fusion is a low related complication alternative for metastatic spine.
We didn't observe implant failure; both in short and medium term follow up, and specially no failure in thoracolumbar and lumbar spine, leading for shorter and safer surgeries for these patients.

These results open a space to investigate the possible causes of spontaneous fusion, such as the use of radiotherapy and chemotherapy or others.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none.

INFECTION (WHOLE SPINE)

P55

NEW SURGICAL STRATEGY FOR PRIMARY PYOGENIC SPONDYLODISCITIS: COMPARISON OF COMBINED ANTERO-POSTERIOR APPROACH VERSUS POSTERIOR-ONLY APPROACH

Dong Ryul Heo, Ja Wook Koo, Sung Hoon Choi, Chang-Nam Kang

Department of Orthopaedic Surgery, Hanyang University College of Medicine, Seoul, Korea.

Study design: A single-institution, single-surgeon retrospective review.
Objective: To compare the radiological and clinical outcome of treatment with combined antero-posterior approach and posterior-only approach in patients with primary pyogenic spondylodiscitis.
Summary of background data: There is much controversy regarding the optimal treatment of pyogenic spondylodiscitis in terms of surgical approach, bone grafting and instrumentation. There have been few studies comparing combined antero-posterior approach and posterior-only approach as surgical treatment for primary pyogenic spondylodiscitis.
Methods: From January 2007 to December 2016, we analyzed 79 patients who underwent surgical treatment with primary pyogenic spondylodiscitis. The study was divided into an anteroposterior group (AP group) using the combined antero-posterior approach and a posterior group (P group) using the posterior-only approach. The preoperative and postoperative data of the two groups were analyzed statistically. Univariate and Stepwise Multivariate Logistic Regression analysis was used to identify factors influencing the decision of the surgical approach.
Results: There were 59 patients in the AP group and 20 patients in the P group, and the mean follow-up period was 70 months (24–151). The lesions were thoracic vertebrae in 12 cases, thoracolumbar vertebra in 6 cases and lumbar vertebra in 61 cases. Preoperative data showed statistically significant differences between the two groups, only the initial height loss, the wedge angle of affected vertebral body, and the kyphotic angle. Postoperative data showed a statistically significant difference between the two groups; corrected angle, function and VAS score at last follow-up, estimated blood loss (EBL), and operation time. Complication revealed pseudoarthrosis in 3 patients of the AP group. the wedge angle of the affected vertebral body ($P < 0.001$, odds ratio [OR] 0.835, 95% CI 0.751–0.928) were identified as factor influencing the decision of the surgical approach.
Conclusion: In the surgical treatment of primary pyogenic spondylodiscitis, interbody fusion and instrumentation through the posterior-only approach is an effective method that is not inferior the procedure using the combined antero-posterior approach. In addition, the combined antero-posterior approach is recommended when the wedge angle of affected vertebral body is large.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P56

FACTORS FOR SURGICAL INTERVENTION IN THE TREATMENT OF PYOGENIC SPONDYLITIS

Hiroaki Kimura, Juichi Miura, Bunnichiro Wadayama

Dept of Orthopedic surgery, Hyogo, Japan

Introduction: Pyogenic spondylitis is a lethal, neurological condition with infection of the spine and destruction of spinal structures. Although it is generally treated conservatively using antibiotics, surgery may be required in the following conditions: neurological deterioration, resistance to antibiotics, and vertebral instability followed by vertebral body deterioration. We analyzed factors associated with requiring surgical intervention by comparing outcomes of patients treated conservatively (group C) with those requiring surgical intervention (group N).
Methods: From 2015 to 2018, we investigated 82 patients in our hospital (53 men and 29 women, average age = 69.4 years), classifying them into group C (n = 46) and group N (n = 36) to analyze the influence of age, sex, compromised host, infected area, pathogenic bacteria, and epidural abscess on the response rate to conservative therapy (RC: the proportion of group C patients for each factor). Healing was defined as the state of no recurrence > 3 months post treatment. Surgical interventions included laminectomy, posterior instrumentation, or anterior fusion combined with posterior instrumentation. Compromised hosts were defined as patients with diabetes, liver cirrhosis, atopic dermatitis, dialysis, or cancer. Statistical analysis was performed using the Chi squared test, and $P < 0.05$ was considered statistically significant.
Results: The following demographic factors were observed in group C and group N, respectively: average age, 68 and 70.9; males, 27 and 26; females, 19 and 10. The groups did not show significant differences in terms of age and sex (P = 0.169 and 0.204 for group C and N, respectively). Patients in their 70 s comprised the majority of both groups C and N. There were 37 compromised hosts with no significant between-group difference (P = 0.287) (RC = 51.1% compromised hosts and 62.9% non-compromised hosts). Cervical, thoracic, and lumbar lesions occurred in 15, 17, and 53 patients, respectively, and a significant between-group difference was noted (P = 0.022) (RC = 41.2% patients with cervical or thoracic lesions and 66% patients with lumbar lesions). Pathogenic bacteria were identified in 72 patients (MSSA = 26, MRSA = 8, Streptococcus = 16, E. coli = 9, and others = 17). RC was 38.4%, 12.5%, 75%, 33.3%, and 70% for patients with MSSA, MRSA, Streptococcus, E. coli, and others respectively, showing a significant between-group difference (P = 0.003). There were 49 patients with epidural abscess (RC = 36.7% patients with epidural abscess and 81.6% patients without epidural abscess) showing a significant between-group difference ($P < 0.001$).
Discussion: Our results showed that cervical or thoracic lesions; infection caused by MSSA, MRSA, or E coli; or epidural abscess complications tended to cause conservative therapy to fail. Therefore, we should decide early surgical intervention for patients with the above conditions who do not show good response to conservative treatment.
Disclosures: author 1: none; author 2: none; author 3: none.

P57

INTRA-WOUND VANCOMYCIN AS ADDITIONAL INFECTION PROPHYLAXIS IN INSTRUMENTED SPINAL SURGERY: A SYSTEMATIC REVIEW

Géraldine C.M. Lafeber, Jeroen G.J. Huybregts, Willem Pondaag, Wilco C. Peul, Carmen L.A. Vleggeert-Lankamp

Dept of Neurosurgery, Leiden University Medical Center (LUMC), Leiden, The Netherlands

Background: Postoperative wound infection remains a critical problem after instrumented spinal surgery. The risk of wound infection after spinal surgery may be decreased by application of intra-wound vancomycin powder in addition to perioperative intravenous cephalosporin prophylaxis. However, high-quality evidence is limited. Moreover, previous studies do not distinguish instrumented from non-instrumented procedures, the latter group being at increased risk for post-operative infections. The present systematic literature review is the first to provide insight in the quality of evidence available concerning the effect of additional intra-wound vancomycin in instrumented spinal surgery only.
Methods: A literature search was performed using an optimally sensitive search strategy. Studies were selected for inclusion by means of predefined criteria. Subsequently, quality of the studies was scored via risk of bias assessment using an adjusted version of the Cowley bias assessment tool.
Results: Thirteen articles, describing a total of 5173 patients, were included. Nine of thirteen studies reported a statistically significant decrease in Surgical Site Infection (SSI)-rates through additional intra-wound vancomycin application. However, none of these were of sufficient quality due to selection- and attrition bias, lack of proper outcome- and patient description and follow-up. Studies of higher quality did not report a difference. One RCT was included. This study did also not report a significant difference and quality was assessed low.
Conclusions: Evidence on the protective effect of additional intra-wound vancomycin usage in instrumented spinal surgery is inconclusive and subject to improvement. In order to further substantiate effectiveness of intra-wound vancomycin, a double-blinded randomized controlled trial is needed (Table 1).

Table 1 Data extraction

Authors	Risk of Bias	SSI description	% SSI		Significance (p)	
			Control	Vanco		
Caroom (2013)	5/10	0	15.0	0.0	0.007	Yes
Dennis Hey (2017)	5/10	1	6.3	0.9	0.049	Yes
Gaviola (2016)	5/10	1	11.0	5.02	0.08	**No**
Heller (2015)	6/10	1	3.8	1.1	0.029	Yes
Kim (2013)	6/10	1	12.5	0.0	0.033	Yes
Martin (2014)	7/10	1	5.3	5.1	0.936	**No**
Martin (2015)	7/10	1	6.9	5.2	0.563	**No**
O'Neill (2011)	6/10	0	13.0	0.0	0.02	Yes
Ross (2016)	4/10	0	6.54	0	0.0269	Yes
Strom (2013)[I)]	4/10	0	12.0	0.0	0.000806	Yes
Strom (2013)[II)]	5/10	0	10.9	2.5	0.0384	Yes
Sweet (2011)	4/10	0	2.6	0.2	< 0.0001	Yes
Tubaki (2013)	4/10	0	1.98	1.99	NR	**No**

SSI description: 0 = vague description, 1 = proper description, 2 = proper description and classification

Risk of bias: 0–4 = high; 5–7 = moderate; ≥ 8 = low

NR: not reported

NS: not specified (including spinal stenosis, other degenerative disc diseases, pseudoarthrosis, fractures, neoplasma, deformity)

Disclosures: author 1: none; author 2: none; author 3: not indicated; author 4: grants/research support: Medtronic, Paradigm Spine, Braun;

author 5: grants/research support: Covidien sponsors a trial on leg-pumps in neurosurgical surgery. Ynske Meyes Fund sponsors a trial on epidural injections in sciatica. These are all investigator initiated trials. The payment is not made to my own account but to our research department. Board of CSRS Europe, faculty for EANS, CSRS, Eurospine and webinar for AO spine.

P58

DOES THE INTEGRITY OF THE VERTEBRAL PLATES AFFECT THE RESULTS OF ENDOSCOPIC TREATMENT OF SPONDYLODISCITIS?

Rafael Llombart Blanco, Victoria Moreno, Carlos Villas, Matías Alfonso

Dept of Orthopaedic surgery, Clínica Universidad de Navarra, Pamplona, Spain

Introduction: Open surgery for debridement and stabilization of the affected segments is the classic surgical treatment of spondylodiscitis. As an alternative for elderly patients or poor general condition, endoscopic cleaning has been suggested. There are studies that demonstrate an early improvement of the pain and allows the identification of the responsible germ in 85% of the cases. Their specific indications have not yet been defined and we do not know the factors that can condition their result.
Objective: The aim of this study is to assess whether the state of the vertebral plates influences the results of endoscopic cleaning in patients with discitis.
Materials and methods: Retrospective study of patients with spondylodiscitis operated by endoscopic cleaning. The indication for an endoscopic cleaning was the failure of the conservative treatment. The variables collected were: age, sex, comorbidities, level of affection, previous surgery in the spine, germ involved, CPR (pre- and post), VAS (pre-operative and post-operative to day, week, month, 3 months, 6 months and a year) and the state of the vertebral plates, dividing it into two groups; 1: destruction of the vertebral endplates and 2: integrity–irregularity.
Results: We analyzed a total of 15 cases of which 55% were men, mean age was 67 years. In 61% of the cases the affected level was L4-L5. The main associated comorbidities were DM and CRI. 52% had undergone a previous spine surgery. The main germ involved was S. Aureus. 90% presented an improvement in pain at 3 months. 36% had full vertebral endplates and in this group the improvement of the EVA was 6 points compared to an improvement of 4 points in the group with destruction of the endplates ($p > 0.05$).
Conclusions: Patients without destruction of the vertebral endplates have better results in terms of pain improvement after endoscopic cleaning.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P59

BIOACTIVE GLASS S53P4 AS BONE GRAFT SUBSTITUTE IN FUSION SURGERY FOR NON SPECIFIC SPONDYLODISCITIS

Markus Pietrek, Ralph Kothe

Klinik für Spinale Chirurgie, Schön Klinik Hamburg Eilbek, Hamburg, Germany

Introduction: Bioactive glass (BAG) is used as a bone graft substitute in various clinical applications, particularly in osteomyelitis due to its antibacterial properties. However, with regard to spinal osteomyelitis, i.e. spondylodiscitis, only three cases have been reported in the literature so far.
Purpose of the study: In surgical treatment for spondylodiscitis, bone grafts are needed in all patients in the filling of cavitary defects and/or intervertebral cages. Therefore, the purpose of this case series was to examine BAG as a potential bone graft substitute with regard to usability, side effects, infection recurrence and fusion rate.
Materials and methods: In 11 patients (3 female, 8 male, average age 72.5 years, range 50–87 years) with non specific thoracolumbar spondylodiscitis, BAG S53P4 was used in fusion surgery as filling of cavitary defects and/or intervertebral cages. BAG was used in 3 different granule sizes (0.5–3.15 mm), with volume ranging from 3 cc to 10 cc. Follow up with clinical examination, CRP test, standing x-ray and CT-scan was performed before discharge, after 3 months and after 12 months.
Results: In all 11 patients, no side effects due to BAG were noticed. Larger granule sizes were easier to use. 2 patients died within one year due to severe comorbidities, not related to the surgery. In the 10 patients available for the 3 month follow up, the infection showed no recurrence. In the 6 patients completing the 12 month follow up, fusion was achieved.
Conclusion: This small case series supports the use of BAG S53P4 as a bone graft substitute in fusion surgery for spondylodiscitis, in the filling of cavitary defects and/or cages. No side effects or infection recurrences have been observed, and in the patients available for 12 month follow up, fusion of the affected segment was achieved. However, controlled trials with larger case numbers are needed to support these primarily results.
Disclosures: author 1: consultant: Silony, Germany; author 2: none.

P60

CAN DISTRIBUTION PATTERN OF INTRASPINAL EPIDURAL ABSCESS OF THE THORACIC AND LUMBAR SPINES BE ONE OF THE PROGNOSTIC FACTORS OF RESIDUAL NEUROLOGIC DEFICIT AFTER SURGERY?-A RETROSPECTIVE STUDY

Shih-Tien Wang, Yu-Cheng Yao, Po-Hsin Chou

School of Medicine, National Yang-Ming University, Taipei, Taiwan

Department of Orthopedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan.

Introduction: Residual neurologic deficits have been reported around 11 to 57.1% for spinal epidural abscess (SEA) after surgical treatment. Preoperative neurologic status, older age, diabetes and methicillin resistant Staphylococcus aureus (MRSA) infection were reported as prognostic factors. There were, however, reports regarding prognostic factors of magnetic resonance imaging (MRI) as well as distribution of the abscess were not much.
Methods: From January 2005 and December 2014, 53 consecutive patients at an average age of 68.4 year-old (range 30–86 year-old) with SEA, 39 were pyogenic and 14 were TB, of thoracic or lumbar spine were surgically treated at our hospital, which were proven by culture or histopathology. All surgeries were performed through posterior-only approach at an emergent basis. According to MRI, the distribution of abscess, ring-enhancement, abscess length and thickness, and canal compromise in terms of anteroposterior (AP) ratio and cross-section area (CSA) ratio were measured and analyzed pre-operatively. The distributions of SEA were divided as anterior (A), posterior (P) and anterior with posterior (A + P). All of the

measurements were measured using computer software (SmartIris; Taiwan Electronic Data Processing Co., New Taipei City, Taiwan) on picture archiving and communication system (PACS). Neurologic status was evaluated and recorded using Frankel grading system preoperatively, postoperatively and at final follow up. According to residual neurologic deficits, the patients with residual neurologic deficits were grouped as group 1, and group 2 for the patients without residual neurologic deficits.

Results: The affected levels were the thoracic spine in 9 patients, 6 patients in thoracolumbar junction, 28 patients in lumbar spine and 10 patients in sacrum. Culture rate was 77.3%, Staphylococcus aureus (included 3 MRSAs) was the most common pathogen for all pyogenic SEAs (35.9%) and Mycobacterium tuberculosis for TB (12 in 14, 85.7%). Thirty-five out of 53 patients (66%) with pre-operative neurologic deficits, and 21 (40%) had residual neurologic deficits after operation. After surgery, the average improvement of neurologic status was 1.2 Frankel grades, which was statistically significant ($p < 0.001$) compared to the pre-operative neurologic status. Clinically, age (> = 70 years), diabetes, presence of urinary incontinence were significantly affect the prognosis of SAE. According to the MRI findings, A + P abscess distribution, AP ratio, CSA ratio, abscess length, and thickness were significantly correlated with residual neurologic deficits (Table 1). However, a better prognosis was found significantly with A abscess distribution, and no difference for P abscess distribution (Table 1). There was no difference regarding pyogenic or TB SEAs.

Conclusion: In our study, A + P abscess distribution, AP ratio, CSA ratio, abscess length, and thickness can be poor prognostic factors of SEAs associated with residual neurologic deficits besides age, diabetes and presence of urinary incontinence. However, A abscess distribution can be a better prognostic factor, and no difference for P abscess distribution.

Table 1 MRI parameters of the patients with or without residual neurologic deficits

MRI parameters	Neurologic deficit (Group 1 n=21)	Non-neurologic deficits (Group 2, n=32)	P value
Abscess distribution			
Anterior only (A)	10 (47.6%)	29 (90.6%)	0.001*
Posterior only (P)	3 (14.3%)	1 (3.1%)	0.289
Anterior and posterior (A+P)	8 (38.1%)	2 (6.3%)	0.009*
Presence of ring-enhancement	13 (61.9%)	15 (46.9%)	0.284
Presence of paravertebral or psoas abscess	10 (47.6%)	15 (36.9%)	0.958
Canal compromise AP ratio (mean±SD)(%)	62.6 ± 10.6	48.9 ± 12.6	<0.001*
Canal compromise CSA ratio (mean±SD)(%)	65.3 ± 16.16	54.0 ± 14.3	0.013*
Abscess length (mean±SD)(cm)	7.30 ± 3.01	5.72 ± 2.27	0.048*
Abscess thickness (mean±SD)(cm)	1.00 ± 0.25	0.70 ± 0.25	<0.001*

AP ratio: anteroposterior ratio
CSA ratio: cross-section area ratio
* statistically significant ($p < 0.05$)

Disclosures: author 1: none; author 2: none; author 3: none.

ADULT DEFORMITY (WHOLE SPINE)

P61

BRIDGING THE GAP BETWEEN STATIC AND DYNAMIC POSTURAL ALIGNMENT: HOW DOES THE SAGITTAL VERTICAL AXIS PERFORM DURING WALKING?

Ayman Assi, Ziad Bakouny, Aren Joe Bizdikian, Joeffroy Otayek, Fares Yared, Virginie Lafage, Nour Khalil, Abir Massaad, Ismat Ghanem, Wafa Skalli

Faculty of Medicine, University of Saint-Joseph, Beirut, Lebanon; Institut de Biomecanique Humaine Georges Charpak, Arts et Metiers ParisTech, Paris, France; Spine division, Hospital for Special Surgery, New York, USA

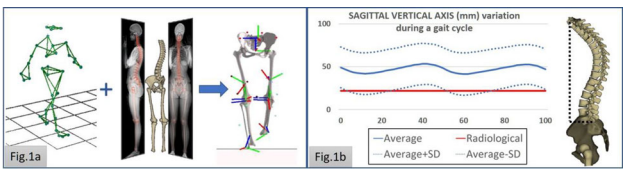
Introduction: Patients with adult spinal deformities (ASD) are known to have altered postural alignment affecting their quality of life and activities of daily living, especially gait. Evaluation of gait through motion capture in ASD is becoming an important tool to assess their dynamic stability. The Sagittal Vertical Axis (SVA), a global postural alignment parameter calculated on full body sagittal radiographs, is known to be highly altered in ASD. Even though this parameter is positional and could vary during gait, no studies have investigated its alteration during walking even in asymptomatic subjects.

Purpose: To understand how SVA varies during gait and what determines its variation.

Methods: 75 asymptomatic adults (age: 30 ± 11 years [18–59],32F) underwent gait analysis with reflective markers on the pelvis, lower limbs and the C7 spinous process. Kinematics of the pelvis and lower limbs were extracted. Subjects then underwent low-dose full-body biplanar radiographs in standing position, with the reflective markers still in place. Subject-specific 3D spino-pelvic, acetabular and lower limb parameters were calculated as well as the 3D radiological SVA (rSVA). Then, the 3D bones were registered on each frame of the gait cycle (Fig. 1a). The SVA was computed during the gait cycle, using the 3D registered bones, at each time frame: average (av_SVA), range of motion (ROM_SVA) and the difference between dynamic and static SVA (ΔSVA = av_SVA- rSVA) were calculated. In order to investigate the determinants of static and dynamic SVA parameters, a univariate analysis (Pearson's correlations) followed by a multivariate analysis (stepwise multiple linear regressions) were performed; the dependent variables were demographics, 3D joint kinematics and 3D skeletal radiological parameters (spino-pelvic, acetabular and lower limbs).

Results: The rSVA ranged from − 66 to 38 mm with a mean of − 9 mm. The av_SVA (ROM_SVA) during gait ranged from 9 to 108 mm (9 to 45 mm) with a mean of 46 mm (23 mm, respectively). ΔSVA ranged from 16 to 120 mm with a mean of 55 mm. Fig. 1b shows the SVA variation during gait relative to its radiological value. The multivariate analysis showed that: rSVA ($R2 = 0.2$) was solely determined by sex (F: − 20 mm vs M: 1 mm, $p < 0.001$); av_SVA ($R2 = 0.4$) during gait was determined by weight ($\beta = 0.97$, $p < 0.001$) and rSVA ($\beta = 0.18$, $p < 0.001$); ROM_SVA ($R2 = 0.2$) was determined by acetabular abduction ($\beta = -0.52$, $p = 0.038$) and the ROM of hip flexion/extension during gait ($\beta = 1.48$, $p < 0.001$); ΔSVA was solely determined by lumbar lordosis ($r = 0.33$, $p = 0.004$).

Discussion: This is the first study to evaluate SVA during walking in asymptomatic subjects. In general, subjects tended to bend their trunk forward during gait (positive ΔSVA), especially those with higher lumbar lordosis and higher radiological SVA. Patients with ASD, who are known to have an increased radiological SVA, might show a more forwarded trunk during gait which could possibly increase their risk of falling.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: grants/research support: ISSG, consultant: Globus, DepuySpine, stock/shareholder: Nemaris; author 7: none; author 8: none; author 9: none; author 10: none.

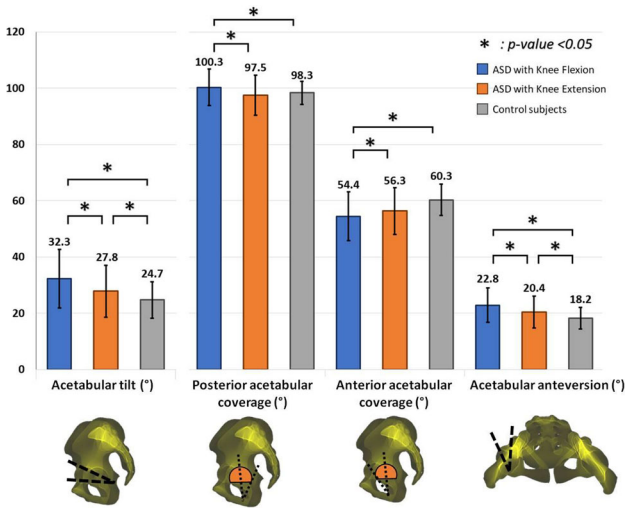
P62

TOWARDS UNDERSTANDING UNDERLYING MECHANISMS BEHIND THE PELVIC TILT RESERVE IN ASD

Ayman Assi, Georges Kawkabani, Renee Maria Saliby, Mario Mekhael, Chris Labaki, Mohammad Karam, Elena Jaber, Krystel Abi Karam, Charbel Haddad, Stephane Jabre, Georges Mjaess, Gaby Kreichati, Khalil Kharrat, Ismat Ghanem, Faouzi Srour, Rami Rachkidi, Virginie Lafage, Wafa Skalli

Faculty of Medicine, University of Saint-Joseph, Beirut, Lebanon; Institut de Biomecanique Humaine Georges Charpak, Arts et Metiers ParisTech, Paris, France; Spine division, Hospital for Special Surgery, New York, USA

Introduction: Subjects with Adult Spinal Deformity (ASD) and severe malalignment are known to use alternative compensatory mechanisms such as knee flexion after having reached their pelvic tilt reserve. Hip morphology was hypothesized to be responsible for this chain of events.
Purpose: To study the 3D hip morphology in subjects with ASD compensating with knee flexion.
Methods: Inclusion criteria for ASD were those of the European Spine Study Group. ASD and control subjects underwent full body biplanar X-rays in standing position. Classic spino-pelvic parameters were obtained in 3D: TK, LL, PI, PT, PI-LL, SVA, frontal C7 plumbline to the sacrum (C7-CSL), frontal Cobb. The following parameters were calculated in 3D bilaterally: acetabular anteversion, abduction & tilt (orientation of the acetabulum in axial, frontal & sagittal planes), anterior and posterior acetabular sector angles (AASA, PASA) and knee flexion (KF). Patients were divided into 2 groups: ASD with KF $> 5°$(ASD-KF), ASD with knee extension (ASD-KE). Hip parameters were compared between the 2 groups of ASD and controls using repeated measures ANOVA.
Results: 169 ASD and 62 controls were included. ASD showed significantly ($p < 0.001$) altered spino-pelvic alignment when compared to controls: larger Cobb angle ($26 \pm 16°$ vs $3 \pm 5°$), PT ($21 \pm 13°$ vs $12 \pm 7°$) & SVA (17 ± 53 mm vs -12 ± 22 mm). 63 ASD had a KF $> 5°$ and an altered spino-pelvic alignment in comparison with the 105 in the ASD-KE group ($p < 0.001$): larger PT ($26 \pm 18°$ vs $15 \pm 10°$) & SVA (52 ± 64 mm vs -4 ± 31 mm). Acetabular tilt, acetabular anteversion and PASA were significantly higher in the ASD-KF group when compared to ASD-KE and control groups; AASA was significantly lower in the ASD-KF group (fig. 1).
Conclusion: The findings of this study showed that ASD subjects compensating with knee flexion have altered hip morphology, characterized by increased posterior coverage (acetabular anteversion, tilt & PASA) and decreased anterior coverage (AASA) which can together lead to posterior femoro-acetabular conflict, thus limiting the increase of pelvic tilt. This underlying mechanism could be potentially involved in the hip-spine syndrome.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: none; author 11: not indicated; author 12: grants/research support: ISSG, consultant: Globus, DepuySpine, stock/shareholder: Nemaris; author 13: none.

P63

THE RELATION BETWEEN MEASURED HEIGHT LOSS, SAGITTAL SPINOPELVIC ALIGNMENT AND PHYSICAL FUNCTION AMONG COMMUNITY-DWELLING JAPANESE ADULTS: MEAN 34 YEARS LONGITUDINAL STUDY

Hisashi Chiba, Mutsuya Shimizu, Tetsuya Kobayashi, Shizuo Jinbo, Issei Senoo, Keisuke Matsukura, Mitsuru Imai, Yuji Atsuta

Dept of rehabilitation, Furano Geriatric Health Services Facility, Furano, Japan

Introduction: It is reported that body height loss is associated with osteoporosis, kyphosis with vertebral fractures, aging, low body-mass index, decline of QOL, digestive problems, urinary incontinence and using medications for both sleep and anxiety. Most of height loss of these reports were calculated as the difference between the subjects' self-reported maximum adult height and their measured current height. The relation between measured height loss, sagittal spinopelvic alignment and physical function has not been fully analyzed. The purpose of this study was to investigate the relation between measured height loss and sagittal spinopelvic alignment and physical function.
Methods: First survey was carried out in 1983 (baseline; BL), and subsequent survey in 2017(follow-up; FU). BL survey was investigated included upright whole spine radiographs, FU survey was investigated with radiographs and physical function. A total of 34 healthy subjects (21 men and 13 women; mean age at BL 43.3 years/ FU 77.4 years) were included. Radiographic measurement by spine physicians included thoracic kyphosis, lumbar lordosis, sagittal vertical axis (SVA), sacral slope, pelvic incidence (PI) and pelvic tilt (PT). Clinical evaluation of physical function by physical therapist included body weight, knee range of motion, active back extension test (BET) and passive back extension test, muscle strength of trunk flexor/extensor and knee extensor using an isometric device, and functional reach test (FRT). Back pain was recorded using visual analogue (VAS), Roland-Morris disability questionnaire (RDQ), and Japanese Orthopaedic Association score (JOA). Measured height loss

(BL height–FU height), sagittal spinopelvic parameters, and physical function were statistically analyzed using correlation and multiple regression analysis. All participants provided their written informed consent.

Results: Height loss was correlated with age (r = 0.48), weight (r = − 0.35), SVA (r = 0.70), PI (r = 0.57), PT (r = 0.48), BET (r = − 0.42), trunk flexor (r = − 0.43), trunk extensor (r = − 0.52), knee extensor (r = − 0.60), FRT (r = − 0.35), VAS (r = 0.40), RDQ (r = 0.60), and JOA (r = − 0.60). The multiple regression analysis showed that SVA (β = 0.65) and trunk extensor (β = − 0.32) were associated with significant height loss.

Discussion: Clinical data from this study showed height loss was associated with sagittal spinopelvic alignment and decline of physical function. In particular, increased SVA and reduced trunk extensor were closely related with documented height loss. Height loss should be recognized not only as a consequence of osteoporotic changes but also a clinical marker of deteriorated physical function and worsening adult spinal deformity.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: not indicated; author 8: none.

P64

MULTI-ROD CONSTRUCTS CLASSIFICATION SYSTEM ACROSS THREE COLUMN OSTEOTOMIES: A RELIABILITY STUDY

Mostafa El Dafrawy, Owoicho Adogwa, Adam Wegner, Michael Kelly, Keith Bridwell, Munish Gupta

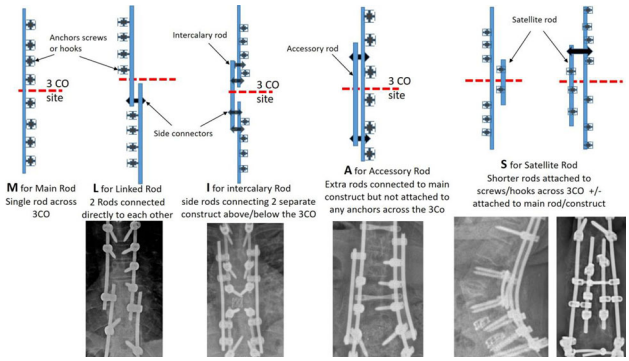
Dept of Orthopaedics, Washington University in Saint Louis, USA

Introduction: Rod constructs across three column osteotomies (3CO) can be modular with variable rod configurations. The high rate of rod failures (RF) across 3CO in adult spinal deformity (ASD) lead to the adoption of multi-rod constructs. Currently no comprehensive classification system exits for multi-rod constructs. We present a new classification system that allows accurate description of various multi-rod constructs. The reliability of the classification system is examined in terms of inter and intra-observer reliability of describing various multi-rod constructs and different rod configurations across 3CO in ASD.

Methods: 35 patients with multi-rod constructs across 3CO were classified by 2 spine fellows according to the new system, then reclassified 2 weeks later. The different multi-rod constructs across the osteotomy sites were classified as follows: number of rods across the osteotomy site followed by a letter corresponding to the type of rod configuration. The letter M was designated for main rod configuration which was defined as a single rod spanning entire length of construct. The letter L was designated for linked rods configuration defined as two rods that are directly connected to each other at the osteotomy site. The letter S was designated for satellite rod configuration which were defined as short rod with anchors above and below the 3CO independent of main construct. The letter A was designated for accessory rods defined as additional rod across 3CO attached to main constructs but not attached to any anchors across the osteotomy site. The letter I was designated for intercalary rod configurations defined as a rod connecting 2 separate constructs across 3CO but the intercalary rod itself is not attached to any anchors across the osteotomy site.

Results: A sample estimation for validation assuming 2 readers and 35 subjects results in a two sided 95% confidence interval with a width of 0.19 with Kappa value of 0.8 and the standard deviation SD (κ), is 0.3. Fleiss kappa coefficient (κ) was used to calculate the degree of agreement between Inter-rater and intra-observer reliability. Inter-rater the Kappa coefficient was 0.3, while for intra-rater k = 0.63(good reliability). Correct observations between both observers were (34/35 and 33/35). The poor inter-rater reliability was due to both observers mis-classifying different constructs, however both observers correctly classified 33 out of the 35 multi-rod constructs tested. The mis-classification was related to difficulty in determining the different rod configurations connections via connectors.

Conclusions: We present a new multi-rod construct classification that allows description of all the various multi-rod constructs with different rod configurations across 3CO in ASD. The classification has good intra-observer reliability. The multi-rod construct classification system is helpful in comparing different rod configurations in terms of rod failures.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: grants/research support: Depuy Synthes Spine; author 5: grants/research support: Scoliosis Research Society - Multicenter Study of Adult Symptomatic Lumbar Scoliosis; author 6: grants/research support: AOSpine & OMeGA for fellowship paid directly to institution, consultant: DePuy, Medtronic, stock/shareholder: J&J, P&G, perForm Biologics, royalties: Innomed, DePuy.

P65

FACTORS INFLUENCING PATIENT SATISFACTION AFTER ADULT SCOLIOSIS AND SPINAL DEFORMITY SURGERY

Kazunori Hayashi, Louis Boissière, Fernando Guevara-Villazón, Daniel Larrieu, Anouar Bourghli, Olivier Gille, Jean-Marc Vital, Ferran Pellisé, Francisco Javier Sánchez PérezGrueso, Frank Kleinstück, Emre Acaro lu, Ahmet Alanay, Susana Núñez-Pereira, Ibrahim Obeid, ESSG

Spine Surgery Unit 1, Bordeaux University Pellegrin Hospital, Bordeaux, France

Object: Achieving high satisfaction with management can be one of the goals after adult spinal deformity (ASD) surgery. However, there is limited literature on associated factors and their correlations with it. The aim of this study was to determine the clinical and radiographic factors independently correlated with patient satisfaction with management at 2 years after surgery.

Methods: A multicenter prospective database of ASD surgery was retrospectively reviewed. The demographics, complications, health-related quality of life (HRQoL) subdomains, and radiographic parameters were examined to determine their correlation coefficients with SRS-22R satisfaction scores at 2 years (Sat-2y score). Subsequently, factors independently associated with low satisfaction (Sat-2y score $\leq$ 4.0) were elucidated to construct two types of multivariate

models: one with 2-year data and one with improvement (scores at 2 years—at baseline) data.

Results: A total of 422 patients who underwent ASD surgery (mean age, 53.1 years) were enrolled. All HRQoL subdomains and several coronal and sagittal radiographic parameters had significantly improved 2 years after surgery. The Sat-2y score was strongly correlated with the SRS-22R SI/appearance (r = 0.64), followed by moderate correlation with subdomains related to standing (r = 0.53), body pain (r = 0.49–0.55), and functional subdomains (r = 0.41–0.55) at 2 years. Conversely, the correlation between radiographic or demographic parameters with Sat-2y score was weak (r < 0.4). Multivariate analysis to eliminate confounding factors revealed that a worse Oswestry Disability Index (ODI) for standing (≥ 2 points; OR 4.48), pain intensity (≥ 2 points; OR 2.07), and SRS-22R SI/appearance (< 3 points; OR 2.70) subdomains at 2 years as well as a higher SVA (> 5 cm; OR 2.68) at 2 years were independent related factors for low satisfaction. According to the other model, a lower improvement in ODI standing (< 30%; OR 2.68), SRS-22R pain (< 50%; OR 3.25), and SI/appearance (< 50%; OR 2.18) as well as inadequate restoration of the SVA from baseline (< 2 cm; OR 3.16) were factors associated with low satisfaction.

Conclusion: Self-image, pain, standing difficulty, and sagittal alignment restoration may be useful goals in improving patient satisfaction with management at 2 years after ASD surgery. Surgeons and other medical providers have to take care of these factors to prevent low satisfaction (Table 1).

Table 1 Spearman correlation between Sat-2y scores and the clinical, radiographic data at 2 years

	Correlation coefficient (r)	*p*
HRQoL data at 2 years		
SRS-22R Function/Activity	0.47	< 0.001
SRS-22R Pain	**0.55**	< 0.001
SRS-22R SI/Appearance	**0.64**	< 0.001
SRS-22R Mental health	0.43	< 0.001
SRS-22R Subtotal score	**0.62**	< 0.001
ODI Pain intensity	− 0.49	< 0.001
ODI Personal care	− 0.41	< 0.001
ODI Lifting	− 0.34	< 0.001
ODI Walking	− 0.38	< 0.001
ODI Sitting	− 0.36	< 0.001
ODI Standing	**− 0.53**	< 0.001
ODI Sleeping	− 0.35	< 0.001
ODI Social life	**− 0.55**	< 0.001
ODI Sex life	**− 0.51**	< 0.001
ODI Traveling	− 0.44	< 0.001
ODI Score	**− 0.57**	< 0.001
SF-36 Physical component score	0.49	< 0.001
SF-36 Mental component score	0.40	< 0.001
NRS Back pain	− 0.40	< 0.001
NRS Leg pain	− 0.27	< 0.001
Radiographic measurements at 2 years		
Coronal Cobb angle	0.08	0.14
Clavicle angle	− 0.02	0.73
Coronal balance	− 0.05	0.39
Sagittal vertical axis	− 0.23	< 0.001
Thoracic kyphosis	− 0.03	0.62
Lumbar lordosis	− 0.06	0.31
Pelvic incidence	− 0.17	0.002
PI–LL	− 0.15	0.006
Lumbar lordosis index	0.17	0.003
Pelvic tilt	− 0.15	0.006
Global tilt	− 0.21	< 0.001

HRQoL = health-related quality of life; SRS-22R = Scoliosis Research Society-22 questionnaire; SI = self-image; ODI = Oswestry Disability Index; SF-36 = the short form-36 items; NRS = numerical rating scale; PI – LL = pelvic incidence minus lumbar lordosis

Disclosures: author 1: grants/research support: Konishi Foundation for International Exchange; author 2: grants/research support: Depuy Synthes, consultant: Medicrea, Spineart; author 3: none; author 4: none; author 5: none; author 6: royalties: spineway; cousin biotech; author 7: not indicated; author 8: grants/research support: dePuy-Spine, Medtronic; author 9: grants/research support: dePuy synthes; author 10: grants/research support: depuy synthes, consultant: depuy synthes, Medtronic, royalties: Alphatec, Clariance, Spineart; author 11: grants/research support: Depuy Synthes, Medtronic, royalties: AOSpine; author 12: grants/research support: Depuy; consultant: Globus; author 13: not indicated; author 14: grants/research support: depuy synthes, consultant: depuy synthes, Medtronic, royalties: Alphatec, Spineart, Clariance; author 15: DePuy Synthes and Medtronic. Additional support was provided through Project PI16/01283, funded by Instituto de Salud Carlos III and co-funded by European Union (ERDF/ESF).

P66

LONG-TERM CLINICAL AND RADIOLOGIC OUTCOMES OF SEMI-CONSTRAINED LUMBAR TOTAL DISC REPLACEMENTS (MORE THAN 10 YEARS FOLLOW-UP)

Sinan Kahraman, Huseyin Ozturk, Yunus Emre Akman, Onur Levent Ulusoy, Ayhan Mutlu, Tunay Sanli, Selhan Karadereler, Meric Enercan, Azmi Hamzaoglu

Department of Orthopedics and Traumatology, Istanbul Spine Center, Istanbul, Turkey

Introduction: The purpose of this study was to evaluate the long-term of clinical and radiologic outcomes of patients whom underwent total disc replacements surgery for lumbar degenerative disc disease.

Methods: 20 patients (16F, 4M) (34 levels) who underwent total disc replacement surgery between 2003 and 2008, who had complete radiological data and had more than 10 years f/up were included. All patients were evaluated with preop and final f/up standing AP/LAT, dynamic x-rays, lumbar low dose CT and MRIs, analyzed by two radiologists. The range of motion of index and adjacent levels were measured with dynamic x-rays. Facet joint degeneration of index and adjacent level (preop and f/up) were classified according to Pathria classification with CT scan. Disc degeneration of adjacent levels was classified according to Phirmann classification on preop and f/up MRIs. Marginal homogeneity test was used for statistical analyses. ODI and VAS scores were used for clinical assessment.

Results: The mean age was 42 (29–54) years. The mean f/up was 12.8 (10–15) years. The total disc replacements were single level in 8 patients and two levels in 11 patients. The others were three (1) and four levels (1). Mean preop range of motion was 12° (6–18) and f/up range of motion was 14° (6–22) at index levels ($p < 0.05$). 12 of the

patients (%60) showed 1 grade increase in facet joint degeneration at index levels. The other levels remained stable. In 7 patients (%35) showed adjacent level facet joint degeneration (5 cranial, 2 caudal). Comparison of preop and f/up MRIs showed mild disc degeneration (1 grade) at adjacent levels in 6 patients (%30). We found mild acceleration (1 grade) in facet joint degeneration between preop and f/up CT scans in both index and adjacent levels ($p < 0.05$). Comparison of preop and f/up MRIs showed mild disc degeneration (1 grade) at adjacent levels ($p < 0.05$). None of total disc replacements showed any radiologic signs of loosening, subsidence, dislocation or heterotopic ossification. VAS scores improved from 7 to 2 and ODI score found 16 at the final f/up.
Conclusion: Semiconstrained total disc replacement showed satisfactory clinical and radiological results after min 10 years f/up. CT scans showed that facet joint degeneration progressed 1 grade at index (%60) and and adjacent levels (%35). Comparison of preop and f/up MRIs showed mild adjacent level disc degeneration (grade 1) in only %30 of the cases. Semiconstrained total disc replacement preserves range of motion of the index levels without any mechanical failure even 10 years after surgery.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: consultant: Medtronic.

P67

TWO YEAR FOLLOW UP OF MULTILEVEL OBLIQUE LUMBAR INTERBODY FUSION (MOLIF) USING HYPERLORDOTIC POROUS METAL CAGES VERSUS PEDICLE SUBTRACTION OSTEOTOMY (PSO) HAS LOWER NEUROLOGICAL INJURY RATES

Darren Lui, Hai Ming Yu, Adam Benton, Susanne Selvadurai, Shahnawaz Haleem, James Houston, Sean Molloy.

St. George's University Hospital, London, UK.

Introduction: Complex Adult Spinal Deformity (CASD) represents a challenging cohort of patients.
The Scoli-RISK-1 study of adults undergoing correction for adult spinal deformity (ASD) has shown a 22.18% perioperative risk of neurological injury in the perioperative period. Restoration of sagittal parameters is associated with good outcome in ASD.

Pedicle subtraction osteotomies (PSO) is an important technique. for sagittal balance in ASD but is associated with significant morbidity. The multilevel oblique lumbar interbody fusion (MOLIF) approach allows access through an extensile single incision from L1 to S1 and staged multilevel MOLIF may obviate the need for a PSO.
Methods: Single surgeon series 2007 to 2015. Prospectively collected data. Scoli-RISK-1 criteria were refined to only include stiff or fused spines otherwise requiring a PSO.
Roentograms examined preoperatively and 1 year post-operatively. Primary outcome measure was the motor decline in American Spinal Injury Association (ASIA) at hospital discharge, six weeks and 6 month, 1 year and 2 years. PROMS,.

Demographics, blood loss, operative time, spinopelvic parameters measured and Spinal Cord Monitoring (SCM) events were recorded.
Results: 68 consecutive patients. 34 each. Group 1(MOLIF) mean age 62.9 and Group 2(PSO) mean age of 66.76. gender MOLIF: 64.7% female versus PSO 76.5%.
Body Mass Index (BMI) Group 1(MOLIF) 28.05 and Group 2 (PSO) 27.17. Group 1(MOLIF) neurological injury 2.94% at discharge but resolved by 6 weeks. Group 2 (PSO) 5 neurological deficits (14.7%) with no recovery by 6 m–2y.

SCM events: Group 1 (MOLIF) 2.94% versus Group 2 (PSO) 8.88%.
Conclusion: Scoli RISK 1 trial shows that a true propsective trial regarding neurological injury in adult deformity surgery is higher than previously reported. The use of PSO as a technique is well established but known to carry morbidity particularly neurological.
A multistage MOLIF approach followed by PSF in this study was safer than PSO in CASD with stiff or fused spines. Over 2 years MOLIF showed a lower perioperative neurological injury rate compared to PSO indicating it can be a safer operative technique whilst achieving superior spinopelvic harmony.
Disclosures: author 1: none; author 2: none; author 3: consultant: Takeda UK, stock/shareholder: Infinity Health; author 4: none; author 5: none; author 6: none; author 7: consultant: Globus, Medtronic, Johnson & Johnson.

P68

DO THE POSTOPERATIVE SCORES CONSIDERED "ACCEPTABLE" FOR PAIN, OSWESTRY DISABILITY AND SRS-16 DIFFER DEPENDING ON AGE, TREATMENT AND ETIOLOGY OF ADULT SPINAL DEFORMITY PATHOLOGY?

Anne F Mannion, Alba Vila-Casademunt, Sarah Richner-Wunderlin, Markus Loibl, Ferran Pellise, Ibrahim Obeid, Joan Bago, Ahmet Alanay, Francisco S Perez-Grueso, Frank S Kleinstueck

Schulthess Klinik, Zurich, Switzerland; Vall d'Hebron Institute of Research (VHIR) and Hospital Vall d'Hebron, Barcelona, Spain; Bordeaux University Hospital, France; Acibadem University, Istanbul, Turkey; Hospital Universitario La Paz, Madrid, Spain

Introduction: Previous studies have suggested that an appropriate measure of outcome may be the proportion of patients whose post-treatment symptoms, if not totally eliminated, have at least reduced to an "acceptable/satisfactory level". We sought to quantify this "acceptable state" for different outcome instruments, in patients with adult spinal deformity (ASD) and its various subgroups.
Methods: This was a cross-sectional analysis of 12-mo outcome data from the database of an international observational study of patients with degenerative or idiopathic ASD (European Spine Study Group; ESSG). Questionnaires were completed at 12 mo follow-up (FU): Oswestry Disability Index; back pain and leg pain rating scales; SRS-22 (from which a total score and sub-domain scores for pain, function, self-image, and mental health were calculated for the recently validated 16-item short set); and symptom-specific well-being (SSWB) „if you had to spend the rest of your life with the symptoms you have now, how would you feel about it?"(5-point scale from „very satisfied"to „very dissatisfied", dichotomised for use as external criterion in receiver operating characteristics (ROC) analysis to determine cut-off scores). Being at least „somewhat satisfied"with the current state was considered an acceptable state. Subgroups were evaluated for etiology of deformity (degenerative or idiopathic), age (≥ 50 vs < 50 y) and treatment (surgical or nonsurgical).
Results: The data from 978 patients (534 surgical, 444 nonsurgical; 52 ± 20 y; 84% women) were available for analysis. All questionnaire scores at 12mo correlated significantly with SSWB scores (from $r = 0.47$ for SRS-function to $r = 0.69$ for SRS-total). 42% patients reported being in an "acceptable symptom state" at 12 mo FU (no effect of age-group or diagnostic group, but effect of treatment group: 34% in nonsurgical vs 48% in surgical group; $p < 0.0001$). The ROC areas under the curve were all relatively high (0.70–0.85; best for SRS-16-item total), suggesting the questionnaire scores discriminated well between patients in an acceptable state or not. The SRS scores

corresponding to being in an "acceptable" state ranged from > 3.0 to > 3.8 depending on the specific SRS domain and subgroup; the cutoff considered to reflect an "acceptable state" for ODI ranged from ≤ 11 to ≤ 29; and for pain, from ≤ 3 to ≤ 5. Generally, degenerative patients were satisfied to live with a higher level of symptoms than were idiopathic; and surgical, than were nonsurgical; and older, than were younger.
Conclusion: Many spine interventions can improve the patient's complaints but rarely do they totally eliminate them. Reporting the percentage of patients achieving a score equivalent to the „acceptable state"may represent a more stringent and discerning target for denoting treatment success. If doing so in studies of specific age-groups, etiologies, and treatment types, the precise cut-off value employed may need to be adjusted, for improved accuracy.
Disclosures: author 1: none; author 2: none; author 3: grants/research support: DePuy Synthes; author 4: none; author 5: grants/research support: DePuySpine. Medtronic; author 6: grants/research support: Depuy synthes, consultant: Depuy synthes, Medtronic, royalties: Clariance, Alphatec, Spineart; author 7: grants/research support: DePuy; author 8: grants/research support: Depuy, consultant: Globus; author 9: grants/research support: De Puy Sinthes; author 10: grants/research support: DepuySynthes.

P69

CAN ADOLESCENT LUMBAR SPONDYLOLISTHESIS ASSOCIATED SCOLIOSIS BENEFIT FROM INTERBODY FUSION

Xu Sun, Chang-zhi Du, Ze-zhang Zhu, Yong Qiu

Department of Spine Surgery, Nanjing Drum Tower Hospital, Nanjing, China

Purpose: To investigate the radiographic and clinical outcomes after a lumbosacral fusion for the spondylolisthesis, and to further compare the curve evolution between sciatic scoliosis and olisthetic scoliosis.
Study Design: Single-center Retrospective study.
Background: Sciatic scoliosis and olisthetic scoliosis are the two most common types of scoliosis in association with spondylolisthesis in adolescents. The compensatory scoliosis tends to improve after a lumbosacral fusion for the spondylolisthesis before the curve becomes structural. However, there have been no comprehensive studies of curve evolution after lumbosacral fusion surgery.
Methods: From January 2010 to September 2018, a total of 36 adolescents with symptomatic spondylolisthesis and coronal Cobb angles greater than 10°were treated with lumbosacral fusion surgery. Patients were divided into sciatic scoliosis group (SS-group) and olisthetic scoliosis group (OS-group) according to the curve characteristics. Radiographic parameters and clinical outcomes were measured preoperatively, postoperatively and at final follow-up.
Results: There were 20 patients in SS-group (M/F: 8/12; Age: 15.6 ± 2.2yrs) and 16 patients in OS-group (M/F: 6/10; Age: 16.8 ± 2.5yrs). Among them, thirteen patients were treated with PLIF and the remaining 23 with TLIF. After surgery, the spondylolisthesis in SS-group and OS-group was reduced by 76.1% ± 12.4% and 79.4% ± 9.6%, respectively. The mean follow-up was 27.8 ± 5.7 months. By the latest follow-up, significant improvement of the coronal Cobb angle, apical vertebral translation (AVT) and coronal balance was observed. In addition, SS-group showed a more significant lower coronal Cobb, L5 tilt and L5 Rotation compared to OS-group. No significant difference was observed between the two groups in terms of PT, SS, LL and SVA. SS-group showed larger increase in ODI scores and large decrease in VAS scores for low-back pain.
Conclusion: Posterior short-segment instrumented lumbar fusion surgery can bring favorable coronal plane improvement in adolescents with spondylolisthesis associated scoliosis. Sciatic scoliosis may have a better curve prognosis compared with olisthetic scoliosis.
Keywords: adolescents, lumbar spondylolisthesis, sciatic scoliosis; olisthetic scoliosis, lumbosacral interbody fusion.
Disclosures: author 1: none; author 2: none; author 3: not indicated; author 4: none.

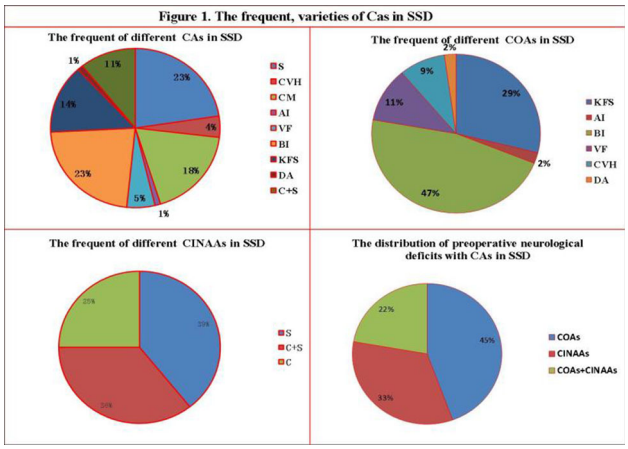
P70

CERVICAL ABNORMALITIES IN SEVERE SPINAL DEFORMITY: A TEN-YEAR MRI REVIEW

Ying Zhang, Jingming Xie, Yingsong Wang, Zhi Zhao, Tao Li, Quan Li, Zhiyue Shi, Qiuan Lu, Ni Bi

Department of Orthopedics, The 2nd Affiliated Hospital of Kunming Medical University, Yunnan Province, China

Cervical Abnormalities In Severe Spinal Deformity: A Ten-year MRI Review.
Background: Documents indicate that scoliosis often co-exist with cervical anomalies (CAs) (including cervical intraspinal neural axis abnormalities-CINAAs and/or cervical osseous abnormalities—COAs). However, paucity studies focus on the incidence of CAs in severe spinal deformities (SSDs) (cobb ≥ 90°).
Objective: To investigate the prevalence of CAs and the clinical relevance in SSDs.
Methods: All the patients with SSDs admitted for spinal surgery were evaluated from 2003 to 2015. Inclusion criteria: patients who present with coronal Cobb over 90° (and/or the sagittal cobb ≥ 90°); SSDs with whole spine MRI done preoperatively; SSDs with documented clinical findings preoperatively. Exclusion criteria: ankylosing spondylitis, adult onset scoliosis, scoliosis secondary to bone destruction, spinal dysraphism.
Results: A total of 108 SSDs fulfilled the criteria were included. There were 9 different CAs in 56 (51.85%) SSDs. The total frequency of detected CAs was 93. The most frequent CAs included syringomyelia (S) (22.6%) and basilar invagination (BI) (22.6%). There were 6 different COAs in 28 (25.9%) SSDs with totally frequency of 45 (48.4%). 10 (35.7%) SSDs were detected with COAs in upper vertebral levels (UVL) (C0-C2). BI was the most common COAs in UVL. 13 (46.4%) SSDs were detected with COAs in subaxial vertebral levels (SVL) (C3-C7). Klippel-Feil syndrome (KFS) was the most common COAs in SVL. There were 3 different types CINAAs in 21 (19.4%) SSDs. The most common CINAAs was S. There were 7(6.5%) SSDs detected with a combination of COAs and CINAAs. SSDs with COAs in UVL had a higher incidence of CINAAs than those in SVL ($p = 0.024$). SSDs with multiple COAs (mCOAs) (≥ 2 kinds OAs) in UVL had a higher incidence of CINAAs than those with single COAs (sCOAs) (1 kind OAs) ($p = 0.029$). On clinical examination, 17 of 108 SSDs (15.7%) had abnormal neurologic signs. 9 of 17 SSDs (52.9%) with abnormal neurologic signs had CAs.
Conclusion: The incidence of CAs in SSDs was 51.85%. 83.9% of them presented intact neurologic status. As the diversity of COAs increased, we found a higher incidence of CINAAs, especially in UVL. Thus, we recommend a thorough preoperative imaging assessment of the cervical spine for SSDs even in the absence of neurological findings.
Keywords: MRI; Abnormality; Spinal deformity; Cervical spine.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none.

GROWING SPINE

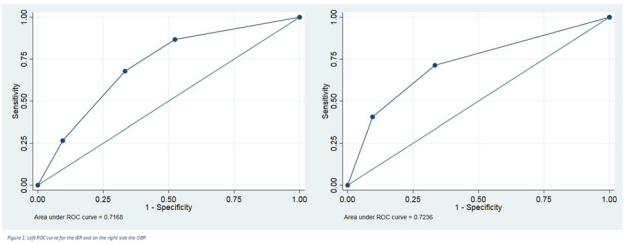
P71

FIRST OUT-OF-BRACE RADIOGRAPHS ARE BETTER PREDICTORS THAN IN-BRACE RADIOGRAPHS OF ADOLESCENT IDIOPATHIC SCOLIOSIS CONSERVATIVE TREATMENT

Francesca Di Felice, Stefano Negrini, Francesco Negrini, Giulia Rebagliati, Fabio Zaina, Sabrina Donzelli

ISICO (Italian Scientific Spine Institute), Milan, Italy. Department of Clinical and Experimental Sciences, University of Brescia, Brescia, Italy. Don Gnocchi Foundation, Milan, Italy. I.R.C.C.S. Istituto Ortopedico Galeazzi, Milan, Italy

Background: in-brace correction is considered a valuable predictor of final results of bracing for Adolescent Idiopathic scoliosis (AIS), while first out-of-brace radiographs (OBR) values need to be verified. First out-of-brace radiographs (OBR) after some months of treatment for Adolescent Idiopathic Scoliosis (AIS) should predict better final results than in-brace radiographs (IBR) since the last show the efficacy of the brace, while OBR demonstrate also the capacity of patients to maintain the obtained correction.
Purpose: To compare the correlation of in brace radiograph and first out of brace radiographs with the end of treatment radiographs to determine which has the best predictive value in a cohort of AIS patients.
Material and methods: Retrospective study embedded in a prospective clinical database including at search date (18-1-2019) 14,507 AIS patients age 10–18.
Participants: 304 consecutive patients (19% males; age 13.10 ± 1.07; 35.7 ± 11.2°) with sub-groups for sex, Risser, curve severity. Inclusion criteria: AIS, Risser 0–4, bracing, all radiographs available (start [SR], IBR, OBR, end of treatment [EoTR]). Statistics: paired ANOVA; correlations and r2; ROC curve for cut-offs to achieve stability (5°).
Results: All radiographs were well correlated (range 0.74–0.95, r 0.55–0.9), with best correlation OBR/EoTR (ρ 0.85–0.95, r 0.77–0.9). EoTR was statistically and clinically different from IBR (8.2 ± 5.5°), only statistically from OBR (1.3 ± 4.9°). At EoTR only thoracic curves were statistically slightly different from OBR (from − 4.8 ± 5.6° to − 2.9 ± 6.1°), while all topographies were different from IBR. 68% of patients kept at EoTR the results obtained at OBR (10% improved, 22% progressed), versus 28% for IBR (1% improved, 71% progressed). For a 20 to 30% IBR correction the probability of stability increases (likelihood positive ratio [LR+] 1.65, LR− 0.27, sensitivity 87%, specificity 48%, rate of correctly classified [RCC] 84%). For a 30 to 50% IBR we found LR + 2.03, LR− 0.48, sensitivity 68%, specificity 67%, RCC 68%. The area under the curve (AUC) was 0.72 (SE = 0.06 CI95% 0.60–0.84). An OBR of at least 20% is the best predictor of stability: LR + 2.1, LR− 0.65, sensitivity 71%, specificity 67%, RCC 71%, AUC 0.72 (SE = 0.05 CI95% 0.63–0.82).
Conclusion: IBR is a good immediate predictor of final results, but OBR is better and gives a real final range offering a concrete target to physicians and patients.
Figure: A: ROC curve for the in-brace radiograph (IBR). B: ROC curve for the out-of-brace radiograph OBR



Disclosures: author 1: none; author 2: stock/shareholder: ISICO; author 3: not indicated; author 4: none; author 5: none; author 6: none.

P72

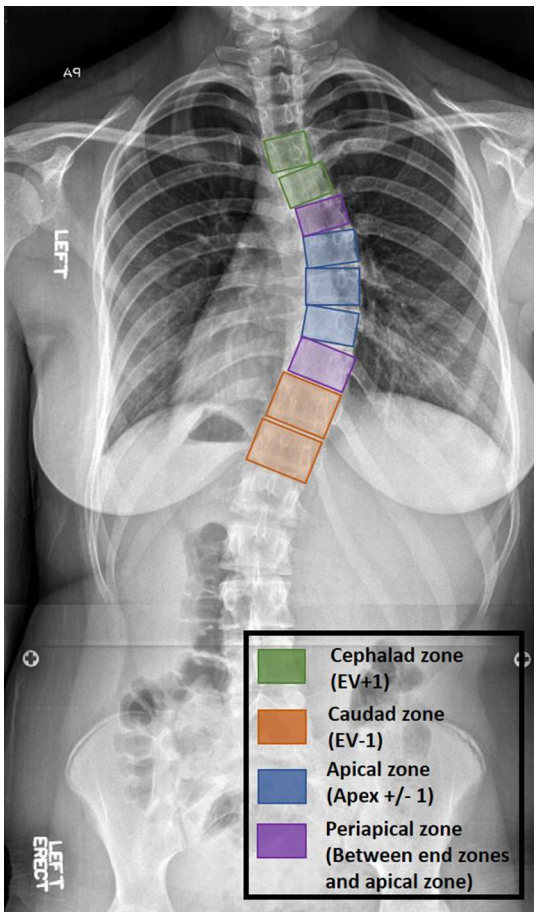
IMPLANT DISTRIBUTION VERSUS IMPLANT DENSITY IN LENKE TYPE 1 CURVES: WHERE SHOULD WE PLACE A SCREW?

Brian Dial, Valentine Esposito, Robert Lark

Duke University, Dept Orthopaedic Surgery, Durham, USA

Purpose: Previous studies have demonstrated that increased implant density (ID) results in improved coronal deformity correction. However, low density constructs with strategically placed fixation points may achieve similar coronal correction. The purpose of this study was to identify key zones along the spinal fusion where high ID statistically correlated to improved coronal deformity correction. Our hypothesis was that high ID within the periapical zone would not be associated with increased % Cobb correction.
Methods: We identified patients with Lenke type 1 curves with a minimum two-year follow up. The instrumented vertebral levels were divided into four zones: 1) cephalad zone, 2) caudal zone, 3) apical zone, and 4) periapical zone. High and low % Cobb correction groups were compared, high % Cobb group was defined as % correction > 67%. Total ID, total concave ID, total convex ID, and ID within each zone of the curve were compared between the groups. A multivariable analysis was performed to identify independent predictors for coronal correction. Subsequently increased and decreased thoracic kyphosis (TK) groups were compared, increased TK was defined as post-operative TK being larger than pre-operative TK and decreased TK was defined as post-operative TK being less than pre-operative TK.
Results: The cohort included 68 patients. The high % Cobb group compared to the low % Cobb group had significantly greater ID for

the entire construct, the total concave side, the total convex side, the apical convex zone, the periapical zone, and the cephalad concave zone. The high % Cobb group had greater pedicle screw density for the total construct, total convex side, and total concave side. In the multivariate model ID and pedicle screw density remained significant for % Cobb correction. Ability to achieve coronal balance and improve thoracic kyphosis was not statistically correlated to ID.
Conclusion: Increased ID for the entire construct, the entire convex side, the entire concave side, and within each spinal zone was associated with improved % Cobb correction. The ability to achieve coronal balance was not statistically influence by ID. The results of this study support that increasing ID along the entire length of the construct improves % Cobb correction.



Disclosures: author 1: none; author 2: none; author 3: consultant: Nuvasive, other financial report: DePuy Synthes.

P73

THE IMPORTANCE OF THE LUMBAR CURVE FLEXIBILITY IN THE PREDICTION OF SPONTANEOUS LUMBAR CURVE CORRECTION USING SELECTIVE THORACIC FUSION IN LENKE TYPES 1–2–3–4 C CURVES

Sinan Kahraman, Yunus Emre Akman, Onur Levent Ulusoy, Ayhan Mutlu, Tunay Sanli, Huseyin Ozturk, Okan Aslanturk, Selhan Karadereler, Meric Enercan, Azmi Hamzaoglu

Department of Orthopedics and Traumatology, Istanbul Spine Center, Istanbul, Turkey

Introduction: The aim of the study was to retrospectively review the clinical, radiographic and postop outcomes of the lumbar modifier C curves (Lenke 1–2–3–4) with selective thoracic fusion and to find out the cut-off value of preop lumbar flexibility, apical vertebral translation and apical lumbar rotation; which may predict more than 50% spontaneously lumbar curve correction at minimum 5 years f/up.
Method: 55 AIS patients (54F, 1M) with posterior selective thoracic fusion having Lenke 1–2–3–4 C curves, mean age 14(11–17), and minimum 5 years f/up (5–23) were included. Group A included patients who had more than 50% spontaneously lumbar curve correction without adding on or decompensation at f/up. Group B included patients with less than 50% spontaneously lumbar curve correction. Two groups were compared in terms of lumbar flexibility, apical vertebral translation and apical vertebral rotation from preop to f/up x-ray to understand the cut-off value of those parameters for more than 50% spontaneously lumbar curve correction. Receiver Operating Characteristic test used for statistics. SRS-22r of preop and final f/up were compared to determine the health related quality of life.
Results: Thoracic curve correction rate was 75% and lumbar curve correction rate was 59% at the f/up. Group A included 35 patients in early postop and the 10 of patients improved by the time and the total number of Group A increased to 45 (82%) at the f/up. Three patients (5%) showed coronal decompensation at early postop and 2 of them became compensated at f/up. Receiver Operating Characteristic analyses showed 69% flexibility is the cut-off value for spontaneously lumbar curve correction ($p < 0.01$). Preop mean apical vertebral translations were similar; 25.8 mm and 27.1 mm for both groups. Preop mean apical vertebral rotation s were mild different; for Group A = 1.9 and for Group B = 2.4. No revisions were performed. One patient underwent debritment due to early infection. All health related quality of life scores improved similarly in both groups from preop to f/up.
Conclusion: In Lenke 1–2–3–4 C curves if the flexibility at the preop bending x-ray is more than 70% ($p < 0.01$) and apical vertebral rotation is equal or less than 2 grades selective thoracic fusion provides satisfactory clinical and radiological spontaneously lumbar curve correction at minimum 5 years f/up. This flexibility rate can be helpful in the decision making for successful selective thoracic fusion.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: consultant: Medtronic.

P74

IMPROVEMENT OF STATIC AND DYNAMIC PULMONARY FUNCTION AFTER SURGERY IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

Youxi Lin, Chong Chen, haining Tan, Tianhua Rong, Jianxiong Shen, Yang Jiao, Wangshu Yuan, Hui Cong

Peking Union Medical College Hospital, Beijing, China

Summary: Surgical correction changes the height and shape of the rib cage in AIS patients, but it is not clear how it affects pulmonary function. We compare static and dynamic pulmonary function before and after surgery and investigate the correlation with radiographic changes. Both static pulmonary and dynamic function increased significantly. Correction in proximal thoracic spine was correlated with changes of static pulmonary function, and in exercise testing, correction in major thoracic spine correlated with a better respiratory response and pattern.

Hypothesis: Static and dynamic pulmonary function improves after correction surgery in AIS patients.
Design: Retrospective study of prospectively collected data.
Introduction: Up to now, there is no consensus on how pulmonary funciton and breathing pattern are affected in AIS patients after correction surgery. Our study aims to analyze the changes of static and dynamic pulmonary function and the correlation with radiographic improvement.
Methods: Patients with AIS and underwent surgical correction were included. Radiographic parameters of the spine were measured, and results of pulmonary function testing (PFT) and cardiopulmonary exercise testing (CPET) before and at last follow-up was collected. Pared-samples T test and Pearson correlation test was used.
Results: Fifteen patients (11F, 4M) were included, with an average age of 14.5(12–17) years at the time of surgery and average follow-up time 20.4(12–31) months. The Lenke type distribution of patients in Type 1, 2, 3, 4, 6 were 2, 9, 2, 1, 1, respectively. The number of curve fused in proximal thoracic (PT), thoracic and lumbar region were 12, 15 and 4, with overall correction of 20.9(51.9%), 41.0(74.6%) and 32.9(76.3%) degrees. T1-T12 height increased from 23.5 cm to 26.3 cm. The actual value of FEV1(2.5 ± 0.6 vs 2.7 ± 0.6) and FVC (3.0 ± 0.8 vs 3.2 ± 0.7) increased ($P < 0.05$), without significant difference in the percentile value. The maximal tidal volume (Vt) in exercise increased significantly from 1.15 ± 0.31L to 1.27 ± 0.31L ($P = 0.006$). The increase of FEV1 and FVC was positively correlated with correction in PT ($r = 0.064$, $P < 0.06$), but not in thoracic or lumbar spine. In exercise test, patients with larger major thoracic curve correction had more increase in minute ventilation (VE) and Vt, both in actual value and percentile value (r 0.562 to 0.725, $P < 0.05$), and the response of VE, Vt and ventilatory reserve to exercise was also positively correlated with thoracic correction (r 0.631 to 0.674, $P < 0.05$), indicating better respiratory pattern.
Conclusion: In AIS patients, correction in proximal thoracic spine improves static pulmonary function, and correction in major thoracic spine leads to a better respiratory response and pattern in exercise.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P75

IMPROVEMENT OF CARDIOPULMONARY FUNCTION AND ITS CORRELATION WITH SURGERY IN PATIENTS WITH SCOLIOSIS

Youxi Lin, Haining Tan, Tianhua Rong, Yang Jiao, Chong Chen, Jianxiong Shen, Wangshu Yuan, hui cong

Peking Union Medical College Hospital, Beijing, China

Summary: The effect of correction surgery on cardiopulmonary function in patients with scoliosis is not clear. We compared PFT and exercise test results before surgery and at last follow-up, and found that static pulmonary function and exercise performance significantly increased after surgery. In addition, both the correction of thoracic curvature and the increase of thoracic height were positively correlated to minute ventilation and tidal volume, indicating better ventilation pattern.
Hypothesis: Pulmonary function and exercise performance improve after posterior correction surgery in patients with thoracic scoliosis.
Design: Retrospective study of prospectively collected data.
Introduction: Surgical correction changes the shape of the spine and rib cage. Improvement of cardiopulmonary function is expected, but so far there is no clear evidence. Our study aims to evaluate the difference of pulmonary function and exercise performance in patients with scoliosis before and after surgery.
Methods: We include scoliotic patients with thoracic curve $\geq 40°$ and proposed for surgical correction. Radiographic parameters of the spine and rib cage were measured, and results of pulmonary function testing (PFT) and cardiopulmonary exercise testing (CPET) before and at last follow-up was collected. Pared-samples T test and Pearson correlation test was used.
Results: Thirty-three patients (22F, 11M) were included, with an average age of 17.8(12–34) years at the time of surgery, and average follow-up time 20.8(12–48) months. Thirteen patients were diagnosed with congenital scoliosis, 14 with AIS and 6 with others. The coronal thoracic curve was corrected from an average of 67.1 to 34.3 degrees (55.9%), and T1-T12 height from 22.0 cm to 24.6 cm. The actual value of FEV1(2.4 ± 0.9 vs 2.7 ± 0.8) and FVC (2.8 ± 1.1 vs 3.1 ± 1.0) increased (both $P < 0.01$), without significant difference in the percentile value. The oxygen intake ($66.7 \pm 13.3\%$ vs $73.0 \pm 10.5\%$), metabolic equivalent (7.3 ± 1.3 vs 8.0 ± 1.5) and heart rate response (69.2 ± 18.9 bpm vs 76.1 ± 17.1 bpm) significantly increased (all $P < 0.05$), indicating better exercise performance. In parameters of ventilation, there was no difference in minute ventilation (VE), tidal volume (Vt), respiratory frequency and ventilatory reserve between pre- and post-operative data. Both the correction of major thoracic curve and increase in thoracic height were positively correlated to VE and Vt (r from 0.376 to 0.530, all $P < 0.05$), indicating better breathing pattern.
Conclusion: Exercise capacity improves after correction surgery in patients with thoracic scoliosis. Ventilation performance are batter in patients with more correction of the curvature and increase of spinal height.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P76

POSTOPERATIVE AXIAL NECK PAIN AND ITS ASSOCIATED PARAMETERS FOLLOWING POSTERIOR CORRECTIVE SURGERY FOR THE AIS PATIENTS

Akira Matsumura, Takashi Namikawa, Minori Kato, Yusuke Hori, Masayoshi Iwamae

Dept. of Orthop. Surg., Osaka City General Hospital, Osaka, Japan

Introduction: The prevalence of axial neck pain (ANP) has been reported at 15% and most common symptom in the Japanese women according to a Japanese national survey. The purpose of this study is to investigate the postoperative ANP and its associated parameters after AIS surgery in the Japanese population.
Methods: One hundred fifty-three consecutive AIS patients underwent posterior corrective surgery at our institute from 2010 to 2016. Thirty-nine patients whose curves were classified as Lenke 5 or 6, and 3 patients who could not be followed for more than 2 years were excluded in this study. We identified 111 AIS patients (mean age at surgery: 15.8 years, and average F/U period: 50.8 months) and evaluated postoperative ANP (neck pain and shoulder stiffness) using Visual analogue scale (VAS) and Neck Disability Index (NDI) at final follow-up (FFU). We measured several radiographic parameters before surgery (Pre) and at FFU, and evaluated the postoperative HRQOL using SRS-22. We analyzed associated parameters for ANP and its correlation with the postoperative HRQOL using SRS-22.
Results: The prevalence of postoperative ANP which was more than 20 mm of VAS was calculated to 25.0% in neck pain and 32.0% in shoulder stiffness. The mean NDI was calculated to 4.3 points. Each domains of SRS-22 at FFU was following; activity: 4.5, pain: 4.6, self-image: 3.9, mental: 4.3, and satisfaction: 4.3. Radiographic parameters (Pre/FFU) were PT: 33.2/16.4°, MT: 62.2/15.7, TL/L:

38.9/10.4°, C2–7 lordosis:− 7.0/− 2.1°, C7 slope: 9.7/11.4°, TK: 11.4/17.7°, C2-SVA: 13.0/− 0.8 mm, and C7-SVA: 3.1/− 13.0 mm. Statistical analysis indicated that neck pain significantly correlated with C7 slope (r = − 0.33, P = 0.04), and shoulder stiffness significantly correlated with MT (r = − 0.43, P = 0.02), TK (r = − 0.34, P = 0.04), and pain domain of SRS-22 (r = − 0.38, P = 0.04). Additionally, F/U period is significantly correlated with shoulder stiffness (r = 0.38, P = 0.04) and the NDI (r = 0.51, P = 0.006).
Conclusions: The prevalence of postoperative ANP in Japanese AIS patients was relatively higher. Postoperative ANP became stronger with ageing and impacted the postoperative HRQOL. Thoracic kyphosis including C7 slope is thought to be a significantly important parameter for the postoperative ANP.

The correlation between V-ANP and parameters

	NDI		neck pain		Shoulder stiffness	
	R	P-value	R	P-value	R	P-value
CL	-0.20	0.30	-0.05	0.80	0.12	0.53
C7 slope	-0.03	0.89	**-0.33**	**0.04**	0.13	0.53
TK	-0.28	0.16	-0.15	0.45	**-0.34**	**0.04**
C2-SVA	0.08	0.67	0.02	0.93	0.11	0.67
C7-SVA	0.06	0.77	0.03	0.93	0.17	0.58
PT	0.19	0.34	0.31	0.10	0.30	0.12
MT	0.38	0.04	0.28	0.14	**0.43**	**0.02**
TL/L	0.14	0.46	0.02	0.92	0.09	0.64
UIV	-0.23	0.24	-0.12	0.55	-0.22	0.27
age	0.13	0.51	0.04	0.92	0.06	0.76
FU period	**0.51**	**0.006**	0.26	0.18	**0.38**	**0.04**

Statistic analysis: JMP 11, Spearman rank-order correlation

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none.

P77

EFFECTIVENESS OF PROVIDENCE NIGHT-TIME BRACING COMPARED TO FULL-TIME BOSTON BRACING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS. A MATCHED COHORT STUDY

Ane Simony, Mikkel Osterheden Andersen, Stig Mindedahl Jespersen, Leah Yaccat Carreon

Dept. Spine Surgery & Research, Lillebelt Hospital, Denmark

Summary: Previous studies report excellent results with Providence Night-time bracing (PNB) in AIS patients. This study compares the outcome after PNB compared to Full time Boston brace in a matched cohort of AIS patients.
Design: A matched cohort study.
Introduction: Providence Night-time Bracing (PNB) is an alternative nonsurgical method to Full time Boston Bracing (FBB) for AIS Patients. Recent studies have shown a dose response curve with the FBB, that is longer brace wear is more effective at preventing curve progression. However, due to limitations with daily function, a night time brace may increase compliance. The aim of the study was to compare the outcomes between PNB and FBB in a matched cohort of AIS patients.
Methods: 71 consecutive AIS patients received treatment, with PNB. Treatment was administered according to the SRS criteria. The clinical outcome of PNB was determined 2 years after brace weaning. The patients treated with PNB was then matched according to age, sex, curve type, apex and Cobb prior to treatment with a cohort of AIS patients, treated with FBB.
Results: 71 consecutive PNB patients, 61 females and 10 males where matched, with 71 patients treated with FBB. The demographics were similar between the two cohorts. The Cobb angle after completion of treatment and the amount of curve correction was similar between the two groups. However, 6 patients in the PNB had surgery, 2 for cosmesis and 4 for curve progression.
Conclusion: Curve progression after PNB was comparable to FBB. Night time bracing seems effective in the treatment of AIS and might reduce the psychological stress of the AIS patients during puberty. The difference seen in the rate of surgery between the 2 groups, reflects the change in surgical mangement from 1990 to 2018, where surgery is indicated at 40°.

	Boston		NightTime		
	Mean	SD	Mean	SD	
CobbStart	33.31°	7.43°	32.75°	5.87°	0.617
CobbEnd	32.51°	7.30°	30.15°	10.40°	0.121
Cobb_Diff	0.80°	6.56°	2.59°	8.32°	0.157
Correction	0.22%	22.94%	8.36%	26.02%	0.500
Surgery	0		6		0.012.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: other financial report: Trips and Travel University of Southern Denmark.

P78

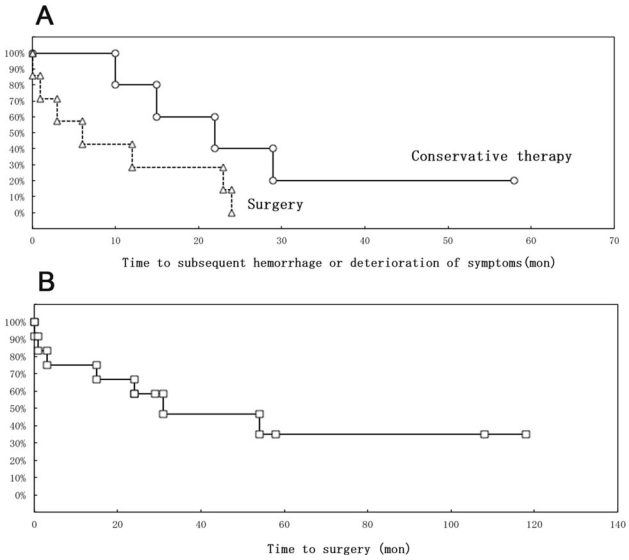
DOES SURGICAL CORRECTION OF SCOLIOSIS IN IDIOPATHIC SYRINGOMYELIA PRODUCE OUTCOMES SIMILAR TO THOSE IN CHIARI I MALFORMATION WITH SYRINGOMYELIA?

Haining Tan, Chong Chen, Youxi Lin, Tianhua Rong, Yang Jiao, Jiaqi Bi, Peiyu Sun, Zheng Li, Jinqian Liang, Jianxiong Shen

Department of Orthopedics, Peking Union Medical College Hospital and Graduate School of Peking Union Medical College, Peking Union Medical College, Chinese Academy of Medical Science, Beijing, China

Introduction: Chiari I malformation with syringomyelia (CIM-S) and idiopathic syringomyelia (IS) are common in neuromuscular scoliosis patients, however, no study has directly compared the surgical outcomes of scoliosis and complications between CIM-S and IS patients.
Purpose of the study: To compare the radiographic and clinical outcomes of one-stage posterior scoliosis correction between CIM-S and IS groups.
Materials and methods: Twenty scoliosis patients with CIM-S were enrolled retrospectively, and they were matched by gender, age and Cobb angle of scoliosis with twenty IS patients. All patients had one-stage posterior fusion surgeries for correcting scoliosis. The curve correction, global coronal balance and sagittal vertical alignment were evaluated before surgery, immediately after surgery, and at the final follow-up (at least 2 years). The syrinx features, intraoperative

neuromonitoring information and postoperative complications were collected.
Results: The preoperative scoliosis and syrinx features were similar between CIM-S and IS group, while a longer syrinx was observed in CIM-S group. All patients did not experience neuromonitoring changes during operation. The fusion range (12.46 ± 2.02 vs. 11.14 ± 2.87, p = 0.184) and the correction of scoliosis obtained surgically, either postoperatively (72.48% vs. 69.33%, p = 0.577) or at the final follow-up (69.87% vs. 67.4%, p = 0.623), were similar in the CIM-S and IS groups. There was either no difference of coronal or sagittal balance between two groups. One (5%) CIM-S patient underwent one revision surgery due to the adding on phenomenon, while one (5%) IS patient had re-operation for broken rods. Otherwise, no neurologic or other major complications related to surgery was observed in CIM-S and IS groups.
Conclusion: Scoliosis in CIM-S had comparable radiographic outcomes without increase risks of neuromonitoring change or neurologic complication as compared to those with IS after one-stage posterior spinal fusion.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none; author 9: none; author 10: none;.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none.

INTRADURAL SPINAL PATHOLOGIES

P79

CONSERVATIVE AND SURGICAL MANAGEMENTS OF SPINAL CORD CAVERNOUS MALFORMATIONS

Yu-ichiro Ohnishi, Hirofumi Sugano, Sho Fujiwara, Takashi Moriwaki, Haruhiko Kishima

Department of Neurosurgery, Osaka University Medical School, Osaka, Suita, Japan

Backgrounds: The natural history of spinal cord cavernous malformations (CMs) are unclear. Therefore the optimal management of spinal cord CMs has not been established.
Objectives: To discuss about the conservative and surgical management of spinal cord CMs.
Materials and methods: We performed a retrospective study of patients diagnosed with spinal cord cavernous malformations. Neurological symptoms and Modified McCormick Scale were assessed. When patients experienced acute onset of hemorrhage or debilitating symptoms, the timing of surgery was determined by shared decision-making process involving both physicians and patients.
Results: We identified a total of 12 patients; 7 (58.3%) were male. Mean age of patients was 38.0 years. Seven patients underwent microsurgical removal. During follow-up in conservative treatments, 6 patients underwent surgery with worsening of symptoms, 1 patient deteriorated in neurological symptoms without surgery, and 4 patients had no deterioration of symptoms. The mean duration from presentation to subsequent hemorrhage or deterioration of symptoms was 15.2 months including asymptomatic recurrence. No patients experienced subsequent hemorrhage after surgical resection. Five patients (71.4%) within the surgical group had improved in neurological state, 2 patients (28.6%) remained unchanged, and no patients experienced deteriorated neurological status.
Conclusions: The surgery of spinal cord CMs presented no recurrence of hemorrhage and exacerbation of neurological symptoms.

P80

THE BEST METHOD TO TREAT SPINAL ARTERIOVENOUS MALFORMATIONS. OUR 14 YEARS EXPERIENCE. A RETROSPECTIVE STUDY

Olesia Slobodian, Yuriy Samonenko, Andryi Nayda, Oleg Svyryduk

Scientific-Practical Center of Endovascular Neuroradiology NAMS of Ukraine

Background: Arteriovenous shunting leads to venous hypertension of the spinal cord (venous congestion, stealing phenomenon, ischemia) and inevitably leads to disability.
Purpose of the study: To analyze which of two surgical methods was more effective and safe.
Materials and methods: A retrospective analysis of endovascular and surgical treatment of 57 patients. The patients were operated in Scientific-Practical Center since 2005 till 2019. The classification proposed by Anson and Spetzler in 1992 was used in order to divide patients into experimental groups. Patients with AVM type I—38 (66.7%), II type—10 (17.5%), III type—5 (8.8%), IV type—4 (7%). For diagnostic MRI, spinal angiography (SAG) were used. The Aminoff-Logue scale was used for assessment of the neurological deficiency severity. Early postoperative complications were counted (CSF leakage, wound infection, early postoperative worsening).
Results: The average age of 36 (63.15%) males and 21 (36.84%) females was 45.7 ± 12 years. 14 (24.6%) patients were treated using the microsurgical method and 43 (75.4%) endovascular. Microsurgical intervention for 11 patients (28.9%) was performed. Complete disconnection of fistula was achieved in 11 (100%) patients. Early postoperative complication was observed in 1 (9%) case-CSF leakage. Endovascular treatment was performed for 27 (71.1%) patients, total disconnection in 16 (42.1%) cases, 17 patients (44.7%) had early transient neurological worsening. Embolization is the first-line treatment for patients with type II AVM-8 (80%) patients, complete obliteration in 5 patients (62.5%), 6 (75%) patients suffered from early neurological worsening. The microsurgical method was used when the risk of spinal cord injury was low for 2 (20%) patients. Total AVM exclusion in 2 (100%)patients and in 1 (50%) patient

neurological deterioration was stabilized. All patients with III type AVM were treated endovascular-5 (100%) cases. AVM was obliterated complete in 1 (20%) patient. 3 (60%) patients had transient neurological deterioration. Totally disconnection of AVM in 1 (33%) patient. Neurological worsening was observed in 1 patient (33%). Type IV: 1 (25%) patient was operated microsurgical. Feeding artery embolization in 3 (75%) cases. Totally disconnection was achieved in 1 (33%) case-endovascular. Neurological deterioration was observed in 1 (33%) patient.
Conclusion: SAG is the best diagnostic method. Microsurgical intervention helps to achieve total disconnection and leads to good neurological results the following day after surgery. Microsurgical intervention is the best method to treat AVM I type seeing it is eye-controlled total disconnection of artery and vein. First-line treatment for AVM II and III types is embolization because surgical treatment aiming to remove the AVM from the spinal cord carries significant risk of neurologic damage. Endovascular disconnection is the best choice to treat AVM IV if superselective angiography is possible.
Disclosures: author 1: none; author 2: grants/research support: BioMarin; author 3: none; author 4: none.

MINIMAL INVASIVE SPINE SURGERY (MISS)

P81

ANALYSIS OF TEMPORAL CHANGES IN DURAL TUBE MORPHOLOGY AFTER LLIF INDIRECT DECOMPRESSION

Yutaka Kono, Hogaku Gen, Yoshio Sakuma

Department of Orthopaedic Surgery, Chiba Central Medical Center, Chiba, Japan

Objective: Lateral lumbar interbody fusion (LLIF) is considered to be one of the effective procedures for central stenosis because it provides an indirect decompression effect with ligamentotaxis. This study was intended to investigate the temporal changes in the dural tube morphology after LLIF and analyze the factors affecting the changes.
Subjects: The study included 50 intervertebral spaces in 40 patients who had undergone extreme lateral interbody fusion (XLIF) indirect decompression for central stenosis after April 2014 and had been followed up for at least 1 year. The severity of stenosis on MRI was classified into 4 grades (A: no or minor, B: moderate, C: severe, D: extreme) according to the modified Schizasr classification (Spine, 2010) and evaluated at pre-procedure, post-procedure, and final examination. In addition, statistical analysis was conducted for the risk factors leading to Grade C or D (poor enlargement due to remodeling) at final examination. The study items included the changes in pre-procedural dural tube cross-sectional area (CSA), locked facets, bony lateral recess stenosis, location of cage placement, cage size, end plate damage, posterior disc height (PDH), and disc angle (DA).
Results: The severity of pre-procedural stenosis was Grade C or D in all subjects, consisting of Grade C in 70% and Grade D in 30%. The post-procedural MRI showed that 10 intervertebral spaces (20%) had improved to Grade A or B, whereas the number remarkably increased to 38 intervertebral spaces (76%) at final examination. Grade C or D poor enlargement was observed in 12 intervertebral spaces (24%) at final examination and the multivariate analysis revealed that the risk factors was small pre-procedural CSA (odds ratio: 1.32, $P < 0.002$).
Discussion: The study results demonstrated that the morphological improvement in spinal canal stenosis on MRI was relatively small immediately after LLIF, but the spinal canal remodeling occurred with time and further enlargement was seen in many cases. However, it was suggested that sufficient morphological improvement might not be achieved in patients with severe spinal canal stenosis, even though clinical improvement was achieved.
Disclosures: author 1: none; author 2: none; author 3: none.

P82

PREDISPOSING FACTORS FOR EARLY CAGE SUBSIDENCE AFTER LATERAL LUMBAR INTERBODY FUSION

Ki-Hyoung Koo

Department of Orthopaedic Surgery Yeson Hospital, Bucheon, Korea.

Study Design: Retrospective study.
Purpose: To identify predisposing factors for early cage subsidence in lateral lumbar interbody fusion.
Overview of Literature: Cage subsidence is an intraoperative and early complication of lateral interbody fusion. It has been still controversial what are the predisposing factors in the surgical technique or patients' conditions.
Methods: Consecutive patients ($n = 45$; mean age, 74.27 ± 7.32 years) underwent lateral interbody fusion at 104 levels by a single surgeon. Radiographs were taken at preoperative and immediately postoperative period as well as 2 weeks and 3 months after operation. Various suspicious parameters were reviewed in each patient and compared between the subsidence and no subsidence groups.
Results: Thirty levels (46.2%) had signs of cage subsidence within 2 weeks after operation. The subsidence group had a significantly higher cage height ($p = 0.024$), lower bone mineral density (BMD) ($p = 0.026$) compared with the no subsidence group. There was a little higher preoperative total lumbar lordosis in no subsidence group ($p = 0.054$). Multivariate analysis indicated that BMD as a negative and cage height as a positive were predisposing factors for early cage subsidence.
Conclusions: Early cage subsidence within 2 weeks after operation was correlated significantly with lower bone mass and higher cage height. In patients with low bone mass, higher cage should not be inserted to prevent early cage subsidence.
Disclosures: author 1: none.

P83

COMPARISON OF SINGLE-POSITION ROBOTIC-ASSISTED SURGERY VERSUS CONVENTIONAL MINIMALLY INVASIVE SURGERY FOLLOWING LLIF: AN IN VITRO ASSESSMENT

Jeffery Larson, Richard Frisch, Gerald Hayward, Jonathan Harris, Jorge Gonzalez, Brandon Bucklen

Musculoskeletal Education and Research Center (MERC), A division of Globus Medical Inc, Audubon, USA

Background Context: Lateral lumbar interbody fusion (LLIF) provides indirect decompression of the neural elements while minimizing the potential vascular complications associated with anterior lumbar interbody fusion (ALIF). Posterior fixation may be applied through various techniques, such as conventional minimally invasive surgery (CMIS), requiring the patient to be repositioned prone to provide access to both pedicles. Conversely, robot-assisted navigation (RAN) of pedicle screws can be utilized from a single position without

flipping the patient. RAN is theorized to reduce patient surgical time, radiation, and blood loss due to positioning and workflow effects.
Purpose: Evaluate the effect of robotic-assisted navigation compared to conventional minimally invasive surgical methods in terms of surgical time and radiation exposure.
Study design/setting: In-vitro cadaveric time trial.
Patient Sample: N/A.
Methods: Eight unembalmed human torsos were implanted with 2 level static LLIF cages followed by posterior bilateral pedicle screw fixation using either CMIS (n = 4) or RAN (n = 4). Preoperative computed tomography (CT) RAN workflow utilized CT scans of the specimen taken offsite and transferred to the robotic system during setup. Screw planning was performed using these CT scans, which were merged with intraoperative fluoroscopy. Surgical times and radiation exposure were measured. Patient flip time from a consecutive patient series was included.
Results: Significant differences in surgical time and radiation dosages were found between groups. Surgical times for preoperative RAN and CMIS were 63.8 ± 4.2 and 123.6 ± 15.9 min, respectively, as shown in Table 1. Times per screw for RAN and CMIS workflows were 2.8 ± 0.6 and 4.0 ± 1.2 min, respectively. RAN resulted in significantly lower surgical time compared to CMIS ($p < 0.05$). Radiation dosages and time were separated into interbody and posterior fixation, and sorted by imaging workflow. RAN and CMIS radiation dosages during posterior fixation were 25.9% ± 13.2% and 59.5% ± 11.2%, respectively, of total radiation exposure ($p < 0.05$), as shown in Table 1.
Conclusion: Significant differences were found between conventional MIS and robot-assisted navigation, with RAN resulting in shorter surgical times and less radiation exposure to the surgeon than CMIS. Consideration should be given to single-position LLIF procedures that utilize RAN to instrument the spine with bilateral pedicle screws.

Table 1. Surgical Time and Surgeon Radiation Exposure.

	Procedural Breakdown	Robot Assisted Navigation (Preoperative)	Conventional Minimally Invasive Surgery
Time (min) Average ± Standard Deviation	LLIF Implantation	27.4 ± 4.1	33.8 ± 9.5
	Patient Flip	-	59.8
	Posterior Fixation*	30.3 ± 3.7	29.7 ± 7.4
	Time per Screw**	2.8 ± 0.6	4.0 ± 1.2
	Total	65.4 ± 4.3	123.4 ± 15.3
Radiation (%)	Posterior Fixation*	25.9 ± 13.2	59.5 ± 11.2

*Includes registration for pre-operative workflow ** Time per screw excluding setup time

Disclosures: author 1: consultant: Stryker Spine, royalties: Stryker Spine; author 2: consultant: Globus Medical, Inc., royalties: Globus Medical, Inc.; author 3: employee: Globus Medical; author 4: stock/shareholder: Globus Medical, Inc., employee: Globus Medical, Inc.; author 5: none; author 6: stock/shareholder: Globus Medical, employee: Globus Medical.

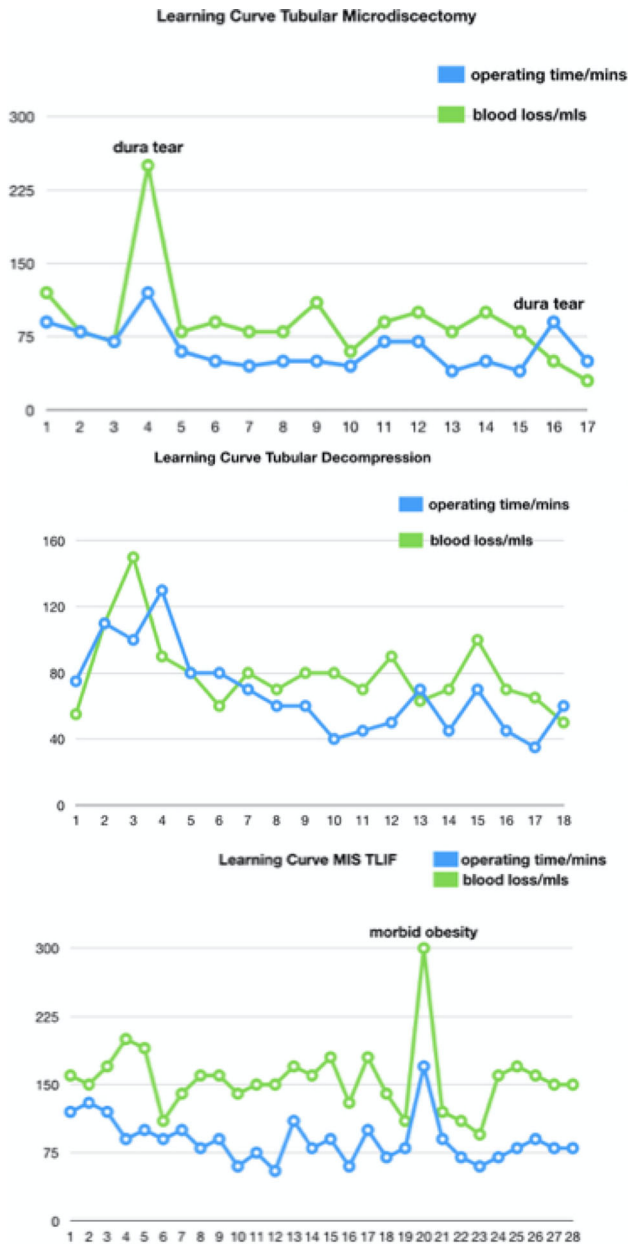
P84

FROM OPTICAL TO DIGITAL: THE CHALLENGES AND LEARNING CURVES WITH 3D4 K DIGITAL VISUALISATIONS IN MINIMALLY INVASIVE SPINE SURGERY (MISS)

Mohd Hisam Muhamad Ariffin

Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

Introduction: The surgical microscope has revolutionised spine microsurgery. The Introduction of muscle sparing tubular access further improved the outcome of MISS. Working through tubular retractors posed a challenge as the position the microscope need to be parallel to tubular access. The extreme angulations of the tubes during microsurgical decompression esp. contralateral works necessitates surgeons to work with stretched out upper limbs and non ergonomic spinal posture. During this time the assistant has to lean over to look into the eyepiece. An exoscope allows the surgeon to work independent of the microscope head and without oculars as the visualisations is provided by the large 3D4 K monitors allowing both surgeon and assistant to work in an ergonomic posture and upper limbs positions. The monitors also allowed the whole team the surgical team to be aware of the procedure and is a great teaching tool for residents. However the value of solely depending on exoscope and 3D4 K monitors during microsurgical work remains to be proven.
Objective: This prospective study is done to evaluate the adaptation and learning curve using exoscope and 3D4 K visualisation, its advantages, disadvantages and complications in tubular access MISS.
Materials and methods: From March 2018-January 2019, 74 patients (99 levels) underwent trans tubular procedure 5 were excluded (pyogenic discitis, 2 revisions, 2 trans tubular transoral).69 patients (28 MISTLIF, 18 tubular decompression, 17 tubular microdiscectomy, 6 OLIF) were analysed for operating time, blood loss and complications. The learning curve graph was plotted using the surgical time and blood loss for each surgical procedures.
Results: From Figure 1, the operating time plateau after 6 cases for tubular microdiscectomy and 9 for tubular decompression and MIS-TLIF. The average operating time was 78.3, 85 and 102 min for tubular discectomy, decompression and mis tlif before the plateau and was reduced to 54, 51 and 79.7 min respectively. No adjustment was needed for OLIF. 4 cases of dural tear (case 20, 21, 52 and 71) and managed by surgical sealant. All patients had symptomatic improvement in radicular pain, claudication distance and neurological function. No neurological deficit post operatively.
Conclusions: Conversion from ocular to digital based MISS is associated with a short learning curve. The surgeon and assistant will benefit from ergonomic posture avoiding stress and fatigue during surgery. The residents teaching is good. The main drawback is the need to rearrange the OT setup as the monitors need to be in front of the surgeons. The higher working distance of the exoscope necessitated the area around the exoscope be kept clear. With further improvement in digital technology hopefully we don't have to use the 3D glasses in future. The complications occurred are comparable to using the surgical microscope meaning that the digital visualisation do provide adequate depth, illumination, clarity and precision of target site treatment.



Disclosures: author 1: consultant: B Braun and Medtronics.

P85

ACCURACY OF A NOVEL, AUGMENTED REALITY NAVIGATION TECHNOLOGY USING INTRAOPERATIVE CONE BEAM CT FOR PERCUTANEOUS SPINE SURGERY

Simon Peh, Sebastian Lippross, Julian Pfarr, Jost Philipp Schäfer, Anindita Chatterjea*, Andreas Seekamp

Orthopaedics and Trauma Surgery, UKSH, Kiel, Germany; *Philips Healthcare, Best, the Netherlands

Background: Philips has developed a navigation technology that combines the use of intraoperative 3D cone beam CT (CBCT) with augmented reality surgical navigation (ARSN). It allows compatible accessories to be tracked in 3D and provides visual feedback to the user on the location and depth of these devices with respect to the optical images and the CBCT volume, without use of live fluoroscopy. As it relies on optical markers placed on the patient's skin to track the patient's movement, there is no need for an invasive reference frame. This novel navigation technology simplifies the conventional 3D navigation workflows which typically require an additional incision to place a bony reference frame and relies on transfer of images from the imaging to the navigation software, potentially resulting in navigation errors.

Purpose of the study: There is a limited amount of data comparing the accuracy achieved in percutaneous procedures with 3D navigation compared to 2D fluoroscopy techniques. This study aimed to determine the clinical accuracy of ARSN for percuatneous thoracolumbar pedicle screw fixations, with use of no additional fluoroscopy, when compared to the fluoroscopy guided method (FN).

Materials and methods: The study was performed on 4 cadavers by a spine surgeon with 12 years + experience in performing FN and minimal experience with ARSN. 136 pedicles from T1 to L5 were instrumented. FN and ARSN percutaneous pedicle screw insertion were alternately performed on each level, to match for anatomical complexity. The accuracy of the screw placements were determined on a post-op CT and were rated according to the Gertzbein grading by 3 blinded, independent reviewers. All screws with a Gertzbein grading of 0 or 1 were considered accurately placed.

Results and discussion: The overall accuracy of ARSN was 94% compared to an accuracy of 88% for FN. The Intra-class coefficient (ICC) value was 0.64, suggesting a good agreement between the raters. All displaced screws with ARSN were in the upper thoracic spine of one cadaver, with scoliosis. The contingency table (Fig 1) comparing ARSN with FN demonstrates that in the levels where ARSN resulted in displaced screws, the experienced FN user had similar levels of displacements. Potentially, the accuracy of ARSN can be further improved when the easily available fluoroscopy option as well as the possibility to revise a screw based on the intra-operative CBCT, is used. No significant difference in the median screw placement time was observed. The staff did not receive any radiation dose when using ARSN for screw placements. Staff could step out when the planning CBCT was performed. The planning CBCT in ARSN however, increased total radiation dose to the patient as compared to FN.

Conclusion: Clinical accuracy of ARSN was comparable to FN ($P > 0.05$). The accuracy was also comparable to literature reported values from other navigation systems for minimal invasive procedures.

	Augmented Reality Surgical Navigation (ARSN)				
	Grade 0	Grade 1	Grade 2	Grade 3	Total
Fluoroscopy Navigation (FN)					
Grade 0	31	16	0	0	47
Grade 1	6	6	1	0	13
Grade 2	2	3	2	0	7
Grade 3	0	0	0	1	1
Total	39	25	3	1	68

Contingency table indicating the corresponding screw grading for pedicle screws placed with the ARSN on one side of the spine and FN on the opposite side

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: employee: Philips Healthcare; author 6: none.

P86

ANATOMICAL FEASIBILITY OF RIGHT OBLIQUE APPROACH FOR L5-S1 OBLIQUE LUMBAR INTERBODY FUSION

Myung-Hoon Shin, Jong-Tae Kim

Dept of Neurosurgery, Incheon St Mary's hospital, The Catholic university of Korea, Incheon, Korea

Introduction: Current procedural guide recommends the use of left oblique approach in right lateral decubitus position for OLIF at L5-S1. However, at the L5-S1 segment, left common iliac vein (LCIV) is often located medially. It may obstruct the anterior surface of disc space. The purpose of this study is to compare left and right vascular anatomy at L5-S1 disc space and validate anatomical feasibility of right oblique approach for L5-S1 oblique lumbar interbody fusion (OLIF).
Materials and methods: Axial T2 MR images at L5-S1 disc level parallel to the mid-discal space were used to study 274 subjects (164 females, 110 males; average age of 62.97 years). Distance from the center of L5-S1 disc to the medial wall of the left or right vessel was measured. According to vessel position, three groups were established: medial, middle, and lateral. To describe morphologic configuration, vessel type and the presence of perivascular adipose tissue (PVAT) around vessels were identified on both sides.
Results: Vessels on the left L5-S1 disc space were located at 12.47 mm from the midline and most (209 subjects, 76.3%) subjects were included in the medial or middle group. On the right side, vessels were located more laterally (16.93 mm, $p = 0.000$) and most (248 subjects, 90.5%) subjects were included in the middle or lateral group. On the left side, vessels were mostly veins (260 subjects; 94.9%) and 139 (50.7%) subjects had the presence of PVAT. On the right side, vessels were mostly arteries (213 subjects; 77.7%) and 242 subjects (88.3%) showed the presence of PVAT.
Conclusions: Vessels on right side of L5-S1 disc were located more laterally and most vessels on the right side were arteries accompanying PVAT that might minimize vessel manipulation. These results indicate that the right side of L5-S1 disc could provide a feasible access for OLIF at L5-S1.
Disclosures: author 1: none; author 2: none.

NEW TECHNIQUES

P87

ANEURYSMAL BONE CYST OF THE SPINE: TREATMENT BY CONCENTRATED BONE MARROW INJECTION

Giovanni Barbanti Brodano, Marco Girolami, Riccardo Ghermandi, Silvia Terzi, Stefano Bandiera, Gisberto Evangelisti, Valerio Pipola, Alessandro Gasbarrini

Dept of Oncological and Degenerative Spine Surgery, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction: Aneurysmal bone cyst (ABC) is a cystic lytic lesion of bone, consisting of blood lacunae separated by connective septa. In 30% of cases ABC is found inside other bone diseases (giant cell tumour, osteoblastoma, chondroblastoma, telangiectatic osteosarcoma), while in 70% of cases it occurs as a primary lesion (1).
Excellent results have been obtained in the treatment of aneurysmal bone cyst (ABC) of the spine by repeated arterial embolizations (SAE) (2–4). Alternative treatments have been proposed when SAE is ineffective or inadequate (5, 6).

This study presents the results of our experience in the treatment of vertebral ABC through the use of concentrated autologous mesenchymal stem cells (MSCs).
Methods: The treatment is performed by direct injection of autologous MSCs harvested from patient's iliac crest and concentrated using the concentration system Res-Q^{TM} 60 BMC. The treatment can be repeated for two or three times at distance of about 4 months.
We successfully treated two teenagers who came to our attention both with histologically confirmed diagnosis of ABC in C2 vertebra.

After these attempts, other nine patients have been treated with MSCs until now (mean age: 18 years, range 12–33; FU range 52–5 months).
Results: In two cases it was necessary to perform an alternative treatment with Denosumab as no healing was observed after MSCs injection. The other cases presented an improvement of the disease at clinical and radiological follow-up, after two or three MSCs injections. The presence of newly formed bone within the ABC appeared as a clear sign of recovery and increased gradually, until the cyst appeared completely ossified about one year after the treatment, with associated disappearance of the pain. In the last case after 5 months follow up the lesion has no signs of healing and selective arterial embolization can't be performed because of the absence of pathological blood circulation, reaching the lesion. We propose to perform another treatment with MSCs injection, trying to stimulate bone regeneration.
Discussion: Promising results in the treatment of vertebral ABC have been achieved by injection of autologous mononuclear cells derived from bone marrow concentration. The goal of this treatment is to interrupt the destructive osteoclastic process of the disease and promote spontaneous bone regeneration.
References: 1. Mascard E, et al. Orthop Traumatol Surg Res. 2015; 101(1 Suppl):S119–27.
2. Boriani S, et al. Spine 2001; 26:27–35.
3. Boriani S, et al. J Neurooncol. 2014;120:171–8.
4. Amendola L, et al. Eur Spine J. 2013;22:533–41.
5. Terzi S, et al. Spine (Phila Pa 1976). 2017 Aug 1;42(15):1130–1138.
6. Barbanti-Brodano G, et al. Eur Spine J. 2017 Feb 6. https://doi.org/10.1007/s00586-017-4978-x.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P88

TRANS-SACRAL INTERBODY FIXATION VS. TRANSFORAMINAL LUMBAR INTERBODY FUSION AT THE LUMBOSACRAL JUNCTION FOR LONG FUSIONS TO THE SACROPELVIS IN PRIMARY ADULT SCOLIOSIS

Michael Faloon, Hong-Lei Yi, Stuart Changoor, Thomas Ross, Oheneba Boachie-Adjei

St. Joseph's University Medical Center, Department of Orthopaedics, Paterson, NJ, USA

Introduction: Achieving fusions at the lumbosacral junction poses many technical challenges. No data exists in the literature comparing radiographic or clinical outcomes between the different surgical

techniques of transacral interbody fixation rods (TSFR) & TLIF in conjunction with iliac fixation.
Purpose: To compare clinical and radiographic outcomes between TSFT and TLIF in constructs that include iliac fixation.
Methods: Between 2008 and 2011, 36 consecutive pts at a single institution with primary adult spinal deformity undergoing long fusions from the thoracic spine across the lumbosacral junction with different approaches of interbody fusion at L5/S1 level were reviewed. Revision surgery, pts without complete pre-op and post-op assessment scores and those without minimum 2 yr f/u were excluded. Pts were subdivided by approach (TSFR v TLIF). Fusion status at L5-S1 were evaluated by multiple X-rays and/or CT scans. Scoliotic curve changes were also evaluated preoperatively and at final f/u. Clinical outcome were assessed by SRS-22 and ODI.
Results: 36 pts were included for analysis. 18 TSFR, 18 TLIF. Mean 14.00 levels were fused in the TSFR group and 10.94 in the TLIF group (P = 0.01). Both groups demonstrated significant postoperative radiographic improvement in coronal parameters. The fusion rates for TSFR and TLIF group were 100% and 88.9%, respectively (P < 0.05). 8 pts in the TSFR group had pelvic fixation with unilateral or bilateral iliac screws, 15 pts in the TLIF group (P = 0.015). No differences were seen in pt reported outcomes between groups.
Conclusion: Radiographic measurement parameters were similar between groups. Pts in both groups demonstrated postoperative improvement in SRS22 and ODI questionnaires. TSFR required fewer iliac screws to augment stability of the lumbosacral junction while achieving a higher rate of fusion. This study suggests that TSFR may decrease potential complication requiring revision while decreasing OR time & implant related costs, especially long term.
Disclosures: author 1: grants/research support: K2M; author 2: none; author 3: none; author 4: none; author 5: none.

P89

CORTICAL VERSUS TRADITIONAL PEDICLE SCREW TECHNIQUES IN POSTERIOR LUMBAR INTERBODY FUSION

Paul Licina, Emma Johnston

Brisbane Private Hospital Research Group, Spring Hill, Australia

Introduction: Compared to the traditional open lumbar pedicle screw technique, the cortical bone trajectory technique spares soft tissue with a shorter wound and less muscle dissection. The purpose of this study was to compare these techniques in lumbar interbody fusion to identify differences in perioperative measures, patient outcomes and fusion rates.
Methods: A consecutive series of patients undergoing primary single level posterior interbody fusion by a single surgeon were prospectively studied. The choice between cortical and traditional pedicle screw technique was based on the surgical pathology. Perioperative data including surgical time, wound length, blood loss, hospital stay, in-hospital pain medication usage and complications were collected. Patient reported outcome measures including VAS and ODI were collected preoperatively and at six weeks, six months and 12 months postoperatively. Fusion was assessed based on a 12 month CT scan analysed by an independent Radiologist. Data was analysed using Fisher exact and unpaired t tests.
Results: Between July 2015 and January 2018, 136 patients were identified, of which 121 met the inclusion criteria. The cortical technique was used in 49 and the traditional technique in 72. There were 32 single cage and 17 dual cage cortical cases, compared with 70 single cage and 2 dual cage traditional cases. The average surgical time was 14 min longer (149 vs 135 min, p = 0.03) for the cortical technique. However, this significant difference was not present when cortical single cages were compared to traditional single cages. Average wound length was significantly shorter in the cortical group (5.09 cm vs 6.45 cm, p = < 0.0001).
There was no significant difference in blood loss between the groups. Hospital stay was shorter in the cortical group, with 67% vs 44% of patients being discharged by the third postoperative day (p = 0.02). In-hospital use of both parental and oral opioid analgesia was equivalent for both groups. There were no significant differences for ODI, back VAS and leg VAS between the groups at any of the postoperative timepoints. Patient satisfaction was slightly higher at six weeks in the cortical group. There were no significant perioperative complications, and no reoperations. Fusion was achieved at 12 months in 88% of the cortical group and 85% of the traditional group. There were three screw breakages in the cortical group and none in the traditional.
Conclusion: The cortical technique offers a smaller wound, shorter hospital stay and improved early patient satisfaction, but the benefits are subtle. The cortical technique took only slightly longer with no major technical challenges or complications. There were no clinically relevant differences in fusion.
In summary, the cortical technique is a viable alternative to the traditional technique but not clearly superior.
Disclosures: author 1: grants/research support: Brisbane Private Hospital; author 2: none.

P90

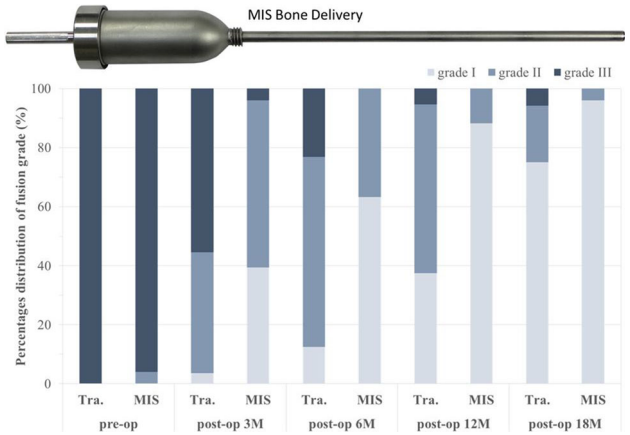
A NOVEL SURGICAL TECHNIQUE IN TRANSFORAMINAL LUMBAR INTERBODY FUSION BY THE BONE GRAFT DELIVERY DEVICE: EVALUATION OF THERAPEUTIC EFFECT IN PATIENTS WITH MINIMAL INVASIVE SPINE SURGERY

Sher-Wei Lim

Department of Neurosurgery, Chi-Mei Medical Center, Chiali, Tainan, Taiwan; Department of Nursing, Min-Hwei College of Health Care Management, Tainan, Taiwan

Patients with lumbar spondylosis, degenerative disc disease, spondylolisthesis, scoliosis or trauma might exist spinal instability and/or low back pain which require spinal fusion. Spine surgeons use bone graft substitutes in fusion surgery to stop the motion between the vertebrae, stabilize a corrected spinal deformity, by solid bridge that form by augmenting bone healing. However, due to a limited operative field and principle of less surgical destruction in minimally invasive surgery (MIS), only minimal amount of autograft or bone substitutes can be transplanted into the interbody space by manually filling or by the bone delivery funnel for helping spinal fusion. Both are time-consuming and increase the risk of iatrogenic injury due to the repeated filling processes during surgery. To overcome these problems, we developed a novel MIS bone graft delivery device which integrates the principle of threaded rod to drive the granule bone graft into the filler tube of device and then move forwards during spinning. With this device, surgeons can directly deliver the graft into the deeper side of interbody disc space in a stable, safety continuous, and effective approach. In order to confirm the safety and clinical performance of this novel surgical technique, we enrolled 73 consecutive patients which were randomized to treatment with the device (N = 39, age: 74.5 ± 7.6 years) or not (N = 34, age: 74.8 ± 6.4 years) and followed the clinical outcomes upon 1, 3, 6, 12, 18 months. With the use of device, the amount of bone graft was significantly increased (6.7 ± 2.9c.c.) compared to the group without device (2.3 ± 0.5c.c.). Noteworthy, the delivery procedure could be

finished within 20 s showing the effectively filling capacity. Both two surgical approaches can successfully relief patient's pain (Visual Analogue Scale in back and leg) and improve in disability (Oswestry Disability Index) after surgery with no significant differences. We further analysis the fusion grade by scoring into three statuses: Grade I: Complete fusion, Grade 2: Incomplete fusion, and Grade 3: No fusion. The percentages of patients achieving Grade I were 3.6% (without device) and 39.5% (with device) after during 3-month follow up period indicating the increased amount of bone graft by delivery device facilitated spinal fusion. Slip angle difference in maximum flexion and extension was lower than 4° showing an excellent spinal stability. In addition, computed tomography images showed that the cage was surrounded by a larger number of bone graft substitutes in patients with device during 12-month follow up period. Several bone bridges were notably formed nearby the cage indicating a solid spinal fusion. In summary, the use of MIS bone graft delivery device significantly improves bone healing capacity and spinal stability in patients by augmenting the amount of bone grafting. This technique also provides an efficiency, safety, and time-saving surgical approach for surgeons in MIS.



Disclosures: author 1: none.

P91

SATELLITE ROD FIXATION AROUND ROD-FRACTURE AREA IN REVISION SURGERY AFTER THREE-COLUMN OSTEOTOMY FOR SEVERE KYPHOSCOLIOSIS: A MINIMUM OF 2 YEARS FOLLOW-UP

Dun Liu, Yang Li, Benlong Shi, Zhen Liu, Xu Sun, Zezhang Zhu, Yong Qiu

Spine Surgery, Drum Tower Hospital of Nanjing University Medical School, China

Introduction: The revision surgery for rod breakage after 3CO can be performed via anterior or posterior approach or combined. However, implant failure was still unfortunately observed in certain revised patients. Since 2012, Satellite rod fixation around rod-breaking area has been widely applied in patients with rod breakage after 3CO in our center. The purposes of this study were to evaluate the radiographic and clinical outcomes of Satellite rod fixation utilized in revision surgery due to rod breakage after 3CO.
Methods: 25 patients (15 males and 10 females) applying Satellite rod fixation in the revision surgery from August 2012 to May 2016 were retrospectively reviewed. The average age of the cohort was 35.2 ± 15.3 years. The Cobb angle, distance between C7 plumb line and center sacral vertical line (C7PL-CSVL), global kyphosis (GK) and sagittal vertical axis (SVA) were assessed. The paired t test was used to analyze the difference.
Results: The Cobb angles at pre-revision and post-revision were 27.9 ± 21.5° and 21.8 ± 16.6°, respectively ($P < 0.001$). At last follow-up, the average Cobb angle was 21.6 ± 16.4° and there was no significant loss of correction ($P = 0.103$). Post-revision C7PL-CSVL changed from 22.6 ± 14.3 mm to 16.6 ± 9.9 mm ($P = 0.014$), of which the average value was 16.3 ± 9.8 mm at last follow-up ($P = 0.588$). The pre-revision and post-revision GK were 35.8 ± 17.0° and 27.5 ± 14.9° ($P < 0.001$). In regard to SVA, the average values were 35.6 ± 34.9 mm for pre-revision and 19.4 ± 14.4 mm for post-revision. There was no significant loss of correction during follow up. Additionally, there was no complication of implant failure during follow-up.
Conclusions: The Satellite rod fixation around rod-breaking area in revision surgery due to rod breakage in patients undergoing 3CO could get rigid fixation and satisfied clinical and radiographic outcomes.
Disclosures: author 1: not indicated; author 2: none; author 3: not indicated; author 4: none; author 5: none; author 6: none; author 7: none.

P92

PEDICLE SCREW ACCURACY IN CLINICAL UTILIZATION OF MINIMALLY INVASIVE NAVIGATED ROBOT-ASSISTED SPINE SURGERY

David Wallace, Arnold Vardiman, Neil Crawford, Leigh Ahrendtsen, Jessica Riggleman, Charles Ledonio

Musculoskeletal Education and Research Center (MERC), A Division of Globus Medical, Inc., Audubon, USA

Introduction: In the emerging field of robot-assisted spine surgery, radiographic evaluation of pedicle screw accuracy in clinical application is an area of high interest. This study describes the pedicle screw accuracy of the first 56 consecutive cases in which navigated robotic assistance was used in a private practice clinical setting.
Methods: A retrospective, IRB-exempt review of the first 56 consecutive navigated robot-assisted spine surgery cases was performed. Pedicle screw malposition, reposition, and return to operating room (OR) rates were collected. A CT-based Gertzbein and Robbins system (GRS) was used to classify pedicle screw accuracy.
Results: In the first 56 robotic cases, 356 total pedicle screws were placed. The average age was 64 years old and 48% were female. Average body mass index was 31 kg/m2. Diagnoses for surgery were degenerative disc disease (48) and adjacent segment disease (7). Eight screws were placed without the robot due to surgeon discretion. Of the 348 pedicle screws inserted by navigated robotic guidance, only 2.6% (9/348) were repositioned, resulting in a 97.4% (339/348) accuracy rate. Based on the GRS CT-based grading, 97.7% (340/348) were graded A or B, 1.7% (6/348) screws were graded C, and only 0.6% (2/348) screws were graded D. Two complications were reported requiring a return to the OR; explant and wound vacuum-assisted closure but were not related to robotic guidance or pedicle screws.
Conclusion: This study demonstrated a high level of accuracy (97.7%) in the clinical use of navigated, robot-assisted surgery, with only 2 non-screw related complications requiring a return to the OR. Additionally, screw placement and angulation accuracy improved with experience.

Table 3: Pedicle Screw Placement Accuracy Grades According to the Gertzbein and Robbins Classification System

	Number of Screws				
Grade	A	B	C	D	E
L1	5	1	0	0	0
L2	21	3	2	0	0
L3	63	8	0	1	0
L4	83	11	0	0	0
L5	86	3	2	1	0
S1	53	3	2	0	0
Total	311	29	6	2	0

Disclosures: author 1: none; author 2: grants/research support: Globus, consultant: Globus, Medtronic, National Monitoring, Abbott; author 3: stock/shareholder: Globus Medical, royalties: Globus Medical, employee: Globus Medical; author 4: stock/shareholder: Globus Medical, employee: Globus Medical; author 5: stock/shareholder: Globus Medical, employee: Globus Medical; author 6: employee: Globus Medical, Inc.

DIAGNOSTICS AND IMAGING

P93

PATIENTS WITH L4/5 LUMBAR DEGENERATIVE SPONDYLOLISTHESIS HAVE DECREASED BONE MINERAL DENSITY AT L4 MEASURED BY QUANTITATIVE CT

Roland Duculan, Alex Fong, John A. Carrino, James C. Farmer, Frank P. Cammisa, Andrew A. Sama, Alexander P. Hughes, Darren R. Lebl, Russel C. Huang, Harvinder S. Sandhu, Carol A. Mancuso, Federico P. Girardi

Hospital for Special Surgery, New York, USA

Background: Most lumbar degenerative spondylolisthesis (LDS) occurs at L4/5 and is attributed to more sagittal alignment of L4/5 facets and more coronal alignment of the L5/S1 facets. Decreased vertebral bone mineral density (BMD) at L4 potentially could be associated with L4/5 LDS either as a contributing factor or as a consequence. Quantitative computed tomography (QCT) characterizes trabecular bone mineral density (BMD) and has some advantages over dual-energy X-ray absorptiometry in the spine, such as greater accuracy in extremely high or low body mass index.
Purpose: To compare L4 BMD by QCT in patients with L4/5 LDS to those with LDS at other levels (i.e. L4/5 normal).
Study design/setting: Cross-sectional preop, tertiary spine center.
Patient sample: 250 consecutive patients with LDS scheduled for surgery.
Outcome measures: L4 BMD by QCT.
Methods: Several days before surgery, consecutive patients scheduled for LDS surgery were enrolled in a study to compare pre- and intraop imaging modalities to characterize LDS. Images included lateral, flexion, and extension radiographs and CT scans from which spinopelvic and QCT measurements were obtained. QCT measurements were made as follows: elliptical regions over the interior vertebra were manually fixed and Hounsfield unit values were derived and converted to BMD in mg/cm3 according to a software program calibrated to the specific CT machine. The sample was grouped as single-level LDS at L4/5, multi-level LDS that included L4/5, and LDS at non-L4/5 levels (i.e. normal L4/5). Mean QCT values for L4 were calculated for each group; the value for the L4/5 normal group was then compared to the other two groups with t-tests.
Results: Mean age 68, 64% women, mean BMI = 29 kg/m2, 50% had a smoking history, and mean back/leg pain were 6.6/5.0 (range 0–10). 173 patients had single-level LDS at L4/5, 46 had multi-level LDS that included L4/5, and 31 had normal L4/5 but LDS at L3/4 only (21 patients) or LDS at L5/S1 only (10 patients). For the entire sample, Meyerding grade1 (85%), mean lumbar lordosis was 46o, and mean pelvic incidence was 59o. For patients with normal L4/5, the L4 BMD was 121.4 mg/cm3 (similar to values reported in the literature by other investigators) but was less for patients with single-level L4/5 LDS (105.7, p = .02) and for patients with multi-level LDS that included L4/5 (106.1, p = .02). BMD values at other vertebrae without LDS were L1/2 = 111.9, L2/3 = 110.4, L3/4 = 100.8, L5/S1 = 126.4, sacrum = 156.3;(similar to values reported by other investigators).
Conclusions: Our analysis showed BMD was markedly lower for L4 in single and multi-level L4/5 LDS. Future studies should address whether a cause/effect relationship exists and assess whether biomechanical and clinical features unique to the L4/5 segment contribute to both phenomena. These findings have implications for surgical management, particularly the decision to fuse single- and multi-level L4/5 LDS.
Disclosures: author 1: none; author 2: none; author 3: consultant: Pfizer, Spreemo, other financial report: Medical Advisory Board = Carestream, GE, Image Analysis Group; author 4: none; author 5: grants/research support: Spinal Kinetics, Inc.; Ivy Healthcare Capital Partners, LLC; ISPH II, LLC; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Centinel Spine, Inc. (fka Raymedica, LLC); Beatrice & Samuel A. Seaver Foundation; 4WEB Medical; Woven Orthopedic Technologies; Depuy Synthes; Orthobond Corporation; Pfizer, Inc.; Paradigm Spine, LLC; 7D Surgical, Inc., consultant: Vertical Spine, LLC; 4WEB Medical, stock/shareholder: VBVP VI, LLC, royalties: NuVasive, Inc., other financial report: Spinal Kinetics, Inc.; Vertical Spine, LLC; Bonovo Orthopedics, Inc.; Viscogliosi Brothers, LLC; Liventa Bioscience (fka AF Cell Medical) Woven Orthopedic Technologies; Healthpoint Capital Partners, LP; Paradigm Spine, LLC; Tissue Differentiation Intelligence, LLC; author 6: grants/research support: AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution)AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution), consultant: DePuy Orthopaedics Inc, Ortho Development, Clariance Inc, 4WEB Inc, Kuros Biosciences AG, Sentio LLC, stock/shareholder: Paradigm Spine LLC, royalties: Ortho Development Corp, other financial report: Scientific Advisory Board – Clariance Inc, Strategic Advisory Board – Kuros Biosciences AG; author 7: grants/research support: 4WEB Medical; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Pfizer, Inc.; author 8: none; author 9: none; author 10: consultant: biorestorative therapies, stock/shareholder: paradigm spine, spinewave, providence medical.

P94

EVALUATION OF A NEW SAGITTAL CLASSIFICATION SYSTEM IN ADOLESCENT IDIOPATHIC SCOLIOSIS

Sidsel Fruergaard, Jain Mohit, Søren Ohrt-Nissen, Martin Gehrchen, Benny Dahl

Dept of Orthopedic Surgery, Spine Unit, Rigshospitalet, Copenhagen, Denmark

Introduction: The overall objective of AIS corrective surgery is to achieve a balanced spine both in the coronal and sagittal plane. The implications of sagittal malalignment are well documented in the adult population but less is known about the consequences in AIS. Recently, a new spinal sagittal classification has been proposed by Genevois-Abelin et al. to provide guidelines for the surgical strategy. The purpose of the present study was to validate this classification.

Purpose: An external validation of a proposed new sagittal classification system for adolescent idiopathic scoliosis (AIS).
Methods: We retrospectively included 105 consecutive AIS patients who underwent posterior spinal fusion. Preoperative long standing EOS radiographs were available on all patients. Patients were classified according to the four suggested sagittal patterns; type 1, 2a, 2b or 3. Furthermore, several predetermined sagittal parameters were compared between the four groups.
Results: The mean preoperative Cobb angle was 64 ± 12° and 73% of the patients were female. Of 105 patients, 51 were type 1, 14 were type 2a, one was type 2b and 39 were type 3. The distribution of the four sagittal patterns was significantly different compared with the original publication ($p < 0.05$). However, the two study populations were comparable in terms of Lenke- and Roussouly types ($p = 0.49$ and 0.47, respectively). In our study population, the four sagittal groups differed significantly in terms of thoracic kyphosis, length of thoracic and lumbar curves, lumbar lordosis, thoracic slope, C7 slope, pelvic incidence, and sacral slope ($p < 0.05$). We found no difference between the groups in terms of cervical lordosis or upper and lower cervical angle.
Conclusion: The distribution of the four sagittal patterns varies between AIS cohorts. Type 2b was rare, which limits the clinical applicability. Contrary to the original publication, we found that the spinopelvic parameters lumbar lordosis, pelvic incidence and sacral slope were significantly different between the four Abelin-Genevois groups. Hence, the corrective surgical strategy may need to incorporate these spinopelvic parameters to achieve a balanced spine requiring a minimum of energy expenditure.
Disclosures: author 1: grants/research support: Medtronic; author 2: none; author 3: none; author 4: grants/research support: K2M and Medtronic; author 5: consultant: K2M.

P95

PREDICTORS OF SURGICAL SITE INFECTION AFTER SPINAL INSTRUMENTATION SURGERY: A CONSECUTIVE SERIES

HIROYUKI INOSE, Atsushi Okawa

Dept of Orthopedics, Tokyo Medical and Dental University, Tokyo, Japan

Background: Malnutrition is a risk factor for surgical site infection (SSI) in many health conditions; however, the evidence connecting preoperative malnutrition with SSI in spinal instrumentation surgery is limited because of the small number of retrospective studies. While the modified Glasgow prognostic score (mGPS), C-Reactive protein (CRP)-albumin ratio (CAR), controlling nutritional status index (CONUT), prognostic nutritional index (PNI), platelet-lymphocyte ratio (PLR), and neutrophil–lymphocyte ratio (NLR) are established methods for evaluating nutritious status, little has been reported on the predictive value of these indicators with respect to postoperative spinal infection. The purpose of this study is to analyze a large consecutive cohort of patients who had undergone spinal instrumentation surgery, to characterize a patient population with SSIs, and to identify preoperative risk factors associated with SSI.
Methods: We retrospectively investigated 384 patients who underwent spinal instrumentation surgery. We evaluated the significance of risk factors, including mGPS, CAR, CONUT, PNI, PLR, and NLR. We then performed stepwise logistic regression analysis to analyze the concurrent effects of various factors on the prevalence of postoperative infection.
Results: Of the 384 patients analyzed, 14 were diagnosed with infections. Univariate analysis showed that BMI, lymphocyte count, albumin, erythrocyte sedimentation rate, CRP, CONUT, mGPS, CAR, and PNI were risk factors for postoperative infection. Stepwise logistic regression analysis revealed that mGPS and BMI before surgery were independent risk factors for postoperative infection. A receiver operating characteristic curve showed that the cuff-off values of mGPS and BMI were 1 and 20.39, respectively.
Conclusions: The risk factors for postoperative infection after spinal instrumentation surgery were mGPS $\geqq$ 1 and BMI $\leqq$ 20.39 kg/m2. These findings could help to identify patients at higher risk of postoperative infection after spinal instrumentation surgery.
Disclosures: author 1: none; author 2: not indicated.

P96

IS VERTEBRAL POSTERIOR EDGE SAFETY LINE FOR CERVICAL POSTERIOR SCREW INSERTION? RADIOLOGICAL STUDY OF VERTEBRAL ARTERY IN THE CERVICAL SPINE

Kyongsong Kim, Misa Kido, Mitsuri Hasegawa, Masaaki Kawauchi

Department of Radiology, Chiba Shintoshi Rurban Clinic, Chiba, Japan

Objective: In the cervical spine surgery, vertebral artery (VA) injury is one serious complication. In the posterior cervical fusion with screwing, it is known that it can avoid the VA injury by not inserting a screw forward to the posterior edge of vertebral body. However there is few report about anatomical study of VA focusing posterior line of vertebral body as a safety line. We report the relationship between posterior line of vertebral body and VA using MRangiography (MRA).
Methods: The subjects were consequence 53 males and 52 females (average age 65.0 years) who had taken cervical MRA for other than cervical spine disease. Using MRA and original image of it, we investigated several anatomical characteristics of VA of cervical spine. Measurements were performed at each vertebral body and intervertebral disc level.
Results: Among all 210 VAs of 105 cases, 3 right VAs and 1 left VA were not visualized blood flow by MRA (hypoplastic) and we evaluated 206 VAs. The penetration level of the VA into the cervical vertebra was mostly C6 (90.1%); C4 with 2.9%, C5 with 4.3%, and C7 with 1.5%. In most cases (87.6%), bilateral VA entered to the cervical vertebra at the same level. Meandering VA like coiling was noted in 30 parts of 17 cases. The VA diameter were average 3.7 ± 0.6 mm/3.8 ± 0.6 mm (right/left). The distance from the posterior line of vertebral body to VA surface were average 7.1 ± 1.9 mm/7.6 ± 1.7 mm (right/left) (C3 with average 3.5 mm/4.1 mm, C4 with 4.8/5.3, C5 with 5.5/6.0, C6 with 6.2/6.0, and C7 with 11.5/11.6). It was short in upper cervical level and tended to be short on the right side. We classified VA by distance from posterior line of vertebral body; the cases with more than 2 mm in anterior were 82.5% for C3, 96.6% for C4, 99.5% for C5, 98.5% for C6, and 100% for C7. The case with $+2 \sim 0$ mm in anterior were 16.0% for C3, 2.9% for C4, 0.5% for C5, 1.5% for C6 (28 parts among total 43 parts were spirals.) The VA, which behind posterior line of vertebral body, were 7 parts of 5 cases; 4 cases were C3 or C4 vertebral level and the others were disc level (C3/4, C4/5, C6/7). Four cases were related with meandering VA.
Conclusions: In current study, mean distance between VA surface and the posterior line of vertebral body was more than 7 mm and it was short in upper cervical level and the right side. Although there is no VA within 2 mm from the posterior edge of vertebral body in many cases and it would be useful as a guide for posterior screwing of cervical spine, VAs of some cases were close to posterior line of

vertebral body and attention is necessary at upper cervical level and portion of meandering VA like coiling. In our study, VA of 7 parts with 5 cases were in the dangerous area more than the vertebral posterior line, and it was also related to the upper cervical level and meandering VA. These results would be useful for safety cervical posterior fusion surgery.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P97

OBJECTIVE AND PRECISE X-RAY LANDMARK LOCALIZATION USING DEEP LEARNING

Frank Niemeyer, Fabio Galbusera, Annette Kienle, Hans-Joachim Wilke

Institute for Orthopaedic Research and Biomechanics, Ulm University, Ulm, Germany

Diagnosis as well as the assessment of treatment outcomes often rely on quantitative evaluation of X-ray images. Parameters characterizing the shape and dimension of anatomic structures, e.g. intervertebral disc height, vertebral body dimensions or disc wedging angle, are derived from the relative positions of anatomical landmarks. Localizing these landmarks, however, is not standardized and is affected by large inter-observer variability, in particular in the case of poor image quality. The aim of this project was to develop a system that automatically, objectively and precisely locates anatomical landmarks of vertebral bodies on X-ray images.

We experimented with different deep convolutional neural network (CNN) architectures and had initial success with a relatively simple network based on Fan & Zhou [1]. Recently, we switched to an Xception-based network [2] pretrained on ImageNet [3], where we replaced the original classification layer with fully connected layers in order to regress the image coordinates of four landmarks (the „corners“of a vertebral body) on lateral X-ray projections. Our training data set consists of 6585 manually evaluated vertebral bodies (ground truth), which we could increase eightfold to 52 680 training samples through image augmentation (random rotation, translation and zoom). 90% of this training set was used for training the CNN, while the remaining 10% were reserved for validation purposes. We used Adam [4] with a learning rate of 5×10^{-5} for optimizing the CNN's parameters.

After 100 epochs of training, the CNN achieves a localization error (RMSE) on the validation set of 1.2% of the image edge length, corresponding to a mean localization error of 2.3 pixels on images of 192 192 pixels. The correlation between the ground truth landmark coordinates and the coordinates predicted by the CNN $\rho > 0.99$. The localization error $< 4.5\%$ (9 pixels) in 99% of all validation cases and $< 3.1\%$ (6 pixels) in 95% of all cases (Figure 1).

Currently, images showing implants (cages, screws) still pose some problems and sometimes „confuse“the CNN. Yet, first experiments revealed that adding even a small proportion of training samples including implant devices already dramatically improves results in these cases. Additional training material could furthermore extend the applicability from being limited to lateral projections of the lumbar spine to other cases (e.g. thoracic, a.p. projection).

Aside from these issues and occasional outliers that are mostly attributable to bad image quality, our system is capable of localizing anatomical landmarks in lateral projections of lumbar vertebrae in a reliable, reproducible and objective way.

[1] Fan & Zhou, Image & Vision Computing. 47, 27–35 (2016).

[2] Chollet, arXiv.org. arXiv:1610.02357 [cs] (2016).

[3] Deng et al., IEEE Conference on Computer Vision and Pattern Recognition (2009).

[4] Kingma & Ba, arXiv.org. arXiv:1412.6980 [cs] (2014)

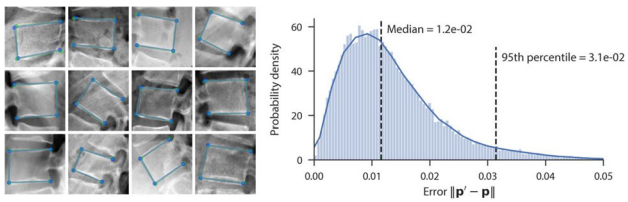


Figure 1: Left: Randomly selected validation samples with ground truth (green) and prediction (blue); Right: Error distribution for predicted landmark locations (distance of predicted landmarks to ground truth)

Disclosures: author 1: none; author 2: none; author 3: none; author 4: grants/research support: Signus, Neos, ApiFix, Spinol, 3D Matrix.

P98

NEW CLASSIFICATION OF CORONAL MALALIGNMENT FOR ADULT SPINAL DEFORMITY: THE ROLE OF LATERAL BENDING FILMS

Ibrahim Obeid, Kazunori Hayashi, Louis Boissière, Derek Cawley, David Kieser, Pedro Berjano, Claudio Lamartina, Munish Gupta, Clément Silvestre, Themi Protopsaltis, Anouar Bourghli, Ferran Pellisé, Prokopis Annis, Elias Papadopoulos, Gaby Kreichati

Spine Surgery Unit 1, Bordeaux University Pellegrin Hospital, Bordeaux, France

Object: A new classification system of coronal malalignment (CM) has been proposed by Obeid et al. (Obeid-CM classification). The classification divides patients into 6 groups according to main coronal curve type (concave or convex), with first modifiers determined by the apex of the main curve (A or B), and second modifiers determined by the stiffness of the curve (1 and 2). Substantial intra- and inter-rater reliability was observed in a previous study. However, it remains to be seen whether lateral bending films helps us to better understand CM. Thus, the aim of this study was to identify whether the use of lateral bending films improves inter-rater reliability of a new classification system for CM compared to those without.

Study design: Observational study for the comparison of inter-rater reliability of the classification.

Methods: Fifteen readers from fourteen international institutions classified 28 cases that represented coronal malalignment (C7-CSVL > 20 mm). At the beginning, the readers were assigned only patients' whole spine anteroposterior and lateral X-ray films. Subsequently, they graded the cases with reference to additional lateral bending films. No other information was obtained for evaluation. Inter-rater reliability of the two assignments was determined and compared by calculating Fleiss' kappa coefficients.

Results: Inter-rater reliability without lateral bending films was calculated as 0.91 for main curve types, 0.76 for subtypes with the first modifier, 0.51 for total with two modifiers. With lateral bending films, this changed to 0.88, 0.73 and 0.53 respectively. All readers altered their decision for grading in a mean of 24.5% of cases after the inclusion of bending films.

Conclusion: Lateral bending films did not significantly improve inter-rater reliability of the Obeid-CM classification. The readers changed their mind in 25% of cases but a previous study revealed the readers changed their grading in 22% of cases even between 2 readings without reference to lateral bending films. Surgeons could grade the patients having CM according to this classification just in reference to anteroposterior and lateral films.

Figure: The X-rays of two cases graded 2A1 and 2A2, respectively. Surgeons could grade and consider the surgical plan without bending films.

Types	Subtypes	
Main coronal curve types	First modifier: the apex of the curve	Second modifier: flexibility of curve
Type 1	**Type 1A**	**Type 1A1**
Concave	between T12 and L4	flexible
		Type 1A2
		Rigid
	Type 1B	
	above T11-12	
Type 2	**Type 2A**	**Type 2A1**
Convex	between T12 and L4	flexible
		Type 2A2
		Rigid
	Type 2B	
	Lumbosacral junction: below L4-5	

Disclosures: author 1: grants/research support: depuy synthes, consultant: depuy synthes, Medtronic, royalties: Alphatec, Spineart, Clariance; author 2: grants/research support: Konishi Foundation for International Exchange; author 3: grants/research support: Depuy Synthes, consultant: Medicrea, Spineart; author 4: none; author 5: none; author 6: grants/research support: Nuvasive, K2M, Depuy Synthes, consultant: Nuvasive, Medacta, Depuy Synthes, K2M, Medtronic, royalties: Nuvasive, other financial report:; author 7: consultant: Depuy, Nuvasive, K2M, Medacta, royalties: Nuvasive, Medacta; author 8: grants/research support: AO Spine & OMeGA for fellowship paid directly to institution, consultant: DePuy, Medtronic, stock/shareholder: J&J, P&G, perForm Biologics, royalties: Innomed, DePuy; author 9: consultant: KISCO; author 10: not indicated; author 11: none; author 12: grants/research support; DePuySpine, Medtronic; author 13: not indicated; author 14: not indicated, author 15: none.

P99

LUMBAR MUSCLE MORPHOLOGY AS A PROGNOSTIC MARKER AFTER DISCECTOMY

Nuno Cruz Oliveira, Elisa Condez, Alexandre Almeida, Pedro Pinho, Ricardo Magalhães, Bruno Santos, Pedro Varanda, Rui Duarte

Orthopedic Surgery Department, Hospital de Braga, Portugal

Introduction: Low back pain (LBP) is a highly prevalent health and socio-economic problem worldwide. In patients with lower disc herniation (LDH), recurrence of LBP after lumbar discectomy causes functional disability. Lumbar paraspinal muscle atrophy might be an etiological factor for LBP. The purpose of this study is to investigate if pre-operative lumbar paraspinal muscle atrophy might be a predictor of recurrence of LBP/disability after lumbar discectomy.
Methods: A T2 weighted axial magnetic resonance imaging (MRI) acquisition at L3-L4 level was collected from 46 patients, aged 18–60 years, who were submitted to lumbar microdiscectomy. Based on the grey scale range of lean muscle and fat tissue, paraspinal muscle morphology was evaluated, by assessing the measures of cross-sectional area (CSA), functional CSA (FCSA) and fat infiltration for the Multifidus (MF) and Erector Spinae (ES) muscles. The association between paraspinal muscle atrophy and the post-surgery Oswestry Disability Index (ODI) was evaluated.
Results: MF muscle had a significantly higher fat infiltration ($p = 0.025$) and a smaller ratio FCSA/CSA ($p = 0.024$) compared to ES muscle. Female patients had a significantly higher fat infiltration ($p = 0.009$) and a smaller ratio FCSA/CSA ($p = 0.042$). There was a significant negative correlation between MF's FCSA and the ODI ($p = 0.019$) and a significant positive correlation between the ODI and fat infiltration (total, MF and ES, $p = 0.001$, $p = 0.004$ and $p < 0.001$ respectively). Total fat infiltration was significantly associated with the disability level ($\beta = .477$, $t = 2.311$, $p = 0.026$), as well as fat infiltration of MF muscle ($\beta = .461$, $t = 2.474$, $p = 0.018$).
Conclusions: In this population, lumbar muscle morphology was altered, with MF muscle experiencing more atrophy than ES muscle. Fat infiltration is associated with higher levels of disability. Pre-operative lumbar paraspinal muscle atrophy, particularly of MF, seems to be a predictor of poor outcome in patients submitted to lumbar discectomy.
Disclosures: author 1: none; author 2: none; author 3: not indicated; author 4: none; author 5: not indicated; author 6: not indicated; author 7: not indicated; author 8: none.

P100

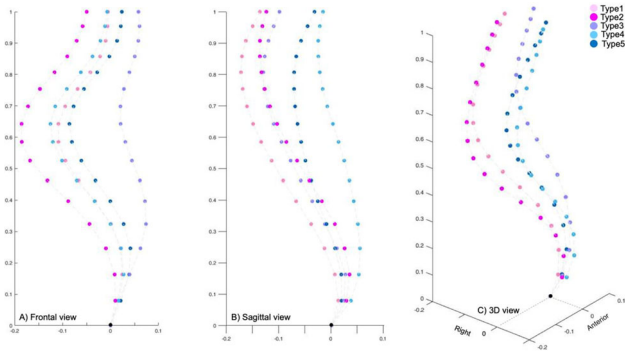
A HIERARCHICAL CLASSIFICATION OF RIGHT THORACIC ADOLESCENT IDIOPATHIC SCOLIOSIS

Saba Pasha, Victor Ho

Children's Hospital of Philadelphia, Philadelphia, USA

Classification of adolescent idiopathic scoliosis aims to guide surgical decision making. Two-dimensional classification of AIS presented some limitation to identify subtle. 3D classification were not accessible to a majority of clinics. We developed a hierarchical classification of 103 right thoracic AIS based on the 3D spinal curve patterns. Five subtypes with significantly different curve patterns were determined. The pairs of frontal and sagittal curves in these subtypes were characterized for a 3D classification using 2D pairs of X-ray images. We hypothesized that statistically different 3D curve patterns exists within a right thoracic AIS patients group. These differences can be characterized by pairs of frontal and sagittal spinal curves.
Introduction: The pre-operative shape of the spinal curve is an important factor in surgical decision-making. The application of the two-dimensional (2D) X-ray images for AIS diagnosis and classification has limited the characterization of the spinal curvature to 2D projections of the 3D spinal curvatures on the orthogonal planes. Methods for 3D classifications of the spinal curve in AIS have been explored, however, complicated and time consuming post-processing techniques associated with these classifications has hampered the dissemination of these classifications as readily applicable tools in clinical setups.
Methods: 103 right thoracic AIS were included. 3D spinal curve was calculated by interpolating the center of vertebrae. A hierarchical classification of the normalized 3D spinal curves was developed to group the patients based on the similarity of their 3D spinal curve. The spinal curves in the three anatomical planes were compared between the scoliotic subtypes.
Results: A total of 5 subgroups in a cohort of right thoracic AIS patients were identified (Fig. 1): Type 1: Normal sagittal profile and S

shape axial view. T1 level or tilted to the right in the posterior view. Type 2: Hypokyphotic (both T5-T10 and T10-L2) and a V shape axial view. T1 tilt to the left in the posterior view. Type 3: L Hypokyphotic (only T5-T10) and frontal imbalance, S shape axial view. T1 level or tilted to the right, and 3 frontal curves. Type 4: Flat sagittal profile (T1-L2) and slight frontal imbalance with a V shape axial view, T1 tilted to the left. Type 5: Hypokyphotic and forward trunk shift with a proximal kyphosis and S shape axial, T1 level or tilted to the right.
Conclusion: The differentiating features between the right thoracic subtypes can be identified from the pairs of frontal and sagittal spinal curves in right thoracic AIS patients allowing for a 3D classification of the spine using two-view X-rays without the need for image post-processing.



Disclosures: author 1: grants/research support: Posna, SRS; author 2: none.

P101

QUANTIFYING CERVICAL SPONDYLOSIS: RELIABILITY TESTING OF A COHERENT CT-BASED SCORING SYSTEM

Eric Rydman, Sara Bankler, Sari Ponzer, Hans Pettersson

Department of Clinical Science and Education, Södersjukhuset, Karolinska Institutet, Stockholm, Sweden

Background: Grading of degeneration of the cervical spine is of great clinical value, considering the vast amount of radiological investigations that are being done with this query. Despite the fact that Computed Tomography (CT) is frequently used in clinical practice there is today no user-friendly and reliable scoring system for assessment of cervical spondylosis on CT-scans available.
Purpose of the study: The purpose of this study was to establish a scoring system for cervical spondylosis based on CT-scans and to test it for reliability.
Materials and methods: Twenty adult patients undergoing CT of the cervical spine due to neck pain following a motor vehicle accident were included in the study. Three independent raters, i.e. one orthopedic surgeon and two radiologists, assessed their CT-scans. Two of the raters repeated the assessments after three months. A radiographic-based scoring system for cervical disc degeneration, addressing disc height, osteophytes and endplate sclerosis, was applied on CT and tested for reliability. A pre-existing, reliable CT-based scoring system for facet joint degeneration, considering joint space narrowing, osteophytes and irregularity of the articular surface was modified and reevaluated. The disc-degeneration-score and joint-degeneration score were summed up and categorized into four degrees of total degeneration. This in order to develop a coherent CT-based total degeneration score for cervical spondylosis.
Results: The scoring systems for cervical disc degeneration and facet joint degeneration both exhibited an acceptable or better level of strength of agreement regarding intra- and interrater agreement. The total disc degeneration score showed a moderate level of inter-rater reliability with a kappa-value of 0.47 and a good intra-rater agreement with intra-class correlation coefficients (ICC) of 0.67 and 0.60 for the two raters performing the assessments. The total facet joint degeneration score showed a moderate level of inter-rater reliability (kappa 0.54) and an excellent intra-rater agreement with ICC 0.75 for one of the raters and fair for the other rater (ICC 0.54). When the total disc and facet joint degeneration score were classified into a three-degree total degeneration score the inter-rater agreement was 0.695 and the ICC 0.82 and 0.73 respectively.
Conclusions: This coherent scoring system assessing both disc degeneration and facet joint degeneration on CT-scans of the cervical spine was shown to meet the standards of reliability.

Scoring system of cervical disc and facet joint degeneration. AP = anteroposterior.

Disc degeneration		
1. Height loss	0%	0
	points	
	≤ 25%	1
	point	
	> 25–≤ 50%	2
points		
> 50%–≤ 75%	3 points	
> 75%	4 points	
2. Anterior osteophytes	No osteophytes	0
	points	
	≤ 1/8 AP diameter	1
	point	
> 1/8–≤ 1/4 AP diameter	2 points	
> 1/4 AP diameter	3 points	
3. Endplate sclerosis	No sclerosis	0
	points	
	Detectable	1
point		
Definite	2 points	
Overall degree of disc degeneration 1 + 2 + 3	0 points (no degeneration)	0
	points	
	1–3 points (mild degeneration)	1
	point	
4–6 points (moderate degeneration)	2 points	
7–9 points (severe degeneration)	3 points	
Facet joint degeneration		
1. Joint space narrowing	Normal	0
	points	
Narrowed	1 point	
2. Osteophytes	No osteophytes	0
	points	
Yes	1 point	
3. Irregularity of articular surface	Normal	0
	points	
Irregular	1 point	

Overall degree of facet joint degeneration (1 + 2+3)	0 points (no degeneration)	0 points
	1 point (mild degeneration)	1 point
	2 points (moderate degeneration)	2 points
	3 points (severe degeneration)	3 points.

Disclosures: author 1: none; author 2: none; author 3: none.

P102

CORRELATION BETWEEN ADAM'S TEST AND DIGITAL PELVIC INCLINOMETER IN ADULTS

Rumiana Tasheva, Krassimir Kolev

National Sports Academy "Vasil Levski", Sofia, Bulgaria

Background: The presented information is part of the initial results of the implementation of a project for functional diagnosis and prevention of spinal pain in teachers at the work place. The project runs from February to the end of November 2019. The Adams test is widely used in practice in screening studies2. The question arises whether there is dependence between the muscle hump and the pelvis inclination. A Digital Pelvis Inclinometer (DPI) is used to objectify the results. The DPI was used to study children for the first time in our study1.

The purpose of the study is to apply the Adam test and trace the correlation with the pelvic tilt in the sagittal plane as measured by the digital inclinometer in the teachers.

Methods: In February 2019, 39 middle-aged teachers 50, 35 (25–77) years were studied with gender distribution is 33: 6 in favor of women. The assessment includes 54 indicators. In this abstract we present the results from two methods. The Adam's test shows the presence of a muscle hump in the lumbar spine. The DPI is applied for measuring left and rigth pelvic inclination. The DPI developed by Sub-4 Technologies, is a precision measuring device used to quantify innominate bone inclination. Data is captured by the DPI via a tiny three-axis accelerometer.

Results: Frequent analysis of Adam's test results demonstrated 20 individuals with a negative result. Data is provided only from the lumbar spine. The presence of a muscle lumbar hump was reported in 7 (17, 9%) and in 4 (10.3%) of them was on the right side. In 3 (7.7%) of the subjects there was a right rib and a left-sided muscle hump in the lumbar section.

In measuring with the Digital pelvic inclinometer, close average values are noted on the left of 3.4° and 3.1° on the right, with a larger difference being observed at the maximum values of 25° on the left and 16° on the right.

The correlation analysis presented with the biseal coefficient is the relationship between the Adams test as an independent variable and the DPI test of the right—dependent variable. There is a close-to-strong relationship of ET = 0.718 in the Adams test, indicating that when changing the DPI results to the right, there will be a change in the Adams test results.

Conclusion: The results of the Adams test show structural changes in lumbar spine in the teachers. On the other hand, there is an increased incision of the pelvis inclination without marked asymmetry. The existence of a correlation between the two methods gives us reason to increase the research contingent for greater statistical reliability of the results.

Keywords: Adams test, Digital pelvic inclinometer, teachers.

References: 1. Tasheva R., Kolev K., et al. (2016) Digital inclinometer as an innovation in the functional diagnostic in children. XIX International Scientific Conference FIS COMMUNICATIONS in physical education, sport and recreation", Nish, Serbia: 363–366.
2. https://www.physio-pedia.com/Adam's_forward_bend_test.

Disclosures: author 1: grants/research support: NSA, employee: NSA; author 2: grants/research support: National Sport Academy "Vassil Levski"- Sofia, consultant: National Sport Academy "Vassil Levski"- Sofia.

NONOPERATIVE TREATMENT

P103

SPINAL INJECTIONS VERSUS CONSERVATIVE TREATMENT FOR SPINAL PAIN: THE KOREAN SPINE PATIENT OUTCOMES RESEARCH TRIAL (K-SPORT) OBSERVATIONAL COHORT

Dong Ah Shin

Dept of Neurosurgery, Severance hospital, Seoul, Republic of Korea

Introduction: Spinal intervention involves drug injection around the spine. It helps to decrease neural inflammation and spinal pain. While its usage has been increasing significantly, its efficacy has been criticized so far. The purpose of this study was to compare the treatment effects of spinal intervention and conservative care.

Materials and methods: This is a prospective observational cohort of non-surgical candidates with spinal pain who were treated in our institute. Spinal intervention included conventional spinal injections and percutaneous epidural neuroplasty. Conservative treatment included medications, physical therapy, and exercise. Primary outcome measures were changes from baseline in visual analog scale of lower back and leg (respectively VAS.back and VAS.leg), SF-36 and Oswestry Disability Index (ODI) at 1, 3, and 6 months. The clinical success was defined as: 1)50%(or 4-point) reduction from baseline VAS.back or VAS.leg and no increase from baseline ODI and SF-36; or 2) 30%(or 2 point) reduction from baseline VAS.back or VAS.leg with one of the following criteria: 30% (or 3 point) reduction in ODI from baseline, or 30% (or 20 point) increase from the baseline SF-36.

Results: Of the 142 patients enrolled in the study, 47 patients underwent spinal intervention and 95 patients underwent conservative treatment. The initial VAS.back, EQ-5D1, EQ-5D4 was higher in the intervention group ($p = 0.0148$, $p = 0.0052$ and $p = 0.0032$). In both groups, spinal pain significantly decreased at 1 month follow up and the effect was maintained throughout 6 months ($p < 0.001$). At all follow up periods, there was no difference in the clinical success between the intervention and conservative group. The treatment effect was no different according to the diagnosis and disease severity.

Conclusions: Both treatments were equally effective in carefully selected patients with spinal pain. However, nonrandomized comparisons of self-reported outcomes are subject to potential confounding and must be interpreted cautiously.

Disclosures: author 1: none.

PATIENT SAFETY

P104

CLINICAL APPROACH AND SURGICAL STRATEGY FOR SPINAL DISORDERS IN PREGNANT WOMEN

Hanna Hitscherich, Maria Wostrack, Sven Eicker, Judith Rösler, Peter Vajkoczy, Nikolaus Kögl, Claudius Thome, Enrico Tessitore, Bernhard Meyer

Dept of Neurosurgery, Klinikum Rechts der Isar, Technical University of Munich, Germany

Introduction: Spinal diseases that require urgent surgical treatment are rare during pregnancy. There are many important diagnostic and therapeutic aspects that must be taken into account in such situations, especially if there is an acute indication for surgery. The data is available only in the form of case reports.
Methods: The study included consecutive pregnant patients who underwent spinal surgery at five neurosurgical high-volume centers between 2010 and 2017. Preoperative, operative, and postoperative clinical data were derived from medical records.
Results: Overall, 23 pregnant patients were assigned to acute spinal surgery. Two of them underwent preoperative cesarian section in the 34th and 32th week. The other 21 patients underwent surgery during pregnancy. Three patients were operated upon twice or more during the same pregnancy. The median age was 33 years (min 22, max 41 years). The median gestational age was 13 completed weeks (min 7, max 34 weeks). The indications were: n = 14 lumbar herniated intervertebral discs presenting with cauda equina syndrome in 4 cases, high graded motor deficit in 7 cases, and acute pain in 3 cases; n = 4 unstable spine injuries; n = 1 intramedullary tumor with paraparesis; n = 1 paraspinal infection; n = 1 swann cell nerve root tumor presenting with higher graded paresis. Perioperative pregnancy monitoring was done with an ultrasound or ultrasound plus CTG after the 24th week of gestation in the majority of cases. All surgeries were performed under general anaesthesia (balanced anaesthesia n = 12, total intravenous anaesthesia n = 9). Median duration of surgery was 90 min (min 41, max 240). 15 patients were placed in a prone position and 6 in a right or left lateral decubitus position depending on the gestational age and the type of surgery. In 9 cases no intraoperative fluoroscopy was done, in 12 cases fluoroscopic verficiation of spine level or guidance of instrumentation placement was performed with a median fluoroscopic time of 6 s (min 1, max 24 s). No postoperative neurosurgical complications occured. Two patients underwent medical abortion due to radiation exposure before the pregnancy was diagnosed. Among the other 19 patients, 2 suffered transient gestational diabetes, and one patient presented with vaginal bleeding without any signs for fetal complications. According to our current follow-up data, no miscarriages, stillbirths or other severe obstetric complications occured during the further courses of pregnancy. All patients improved neurologically after the surgery.
Conclusions: Spinal surgical procedures during pregnancy seem to be generally safe. Nevertheless, the indication for surgery has to be very strict and surgical procedures during pregnany should be reserved for emergency cases with acute or threatening neurological deficit. For pregnant patients the surgical strategy should be individually tailored for the mother and the fetus.
Disclosures: author 1: employee:; author 2: none; author 3: none; author 4: none; author 5: grants/research support: Brain Lab, consultant: Spine Art, stock/shareholder: BIT Pharma; author 6: consultant: Intrinsic Therapeutics, Inc; author 7: grants/research support: BrainLab, DePuySynthes, Medtronic, Signus Medical, Pfizer, TETEC, Icotec, BITPharma, Intrinsic Therapeutics, Edge Therapeutics, consultant: DePuySynthes, Intrinsic Therapeutics, Signus Medical, other financial report: BrainLab, DePuySynthes, Medtronic, Icotec, BITPharma, Intrinsic Therapeutics, Edge Therapeutics; author 8: consultant: Depuy Synthes, Nuvasive, Spineart, Brainlab; author 9: grants/research support: Medtronic, Depuy, Relievant, Ulrich, icotec, consultant: Medtronic, Depuy, Relievant, Ulrich, icotec, royalties: Spineart.

COMPLICATIONS

P105

UNPLANNED READMISSION FOLLOWING COMPLEX SPINE SURGERY - 2-YEARS FOLLOW UP USING THE SPINE ADVERSE EVENT SEVERITY (SAVES) SYSTEM

Tanvir Johanning Bari, Sven Karstensen, Mathias Dahl Sørensen, Martin Gehrchen, John Street, Benny Dahl

Spine Unit, Department of Orthopedic Surgery, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark; Combined Neurosurgical and Orthopedic Spine Program, Vancouver General Hospital, University of British Columbia, Vancouver, British Columbia, Canada

Department of Orthopedics and Scoliosis Surgery, Texas Children's Hospital & Baylor College of Medicine, Fannin St, Houston, Texas, USA.

Introduction: Recent studies suggest that prospective registration more accurately reflects the true incidence of adverse events (AEs) after spine surgery. To our knowledge, no previous study has investigated whether index admission AEs influence subsequent unplanned hospital readmission following complex spine surgery.
Purpose of the study: To report the rate of readmissions following complex spine surgery and to investigate if prospectively recorded AEs can predict readmission.
Materials and Methods: At a single-center, all patients undergoing surgery in 2013 were prospectively included. Perioperative AEs were registered using the Spine AdVerse Events Severity system. Patients were followed for a minimum of two-years from index surgery discharge date. Covariates were assessed for predictive ability using a proportional odds model. Readmission within 90 days of discharge was further analyzed using logistic regression. Results were reported as odds ratios (OR) with 95% confidence intervals (CI).
Results: A consecutive cohort of 679 patients was included. Patients underwent spine surgery for various complex pathologies and 443 (65%) were hospitalized within 2 years of index discharge. The most frequent department for readmission was internal medicine (30%) and 20% were to a spine center. Cumulative incidence of readmission for any reason was estimated using the Aalen-Johansen estimator to 13% at 1 month (CI 10–16%), 26% at 3 months (CI 23–30%), 50% at 1 year (CI 46–54%) and 59% at 2 years following discharge (CI 55–63%). Multivariate proportional odds model adjusted for demographics showed significantly increased odds of readmission when a major AE was recorded during the index surgery (OR 1.6 CI 1.1–2.4, P = 0.01). Following multivariate logistic regression with 3-months readmission as outcome, major operative blood-loss (OR 2.9, CI 1.2–6.9, P = 0.02) and postoperative hematoma (OR 3.1, CI 1.3–7.0, P < 0.01) were associated with increased odds of readmission.
Conclusion: In a single-center study, prospectively recorded major perioperative AEs were correlated to elevated odds of readmission after complex spine surgery. Internal medicine was the most frequent department for readmission.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: grants/research support: K2M and Medtronic; author 5: none; author 6: consultant: K2M.

P106

MORTALITY AND REVISION SURGERY FOLLOWING COMPLEX SPINE SURGERY: 2-YEAR FOLLOW-UP USING THE SPINE ADVERSE EVENT SEVERITY (SAVES) SYSTEM

Tanvir Johanning Bari, Sven Karstensen, Mathias Dahl Sørensen, Martin Gehrchen, John Street, Benny Dahl

Spine Unit, Department of Orthopedic Surgery, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark; Combined Neurosurgical and Orthopedic Spine Program, Vancouver General Hospital, University of British Columbia, Vancouver, British Columbia, Canada; Department of Orthopedics and Scoliosis Surgery, Texas Children's Hospital & Baylor College of Medicine, Houston, TX, USA

Introduction: Prospective registration of Adverse Events (AEs) most accurately reflects their true incidence. Their consequence, however, is incompletely understood. The aim of this study was to examine the effect of perioperative AEs on patient mortality and unplanned revision spine surgery.
Purpose of the study: To report the rates of revision surgery and mortality after complex spine surgery, and to investigate if prospectively registered AEs are associated to increased risks of revision or death.
Materials and methods: All patients undergoing complex spine surgery at a single tertiary center in 2013 were prospectively included. Perioperative AEs were registered using the Spine AdVerse Events Severity system. The Danish Nationwide Patient Registry was used to identify mortality and revision spine surgery at a minimum of two years following index surgery. Mortality and Revision rates were estimated using a Competing-Risk-model. Predictors were assessed using a proportional odds model and reported as odds ratios (OR) with 95% confidence intervals (CI).
Results: A total of 679 patients with a mean age of 52 years (± 21.8) were consecutively included and underwent complex spine surgery for traumatic, degenerative, oncological, infectious or deformity conditions. Aalen-Johansen estimates of mortality rates were 3% at 1 month (CI 1–4%), 7% at 3 months (CI 5–9%), 13% at one year (CI 10–16%) and 15% at two years (CI 12–18%). Unplanned revision surgery rates were 7% (CI 5–9%), 9% (CI 7–12%), 15% (CI 13–18%) and 19% (CI 16–22%) for the same time periods, following the primary procedure. Multivariate proportional odds analysis adjusted for age, sex, number of instrumented vertebra, diagnosis, length of stay and osteotomy showed significant increased odds of revision with the presence of a major intraoperative AE (OR 4.8, 95% CI 2.2–10.4, $P < 0.001$). Any major AE was associated with increased odds of mortality (OR 3.2, CI 1.6–6.3, $P < 0.001$).
Conclusion: In this single-center study, perioperative AEs were registered prospectively following complex spine surgery. We report the rates of revision surgery and mortality using a competing risk model with a minimum follow-up of 2 years. The risk of both revision and mortality were significantly increased when a major perioperative AE was recorded.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: grants/research support: K2M and Medtronic; author 5: none; author 6: consultant: K2M.

P107

RATES OF HOSPITAL-BASED, INTRA-OPERATIVE, AND SHORT-TERM COMPLICATIONS FOLLOWING THORACIC COSTOTRANSVERSECTOMY BASED ON UNDERLYING DIAGNOSIS

Ashraf El Naga, Richard Bransford, Eric Rebich, Celeste Tavolaro, Edward Jung, Haitao Zhou, David Gendelberg, Carlo Bellabarba

University of Washington, Orthopaedics and Sports Medicine, Seattle, USA

Background Context: Though several case series have described outcomes following posterior thoracic corpectomies via a costotransversectomy type approach (TCCA) for anterior vertebral body reconstruction, few have comprehensively reported hospital-based, intraoperative, and short-term post-operative complications based on underlying diagnosis.
Purpose: We seek to describe the rates of hospital-based, intraoperative, and 90-day post-operative complications in patients undergoing TCCA based on surgical indication.
Methods: A retrospective chart review of patients undergoing TCCA at a single academic referral center between April 2008 and April 2018 was conducted. Clinical data included patient age, surgical indication, and American Society of Anesthesia (ASA) score. Operative data included the corpectomy levels, nerve roots sacrificed, unilateral versus bilateral approaches, dural tears, and pleural injury. Outcome measures included 90-day mortality and 90-day re-operation as well as hospital-based complications. Categorical variables were compared with the Chi squared test or Fisher's exact test and continuous data were compared with ANOVA or independent samples t-test with statistical significance set at $p < 0.05$.
Results: We identified 123 patients undergoing TCCA: 35 for infection, 42 for malignancy, 25 for trauma, and 21 for deformity encompassing a total of 188 vertebral body levels. Overall complication rates are described in Table 1. Overall, 59(48.0%) patients have at least one complication with 22(17.9%) patients having 2 or more complications.
10 patients (8.5%) sustained iatrogenic dural tears. 8 (6.8%) patients sustained pleural injuries—5 were directly repaired and 3 were managed with a chest tube that was removed on post-operative days 2, 3, and 4. Patients with a diagnosis of malignancy had higher rates of pleural injuries (14.3% vs 2.5%, $p = 0.019$).

When compared to all others, patients with a diagnosis of infection were more likely to undergo 2 level corpectomies (80% vs 26.1%, $p < 0.0005$) and have worse preoperative ASA scores ($p = 0.024$). Patients with a diagnosis of malignancy had significant higher 90-day mortality (19.0% vs 4.9%. $p = 0.022$) and were more likely to undergo three level corpectomies (9.5% vs 3.7%, $p = 0.002$), undergo upper thoracic (T1-T4) corpectomies (37.9% vs 12.4%, $p = 0.001$), and require sacrifice of bilateral nerves (21.4% vs 4.9%, $p = 0.019$). 90-day re-operation rates, post-operative ventilator days, ICU stays, and hospital length of stays did not vary between the different groups ($p = 0.970$, 0.224, 0.350, and 0.094 respectively).
Conclusions: Close to half of patients undergoing costotransversectomy will have an unanticipated hospital-based complication not directly related to the procedure. Short term complications and outcomes may vary with the underlying patient diagnosis. This information can be helpful in pre-operative patient counseling regarding the risks associated with costotransversectomy.

TABLE. Overall complication rate.

Complication	# of Patients (%)
90-day mortality	12 (9.8)
90-day unanticipated surgery	19 (15.4)
Wound dehiscence/infection	16 (13)
Wound exploration	3 (2.4)
AKI	13 (10.6)
Atrial fibrillation/EKG changes	9 (9.3)
DVT/PE	7 (5.7)
Prolonged delirium	7 (5.7)
Resp failure, reintubation	6 (4.9)
Pleural effusion	5 (4.1)
Ileus	4 (3.3)
Pneumonia	4 (3.3)
Urinary tract infection	3 (2.4)
GI bleed	2 (1.6)
Ischemic optic neuropathy	1 (0.8)

Disclosures: author 1: none; author 2: other financial report: Globus; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P108

NEUROLOGIC CHANGES FOLLOWING POSTERIOR THORACIC CORPECTOMIES VIA A COSTOTRANSVERSECTOMY TYPE APPROACH

Ashraf El Naga, Richard Bransford, Celeste Tavolaro, Eric Rebich, Edward Jung, Haitao Zhou, David Gendelberg, Carlo Bellabarba

University of Washington, Department of Orthopaedics and Sports Medicine, Seattle, USA

Background: Iatrogenic cord injury is perhaps the most concerning risk associated with thoracic corpectomies via costotransversectomy approaches (TCCA). Few studies have comprehensively described the rates of post-operative motor score changes and associated intraoperative neuromonitoring changes.
Purpose: We seek to describe the rates and sequelae of changes to lower extremity motor score (LEMS) and neuromonitoring signal changes in patients undergoing TCCA.
Materials and methods: This is a retrospective chart review of 118 consecutive patients undergoing TCCA over a 10-year period with documented pre- and post-operative motor examinations conducted at a single academic referral center. Outcome measures included documented LEMS (out of 50) and intraoperative neuromonitoring changes. Data was retrospectively collected from operative notes, intraoperative neuromonitoring reports, and the post-operative inpatient and outpatient clinical notes. Preoperative LEMS greater than or equal to 48 were considered intact. Post-operative LEMS were categorized into improved, unchanged or lower as compared to the preoperative scores. Categorical data was assessed with the Fisher's Exact test. Significance was set at $p = 0.05$.
Results: Of the 118 patients, 68 were intact pre-operatively and 50 were not intact. 4% of non-intact patients demonstrated a declining post-operative examination as compared to 14.7% of intact patients ($p < 0.0005$). Overall, 106 patients (89.8%) demonstrated an unchanged or improved LEMS examination by discharge. 12 (10.1%) patients demonstrated a decline in LEMS by discharge. All 12 of these patients had intraoperative neuromonitoring with 9 demonstrating intraoperative neuromonitoring changes to sensory and/or motor evoked potentials: 5 at the time of the corpectomy, 3 with cage/graft placement, and 1 at the time of rod placement. One patient died of respiratory failure on post-operative day 5. By final follow-up, 8 of the remaining 11 patients returned to within 2 points of their preoperative LEMS. 3 of the 118 patients (2.5%) had sustained reductions in their LEMS of 16, 4 and 3 points at a mean follow up of 8 months.
Conclusions: Most patients undergoing TCCA procedures have unchanged or improved LEMS by discharge. Approximately 10% of patients had an initial decline in their LEMS with less than 3% of patients demonstrating lasting decline in neurologic status at final follow-up. Most neuromonitoring changes occurred at the time of corpectomy or graft/cage placement. This information can be valuable in counseling patients regarding the risk of neurologic outcome following TCCA.
Disclosures: author 1: none; author 2: other financial report: Globus; author 3: none; author 4: none; author 5: none; author 6: none; author 7: none; author 8: none.

P109

COMPLICATIONS OF LONG FIXATION TO SACRUM: ROLE OF ILIAC FIXATION

Khaled El-Youssef, Shahnawaz Haleem, Louis Boissiere, Guillaume Riouallon, Clement Silvestre, Vincent Fier, Georges Abi Lahoud, Yann Philippe Charles, Ibrahim Obeid

Clocheville Hospital, Tours, France

Objective: To determine the risk factors and complication rates after surgical correction of Adult Spinal Deformity (ASD) patients using Sacral (S1) or Iliac fixation.
Method: A retrospective review of prospectively collected data from six spinal centres performing adult deformity surgery on patients according to Schwab criteria.
Inclusion criteria were patients operated for adult spinal deformities (excluding neuromuscular, post infectious and tumours origins), Upper Instrumented Vertebrae (UIV) L2 or more cranially, Lower instrumented vertebrae (LIV) at S1 or Iliac fixation, and a minimum of 2 years follow up.

Patient demographics data, comorbidities, operation data, spinopelvic parameters and complications were analysed using univariate and multivariate analyses.
Results: A total of 435 ASD patients [348 female and 87 male patients (mean age 63 years)] were enrolled in this study.
No differences were seen in pain and disability scores pre-operatively and post-operatively, in operating time or length of stay. Insignificant increased estimated blood loss (EBL) ($p = 0.107$), a higher UIV and incidence of PJK was seen in the Iliac group (10% vs 3.7%, $p < 0.045$). The S1 group had increased failure of distal fixation (8.1% vs 3.7%, $p < 0.048$) and pseudarthrosis (8.15% vs 3.67%, $p < 0.048$).

Univariate analysis was performed to ascertain significant variables causing complications (Table 1). Significant variables at $P < 0.2$ on simple logistic regression analysis were analysed further..

Multivariate analysis of showed that EBL and PJK were not significantly correlated to pelvic fixation type however, previous spine surgery, fixation to the sacrum (without iliac extension) and 3 column osteotomy were predictive factors of complications. Odds ratio were 2.499, 0.370 and 2.025 respectively.
Conclusion: Analysis of risk factors and complication rates in long fixation in ASD showed that Iliac extension reduced the risk of reoperation by three fold compared to sacral fixation without adding

Table 1 Variables obtained at Univariate analysis

Variables	No complication	Complication	P-value
Age (SD)	63.27 (10.77)	61.27 (10.44)	0.083
BMI (SD)	25.21 (4.10)	26.14 (4.09)	0.076
Number of instrumented levels (SD)	10.61 (3.91)	11.57 (4.40)	0.028
PI first visit postop (SD)	56.50 (13.42)	59.63 (12.87)	0.034
SVA first visit postop (SD)	42.33 (85.31)	58.46 (123.25)	0.142
Prior spine surgery			
No	74.8%	25.2%	0.022
Yes	61.4%	38.6%	
Pelvic fixation			
S1	77.8%	22.2%	0.107
Iliac	70.3%	29.7%	
PSO			
No	75.2%	24.8%	0.005
Yes	58.8%	41.2%	

morbidity, while previous spine surgery and the addition of a 3 Column Osteotomy doubled complication rates.

Disclosures: author 1: none; author 2: none; author 3: grants/research support: Depuy Synthes, consultant: Spineart, Medicrea; author 4: grants/research support: medtronic, consultant: medtronic; author 5: consultant: KISCO SMAIO; author 6: consultant: Medicrea Clariance, royalties: Medicrea Clariance; author 7: none; author 8: grants/research support: Stryker, Clariance, consultant: Stryker, Clariance, Ceraver, royalties: Stryker, Clariance; author 9: grants/research support: depuy synthes, consultant: depuy synthes, Medtronic, royalties: Alphatec, Spineart, Clariance.

P110

DECREASED RATE OF SURGICAL SITE INFECTION AFTER SPINAL SURGERY WITH INSTRUMENTATION USING BUNDLED APPROACH INCLUDING SURVEILLANCE AND INTRA-WOUND VANCOMYCIN APPLICATION

Shunsuke Fujibayashi, Takashi Sono, Bungo Otsuki, Takayoshi Shimizu, Koichi Murata, Shuichi Matsuda

Dept of Orthopedic Surgery, Kyoto Univ, Japan

Introduction: Surgical site infections (SSIs) increase the risk of mortality post-surgery, extend hospital stay, and increase the costs of healthcare. Our aim in this study was to evaluate the effectiveness of a multidisciplinary, evidence-based, surveillance program combined with intra-wound application of vancomycin in lowering the incidence rate of SSI after spinal surgery with instrumentation.

Materials and methods: We conducted a retrospective analysis of 637 patients who underwent spinal fusion with instrumentation in our institution at 3 different time periods: prior to our surveillance program (control group), surveillance only (surveillance group 1), and surveillance combined with intra-wound vancomycin application (surveillance group 2). The following covariates were considered in the evaluation of between-group differences in SSI rate: sex, age, surgical site, National Nosocomial Infection Surveillance (NNIS) risk index, American Society of Anesthesiologists (ASA) physical status classification, and other health comorbidities. The causative organism in cases of SSI was confirmed in all cases.

Results: The rate of SSI was significantly lower in the surveillance group 2 (1.4%) than in the control group (4.6%; P = 0.04). On multivariate logistic regression analysis, steroid use (adjusted odd's ratio (OR), 6.06; 95% confidence interval (CI), 1.45–23.6) and operative time (adjusted OR 1.01; 95% CI 1.00–1.01) were identified as independent risk factors of SSI. Staphylococcus species and Propionibacterium acnes were the principal causative organisms. A bundled approach that includes surveillance and intra-wound application of vancomycin is an effective strategy to lower the risk of SSI after spinal fusion with instrumentation. The use of steroid and longer operative time are risk factors of SSI.

Conclusion and discussion: Our findings support the implementation of a program of surveillance, combined with intra-wound vancomycin application, to reduce the incidence rate of SSIs in spinal surgery with instrumentation.

Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none.

EPIDEMIOLOGY AND MEDICAL ECONOMICS

P111

THE INCIDENCE AND MANAGEMENT TRENDS OF METASTATIC SPINAL TUMORS IN SOUTH KOREA: A NATIONWIDE POPULATION-BASED STUDY

Dong Ryul Heo, Ja Wook Koo, Sung Hoon Choi, Chang-Nam Kang

Department of Orthopaedic Surgery, Hanyang University College of Medicine, Seoul, Korea

Background: The contemporary spinal surgeons are becoming increasingly aware of metastatic spinal tumors. However, variations still exist in the occurrence and management of patients for spinal metastases.

Purpose: This study aimed to examine the incidence of metastatic spinal tumors and trends in its management in South Korea.

Study design/setting: Population-based study/From 2008 to 2017, there were a total of 38,007 metastatic spinal tumor cases.

Methods: The national database 2008 to 2017 acquired from the Korean Health Insurance Review & Assessment Service (HIRA) was analyzed. The international disease category in the revised ICD-10 codes, medical behavior codes and examination codes, were used to identify metastatic spinal tumor patients.

Results: Metastatic spinal tumor was most common in patients in their 60 s (25.7%). The age-adjusted incidence of metastatic spinal tumor per 100,000 persons was 8.16 patients in 2008 and 6.18 patients in 2017 ($p = 0.03$). In 2008, the sex-adjusted incidence of males and females was 8.60 and 8.20 patients per 100,000 persons, respectively. However, In 2017, it was 8.70 and 4.15 patients, respectively ($p < 0.001$, $p = 0.04$). For the decade, the most common primary tumor site was lung (26.9%). In the treatment, radiation therapy decreased from 3502 to 3435 patients ($p = 0.62$). On the other hand, surgical therapy increased from 1158 to 1382 cases ($p < 0.001$). In particular, the debulking procedure and instrumentation have increased in surgical procedures ($p < 0.001$). Total medical healthcare costs were US$ 19,925,296 in 2008, and US$ 30,268,217 in 2017 ($p < 0.001$), revealing a continuous rise.

Conclusions: The ten-year incidence of spinal metastases per 100,000 persons was 6.68 patients in South Korea. The surgical procedure such as debulking procedures and instrumentation increased in terms of treatment. The total medical healthcare cost of metastatic spinal tumors is increasing rapidly.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: none.

P112

COMPARED TO PATIENTS PREOPERATIVE EXPECTATIONS, SURGEONS' PREOPERATIVE EXPECTATIONS MORE OFTEN CORRESPOND TO PATIENT-REPORTED FULFILLMENT OF EXPECTATIONS TWO YEARS AFTER LUMBAR SURGERY

Carol A. Mancuso, Roland Duculan, Frank P Cammisa, Andrew A Sama, Alexander P. Hughes, Darren R. Lebl, Federico P. Girardi

Department of Orthopedics, Hospital for Special Surgery, New York, NY, USA

Background: Patients and surgeons may not have the same preop expectations of lumbar surgery. Whose expectations more closely coincide with patient-reported fulfillment of expectations has implications for surgeon–patient communication.
Purpose: To determine if patient-reported fulfillment of expectations more closely matched patients' or surgeons' expectations.
Sample: 402 lumbar surgery patient-surgeon pairs.
Outcome: HSS Lumbar Spine Surgery Expectations Survey.
Methods: Using the valid 20-item Expectations Survey for symptoms, physical function, and mental well-being, patients of 5 spine surgeons preop rated how much improvement they expected for each item with response options of complete to no improvement; a total score was generated (range 0–100). Preop surgeons independently completed an identical Survey rating expected improvement for each patient for each item, yielding a similar 0–100 score. Two years later patients completed a postop survey to rate how much improvement they actually received for each item; options ranged from complete to no improvement. A „patient proportion"reflecting expectations fulfilled was calculated as improvement received (numerator) divided by improvement expected (denominator); range 0 (no improvement) to 1 (improved as expected) to > 1 (improved more than expected). A similar „surgeon proportion"was calculated using patient-reported improvement received (numerator) divided by surgeons' improvement expected (denominator). Patients' and surgeons' proportions were compared and assessed in multivariable analysis.
Results: Mean age was 55, 55% were men, 21% were non-white race/ethnicity. Patients completed the postop survey after 2.1 years; during this period 11% had a spine-related re-hospitalization. The mean proportion of expectations fulfilled was .79 $\pm$ .34 for patients and 1.01 $\pm$ .43 for surgeons ($p < .0001$). Using a 10% range around the proportion to represent equivalence (i.e. 90–1.10), 14% of patients had high, 26% equivalent, and 60% had low proportions of expectations fulfilled [reflecting a preop tendency to overestimate anticipated postop improvement], whereas 38% of surgeons had high, 30% equivalent, and 32% had low proportions [reflecting comparable estimations for postop improvement]. In multivariable analysis for both patients and surgeons, minority race/ethnicity, less improvement in back pain and disability, and subsequent spine-related re-hospitalization were associated with lower proportions; additionally for patients, less education, and for surgeons, more preop depressive symptoms, also were associated with lower proportions ($p < .05$ for all variables).
Conclusions: Compared to patients' preop expectations, surgeons' preop expectations more often corresponded to patient-reported fulfillment of expectations 2 years postop. These findings have potential implications for clinical practice including ensuring surgeons impart and patients acknowledge realistic expectations.
Disclosures: author 1: grants/research support: US Agency for Healthcare Research and Quality; author 2: none; author 3: grants/research support: Spinal Kinetics, Inc.; Ivy Healthcare Capital Partners, LLC; ISPH II, LLC; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Centinel Spine, Inc. (fka Raymedica, LLC); Beatrice & Samuel A. Seaver Foundation; 4WEB Medical; Woven Orthopedic Technologies; Depuy Synthes; Orthobond Corporation; Pfizer, Inc.; Paradigm Spine, LLC; 7D Surgical, Inc., consultant: Vertical Spine, LLC; 4WEB Medical, stock/shareholder: VBVP VI, LLC, royalties: NuVasive, Inc., other financial report: Spinal Kinetics, Inc.; Vertical Spine, LLC; Bonovo Orthopedics, Inc.; Viscogliosi Brothers, LLC; Liventa Bioscience (fka AF Cell Medical) Woven Orthopedic Technologies; Healthpoint Capital Partners, LP; Paradigm Spine, LLC; Tissue Differentiation Intelligence, LLC; author 4: grants/research support: AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution)AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution), consultant: DePuy Orthopaedics Inc, Ortho Development, Clariance Inc, 4WEB Inc, Kuros Biosciences AG, Sentio LLC, stock/shareholder: Paradigm Spine LLC, royalties: Ortho Development Corp, other financial report: Scientific Advisory Board – Clariance Inc, Strategic Advisory Board – Kuros Biosciences AG; author 5: grants/research support: 4WEB Medical; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Pfizer, Inc.; author 6: none; author 7: grants/research support: Aesculap (Paid to Institution); MiMedx Group Inc (Paid to Institution); Nuvasive, Inc. (Paid to Institution), consultant: Ortho Development Corp; SPINEART USA; Nuvasive, Inc; DePuy Synthes Spine; Lanx, Inc; EIT Emerging Implant Technologies, stock/shareholder: Healthpoint Capital Partners; Paradigm Spine, LLC; Centinel Spine, Inc.; Spinal Kinetics, Inc.; Liventa Bioscience, royalties: Lanx, Inc; DePuy Synthes Spine; Nuvasive, Inc; Ortho Development Corp.

P113

IMPROVEMENT IN MULTIPLE DOMAINS OF FUNCTIONAL STATUS WITH INCREASING PHYSICAL ACTIVITY AFTER LUMBAR SURGERY: LONGITUDINAL ANALYSIS

Carol A. Mancuso, Manuela C. Rigaud, Roland Duculan, Frank P. Cammisa, Andrew A. Sama, Alexander P. Hughes, Darren R. Lebl, Russel C. Huang, Harvinder S. Sandhu, Federico P. Girardi

Department of Orthopedic Surgery, Hospital for Special Surgery, New York, NY, USA

Background: Major goals of lumbar surgery are pain relief and safe and timely restoration of functional status with return to desired roles and responsibilities. In addition to increasing mobility, prudent physical activities, such as walking more in the near-term postop period, may facilitate return to functional status in diverse domains of daily life.
Purpose: To determine if increased physical activity after recuperation from lumbar surgery is associated with improvement in a composite measure of overall functional status.
Sample: 220 patients enrolled during routine 3-month postop visits, subsequently followed for an additional 4–6 months.
Outcome: RAND-12 composite score (subscales for daily activities, work and social roles, pain, and mental health).

Methods: At enrollment patients completed the RAND-12 (composite score = 50 for the general population) and the 3-domain Paffenbarger Physical Activity and Exercise Index (PAEI) measuring blocks walked, stairs climbed, and sports during the past week, yielding an overall total in Kcal/week. Patients also rated global change in pain since surgery on a 7-point scale. After 4–6 months patients again completed the RAND-12 and PAEI. OR records were reviewed and a Surgical Invasiveness Index value was calculated (maximum 10 points/vertebral level); higher is greater complexity. In multivariable analysis the dependent variable was change in RAND-12 scores, the main independent variable was change in overall PAEI Kcal/week, and analyses were controlled for covariates.
Results: Mean age was 64, 52% were men, 40% had major comorbidity. Mean time from surgery to enrollment was 2.9 months; since surgery 64% reported at lot of pain improvement, 25% moderate-little, 11% same-worse. Mean time from enrollment to follow-up was 4.2 months; at the follow-up patients reported improvement for both the RAND-12 and PAEI, with enrollment, follow-up and within-patient change mean scores for the RAND-12 of 37, 43, and 6 (paired ttest $p < .0001$), and for the PAEI of 1699, 3133, and 1434 kcal/week (paired ttest $p < .0001$). In multivariable analysis, more improvement in RAND-12 score was associated with greater increases in PAEI Kcal/week ($p = .003$), controlling for age, sex, comorbidity, pain, and surgical complexity. Change in PAEI blocks walked (880 kcal/week, paired ttest $p < .0001$) gave similar multivariable results ($p = .05$). In multivariable analysis, the RAND-12 subscales that most improved with increased physical activity were physical function ($p = .005$), role physical ($p < .0001$), social function ($p = .03$), pain ($p = .01$) and mental health ($p = .006$).
Conclusions: Improvement in physical activity, primarily walking more, was associated with improvement in diverse subscales of functional status. Our study showed that in addition to preserving mobility, increased physical activity in the near-term postop period is a gateway behavior with beneficial downstream effects on diverse domains of physical and mental health.
Disclosures: author 1: none; author 2: none; author 3: none; author 4: grants/research support: Spinal Kinetics, Inc.; Ivy Healthcare Capital Partners, LLC; ISPH II, LLC; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Centinel Spine, Inc. (fka Raymedica, LLC); Beatrice & Samuel A. Seaver Foundation; 4WEB Medical; Woven Orthopedic Technologies; Depuy Synthes; Orthobond Corporation; Pfizer, Inc.; Paradigm Spine, LLC; 7D Surgical, Inc., consultant: Vertical Spine, LLC; 4WEB Medical, stock/shareholder: VBVP VI, LLC, royalties: NuVasive, Inc., other financial report: Spinal Kinetics, Inc.; Vertical Spine, LLC; Bonovo Orthopedics, Inc.; Viscogliosi Brothers, LLC; Liventa Bioscience (fka AF Cell Medical) Woven Orthopedic Technologies; Healthpoint Capital Partners, LP; Paradigm Spine, LLC; Tissue Differentiation Intelligence, LLC; author 5: grants/research support: AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution)AO Spine North America, Spinal Kinetics, MiMedx Group Inc (all paid to institution), consultant: DePuy Orthopaedics Inc, Ortho Development, Clariance Inc, 4WEB Inc, Kuros Biosciences AG, Sentio LLC, stock/shareholder: Paradigm Spine LLC, royalties: Ortho Development Corp, other financial report: Scientific Advisory Board – Clariance Inc, Strategic Advisory Board – Kuros Biosciences AG; author 6: grants/research support: 4WEB Medical; NuVasive, Inc.; Mallinckrodt Pharmaceuticals; Pfizer, Inc.; author 7: none; author 8: none; author 9: consultant: biorestorative therapies, stock/shareholder: paradigm spine, spinewave, providence medical; author 10: grants/research support: Aesculap (Paid to Institution); MiMedx Group Inc (Paid to Institution); Nuvasive, Inc. (Paid to Institution), consultant: Ortho Development Corp; SPINEART USA; Nuvasive, Inc; DePuy Synthes Spine; Lanx, Inc; EIT Emerging Implant Technologies, stock/shareholder: Healthpoint Capital Partners; Paradigm Spine, LLC; Centinel Spine, Inc.; Spinal Kinetics, Inc.; Liventa Bioscience, royalties: Lanx, Inc; DePuy Synthes Spine; Nuvasive, Inc; Ortho Development Corp.

P114

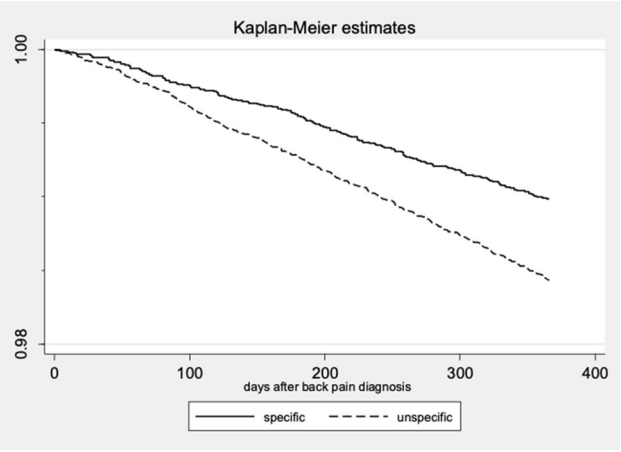
OCCURRENCE OF PSYCHIATRIC COMORBIDITY IN PATIENTS WITH UNSPECIFIC AND SPECIFIC BACK PAIN DIAGNOSES

Pernille Sanberg Ljungdalh [1], Olav Sivertsen Garvik [2], Elsebeth Stenager [3], Berit Sciøttz-Christensen [1], Bente Mertz Nørgård [2], Maria Iachina [2]

1) Spine Centre of Southern Denmark, Hospital Lillebaelt, Middelfart, Denmark and Department of Regional Health Research, University of Southern Denmark, Odense, Denmark; 2) Centre for Clinical Epidemiology, Odense University Hospital, and Research Unit of Clinical Epidemiology, University of Southern Denmark, Odense, Denmark; 3) Psychiatric Research Unit, Åbenrå, Department of Regional Health Research, University of Southern Denmark, Odense, Denmark

Background and Aim: Several studies have investigated the association between back pain and psychiatric comorbidity, suggesting that patients with back pain are more prone to psychiatric disorders compared to the background population. However, psychiatric comorbidity has to our knowledge not been investigated in patients with specific back pain with known anatomic or pathophysiological cause of symptoms, compared to patients with unspecific back pain with lack of specific cause.
The aim of this study was to estimate the association between specific and unspecific back pain disorders (BPD) and psychiatric comorbidity at a single center in Denmark. The hypothesis was that patients with unspecific BPD were more prone to having a psychiatric comorbidity compared to patients with specific BPD.
Design and methods: We investigated the association between BPD and psychiatric comorbidity one year after back pain diagnosis using population-based registry data. No patients in the study population had psychiatric diagnoses within a period of 5 years prior to their back pain diagnosis. The population was defined as all adult patients ($\geq$ 18 years of age) with a relevant BPD from the Spine Centre of Southern Denmark, a center with standardized coding practices of both specific and unspecific BPD. The data originated from the National Danish Patient Registry (DNPR). Outcome information on psychiatric diagnosis was retrieved from the National Danish Patient Registry - Psychiatry (NPD-Psych). The Central Civic Registry (CPR) allowed for linkage between registries.
Results: From 2010 to 2014 we identified 19,952 patients with unspecific BPD and 16,156 patients with specific BPD. Patients with unspecific BPD were more frequently under the age of 60 (unspecific 73.4%/specific 56.9%) and predominantly female (unspecific 59.8/specific 49.9%). The level of education, cohabitation with an adult and comorbidity were similar between the groups. Living with a child under the age of 25 was most frequent in patients with specific BPD (unspecific 67.5%/specific 56.9%).
Among patients with specific BPD 164 patients (1.00%) had psychiatric comorbidity. Among patients with unspecific BPD 312 patients (1.60%) had psychiatric comorbidity. The crude OR for psychiatric comorbidity in patients with unspecific BPD compared to patients with specific BPD was 1.55 (95% CI 1.28–1.87) and when adjusting for relevant confounders the OR was 1.35, (95% CI 1:10–1.65). Furthermore, the time to occurrence of psychiatric comorbidity in patients with unspecific BPD was shorter compared to patients with specific BPD.

Conclusions: Patients with unspecific BPD were more likely to develop psychiatric comorbidity compared to patients with specific BPD and received their psychiatric diagnosis earlier. Comparing psychiatric comorbidity in patients with BPD to psychiatric comorbidity in the background population on a national level would strengthen the results from this study.



Disclosures: author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none.

P115

THE COST OF ROUTINE RADIOGRAPHS, 6 WEEKS AFTER LUMBAR FUSION SURGERY

Ane Simony, Hanne Thomsen, Morten Vuust

Dept Radiology, Frederikshavn Hospital. Denmark; Center for Spine Surgery & Research, Lillebelt Hospital, Middlefart Denmark

Purpose: The purpose of this study was to examine the diagnostic value and calculate the cost of radiographs, 6 weeks after lumbar fusion surgery degenerative disease.

Material: 210 consecutive patients were examined with routine standing radiographs, 6 weeks after instrumented lumbar fusion surgery. All the patients had surgery with pedicle screw placement with fluoroscopic guidance, postoperative radiographs were obtained before the patients were discharged. A routine program required postoperative radiographs at 6 weeks and 12 months after surgery.

Methods: Patients age $\geq$ 18 years, treated with lumbar fusion surgery with pedicle screws from TH12-S1 where included in the study. All radiographs were examined independently by a radiologist and an orthopedic surgeon. The following parameters were evaluated: screw placement, implant failure, implant loosening and adjacent level kyphosis or fracture.

The cost of radiographs was calculated, by the direct cost of equipment and the indirect cost of the time spent by the radiologist to examine the radiographs.

Results: 210 patients had 6 weeks postoperative radiographs after lumbar spinal fusion surgery and 193 patients were eligible to participate; 108 females, mean age of 60.4 years, mean 5.6 pedicle screws per patient. 5/1012 pedicle screws were suboptimal placed, needing revisions in 2 cases and 8/1012 implant loosening which was revised in 2 cases. 1 patient had a proximal junctional fracture and was also revised. 57% of the patients with implant related failure were symptomatic at the time of follow-up. All 5 of the patients who were revised due to implant related failure had suffered from trauma by falling, had kyphosis present at the 6-week follow-up, or suffered from severe back pain at the time of radiographic examination.

The incidence of implant related failure was 0.79%, 2.5% of the patients were revised due to implant failure and backpain. The total cost diagnosing implant related failure were 1640 Euro/patient, the total cost for diagnosing screw loosening 4375 Euro/patient and 13.124 Euro/patient, to diagnose adjacent level fractures on routine 6 weeks radiographs.

Conclusion: The incidence of early implant failure, after lumbar spinal fusion surgery is a rare event; with 0.79% diagnosed with implant failure, 57% of the patients presented with symptoms related to their implant failure. Routinely radiographs after 6 weeks are not recommended to diagnose implant related failures in adult patients. Only patients who present with pain, kyphosis or previous trauma should be referred to radiographs, after a relevant clinical examination.

Disclosures: author 1: none; author 2: none; author 3: none.