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ABSTRACTS

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GEOMETRICAL RELATIONS BETWEEN THORACIC KYPHOSIS AND PELVIC PARAMETERS

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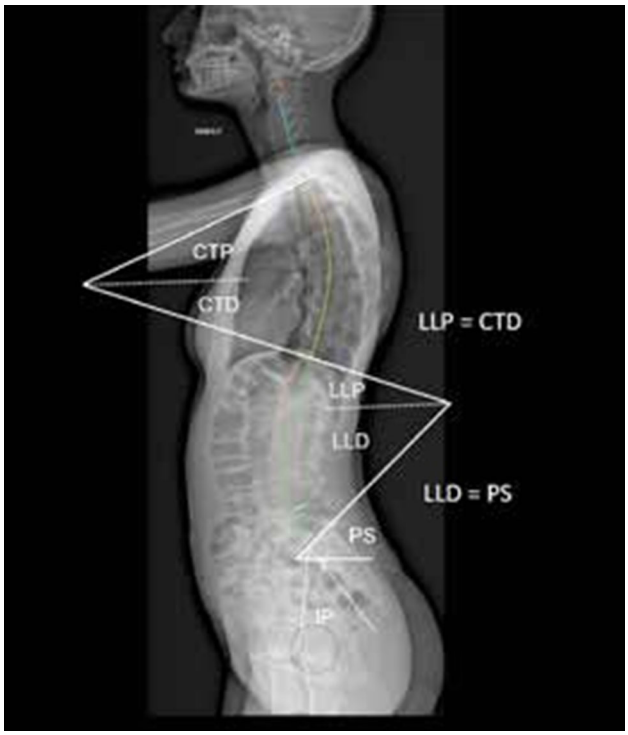
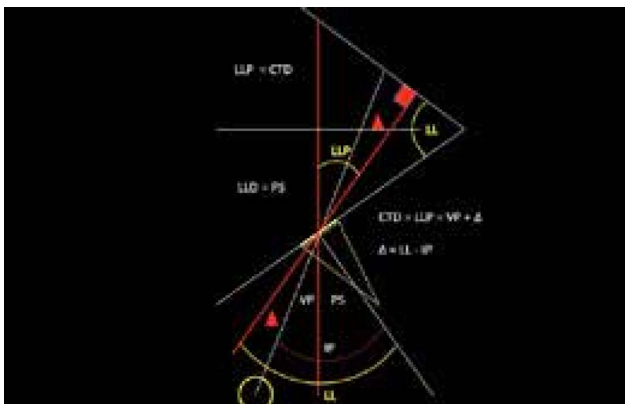
Introduction: In the case of surgical correction of thoracic deformations, it is important to assure the sagittal equilibrium of the spine, to obtain thoracic kyphosis (TK) adapted to the lumbar lordosis (LL) and to the pelvic incidence (PI). Today, we do not know the relationship linking the TK of an individual to his pelvic parameters. Even though, geometrically the distal thoracic kyphosis (DTK) is equal to the proximal lumbar lordosis (PLL) and the sum of the pelvic version (PV) and the difference separating the LL from the PI − PLL = DTC = PV + 810 + (Figs. 1 and 2) With the hypothesis of the PTC equalling the DTC in the case of a balanced spinal cord, we propose the equation CT = 2(VP + &#8710+) expressing the relation between the TK and the pelvic parameters. The aim of this work is to verify this relation in a normal adolescent population.

Materials and methods: We have analysed 100 EOS radiographies of the entire rachis, standing and in profile, of adults and adolescents, healthy and young between 13.7 and 20 years old. We have measured the pelvic parameters, the global lumbar lordosis and its two proximal and distal components (DLL), the global thoracic kyphosis and the two PTK and DTK components of the sagittal level. We have compared the measured global theoretical TK calculated with the formula CT = 2(VP + &#8710+).

Results: The difference between the measured TK and the calculated TK was on the average + 3.5° ($p < 0.001$). This difference was strongly correlated to the sagittal lodge ($r > 0.75$). The average value of &#8710+ was 10°. DTK being geometrically equal to VP + &#8710+, the measured PTK was actually higher (3.5°) compared to the calculated PTK.

Conclusion: This work validates the formula CT = 2(VP + &#8710+). This allows to calculate, with a variation of 3.5°, the global thoracic kyphosis of an individual in static position on a rachis in equilibrium taking into account the pelvic version and the difference between the lumbar lordosis and the pelvic incidence. It is demonstrated geometrically. It is currently used for the bending of the tailor-made rods for surgical correction of idiopathic scoliosis of adolescents.





COMPARISON OF MUSCULAR CHARACTERISTICS OF ADULT SUBJECTS WITH LUMBAR SCOLIOSIS

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Introduction: The muscles are a major factor in the postural regulation during the pathological evolution or ageing. More specifically, the spinal-pelvic muscles can be used for compensating mechanisms such as the pelvic retroversion, bending of the knee, cervical

compensation or thoracic compensation. In order to improve our understanding of compensating mechanisms, this study aims to compare, in a first step, the volume of the spinal-pelvic muscles of patients suffering from SA with a control group of well aligned subjects.
Materials and methods: 28 patients with lumbar TSA (Cobb angle $> 20°$, > 40 years, primary cases) have been included. They have been compared to two control groups without deformation of the spinal column coming from previous studies—one group of young subjects (n = 23, < 20 years) and a group of old subjects (n = 11, > 40 years). All subjects had an MRI (Dixon method, from C7 to knee). With the help of a validated dedicated software, volumetric 3D reconstructions of the 30 spinal-pelvic muscles have been realised. The muscular volumes of the two groups have been compared.
Results: Average age was 60 ± 16 ans, 71% women, average IMC 26 ± 4 kg m^2 without significant differences between the SA and the older groups (57 ± 11 years). The age and IMC were lower for the younger group ($19 + 1$ years). Average Cobb angle of the SA group was $45° \pm 11°$: The total muscular volume was similar comparing the SA to control groups of older age, erector spinae muscles (0.24 ± 0.06 vs. 0.68 ± 0.08 dm^3, $p = 0.001$), psoas (0.49 ± 0.09 vs. 0.60 dm^3, $p = 0.001$), obliques (0.42 ± 0.08 vs. 0.50 ± 0.08 dm^3, $p = 0.02$) were significantly smaller in the SA group. Comparing the young group with the SA the total muscular volume was higher for the young group ($+ 3.3$ dm^3) and erector spinae (0.24 ± 0.06 vs. 0.74 ± 0.08, $p = 0.0001$), average gluteus medius (0.51 ± 0.07 vs. 0.62 ± 0.13, $p = 0.01$), lateral depths (1.33 ± 0.21 vs. 2.08 ± 0.29, $p = 0.001$) were significantly higher for the young group.
Conclusion: This is the first study comparing the spinal-pelvic muscular volume of patients with SA and a control group without deformation. The results show a muscular degeneracy of double origins—ageing and deformation. The erector spinae, in particular, are clearly affected.

EVALUATION OF THE DISTRIBUTION OF LUMBAR LORDOSIS OF ASYMPTOMATIC PATIENTS

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Introduction: Berthonnaud has described the lumbar lordosis LL by defining two arches of tangent circles—the inferior arch of the plateau S1 at the apex and the superior arch of the apex at the point of inflexion between lordosis and kyphosis. This description differs from the anatomical definition using the L1–S1 angle. The variability of the sacral slope SS and the pelvic incidence PI in the population explains the morphological differences of LL of the five types of spines described by Roussouly. The aim of the study is to establish and define a ratio between the superior arch SA and the inferior arch IA of the lordosis for each type of spine in an asymptomatic population.
Materials and methods: 373 voluntary healthy adults had their rachis radiographed entirely in profile, the pelvic parameters, global LL, localisation of the inflexion point and the Roussouly type have been measured. As the IA equals SS, the SA identified by the formula SA equals LL minus IA equals LL minus SS. The ratio of the lumbar lordosis RA SA on IA was calculated for each back type.
Results: SA was stable for each back type at 20° PI, SS an LL were 40°, 30° and 51° for types $1 + 41$, 30 et 48 For types $2° + 45°$, 39° and 60°, for types anteverted $3° + 56°$, 40° and 60°, for types $3° + 62°$, 49° and 70°, for types 4. IA increased with PI. The ratio was 0.52 for the entire analysed population 0.76 for types $1 + 0.6$ for types 2 + types 3 anteverted + 0.49 for types 3 and 0.41 for types 4.
Conclusion: This study shows the inverse proportionality between the PI and RL concerning asymptomatic subjects. With a constant SA, the LL depends on the SS an thus LL equals SS plus 20°. This distribution of angles of the lumbar lordosis is fundamental and confirms that the surgical reconstitution of the lordosis must be concentrated on the distal part of the lumbar segment of the SS in correspondence to PI. This study shows normal values for LR by spine type. Planning the arthrodesis must take into account this new ratio to restore the adapted curves of the rachis.

NEW CLASSIFICATION OF CORONAL DISEQUILIBRIUM OF SPINAL DEFORMATION AFFECTING ADULTS: VALIDATION STUDY

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Introduction: As for the sagittal disequilibrium SD the coronal disequilibrium CD can be the source of a handicap and can affect the quality of life. The CD has not been studied as much as the SD, even though it absolutely primordial to take it into account for the surgical strategy of spinal deformations SPD. A recently published coronal classification allows to evaluate the CD (Obeid-CM) according to the side of the disequilibrium in comparison to the main curvature (concave or convex), the rigidity of the curvatures and the degeneration of the lumbar-sacral pivot. The aim of this study is to validate this classification in a inter- and intra-observer reproducibility study.
Materials and methods: 15 readers from 14 international centres have classified 28 cases with CD (C7-CVSL > 20 mm) based on the Obeid-CM classification using radiography of the entire spinal cord, frontal and in profile. The classification has been realised twice within an interval of 2 weeks and in a different order for each reader. The inter- and intra-observer reproducibility has been calculated using the kappa coefficient from Cohen and Fleiss.
Results: The inter-individual reproducibility is 0.91 for the main curvature, 0.75 for sub-types with 1 category and 0.52 for sub-types with 2 categories. The intra-observer reproducibility is 0.95, 0.86 and 0.73 respectively. No intra-observer difference has been observed for the 4 readers having participated in the description of the classification and other readers.
Conclusion: The reproducibility of the Obeid-CM classification seems to be satisfying and can be co pared to other validated classifications of spinal deformations. The reproducibility is identical for surgeons who are not experts for spinal deformations showing the ease of use. The comprehension and use of this classification should allow to better apprehend the CD concerning spinal deformation, guiding the surgical strategy.

ANALYSIS OF C2 POSITION OF ADULT PATIENTS WITH LUMBAR SCOLIOSIS

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Introduction: Numerous parameters exist in literature to measure the global alignment on C7 or T1. A common limit of these parameter is the fact that they do not take into account the cervical segment which is of highest importance for compensatory mechanisms of the spinal cord and the preservation of the horizontal view. A recent stereographical analysis of asymptomatic subjects has introduced a new 3D (OD-HA) parameter defined as the angle between the vertical reference line and the line joining the summit of the odontoid (OD) at the center of the hip axis. This study aims to analyse the 3D alignment of patients suffering from SA with and without extreme OD-HA value.
Materials and methods: Study of the prospective cohort. 90 patients suffering from lumbar scoliosis (Cobb $> 20°$) were included. All subjects have received a low dose bi-planar radiography with 3D reconstruction of the spinal cord. Based on normative OD-HA values published, we have defined an abnormally high value as average ODHA of the asymptomatic subject +2SD (i.e. OD-HA $> 6.1°$). The 3D radiographic parameters and the ODI of patients with OD-HA $> 6.1°$ (high) or $< 6.1°$ have been compared.
Results: The average OD-HA was $5° \pm 3.6°$ (0.4°–18.6°). 22 patients had an abnormally high OD-HA. They were older than the other patients ($68 + 9$ years vs. $53 + 14$ years, $p = 0.001$) without any significant difference for the sex and IMC. The rate of the rotary dislocation was not different (54% vs. 62%, $p = 0.06$). However, the coronal and sagittal deformation was more important for patients with an elevated OD-HA—higher Cobb angle, coronal disequilibrium, pelvic retroversion and inferior lumbar lordosis (table). Patients with a higher OD-HA showed a significantly worse ODI (50 ± 23 vs. 30 ± 18, $p = 0.0005$).
Conclusion: No negative ODHA due to cervical compensation has been observed to maintain the head above the pelvis and never behind. Patients with an abnormally high OD-HA were older and had worse functional results and a more important sagittal misalignment, even after activation of all compensatory spinal-pelvic mechanisms. An analysis of the entire body would be interesting to evaluate the recruitment of inferior members of patients showing extreme OD-HA values.

	ODHA élevé (n=22)		Cohorte (n=68)		p
	Moyenne	DS	Moyenne	DS	
Angle de Cobb (°)	44	17	37	14	0.06
CC7PL (mm)	28	24	18	14	0.03
Incidence pelvienne (°)	56	11	54	13	0.41
Version pelvienne (°)	25	10	18	11	0.004
Pente sacrée (°)	31	10	36	10	0.04
L1S1 (°)	39	19	52	17	0.003
T1T12 (°)	45	24	41	16	0.38
C3C7 (°)	23	19	11	16	0.008
IP-LL (°)	16	15	1	17	0.0004
GST9 (°)	-13.5	7.7	-11.9	4.5	0.24
GST1 (°)	2.3	9.3	2.2	4.0	0.96
SVA (mm)	70	71	20	32	0.000

EVALUATION OF THE PROXIMAL ARCHING OF THE ROD CONCERNING SCHEUERMANN DISEASE: POTENTIAL PJK RISK FACTOR

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Introduction: The correction of kyphosis in case of Scheuermann disease (SD) can be realised by posterior instrumentation associated to multiple Ponte osteotomies. However, the risk to develop a proximal functional syndrome PJS is an important problem. The aim was to evaluate the proximal arch of the rod in radiographic results of patients with MS after correction of their kyphosis.
Materials and methods: Retrospective, monocentric study. This analysis included 59 patients with MS (57 men and 2 women) having received posterior corrective surgery between 2002 and 2015, with a minimum of 12 months of controls. The «Proximal Contouring Rod Angle» (PCRA) is the angle between the superior plateau of the superior instrumented vertebrae SIV and the inferior plateau of the second caudal vertebrae UIV (UIV-2). A PJK was defined by presence of a regional proximal kyphosis angle PJA over 10° and increase of this angle by over 10°. The patients have been separated in two groups, PJK and non-PJK. Comparisons have been realised with a control group T Student. An analysis of the ROC curvature and an analysis of logistic regression have been realised.
Results: The average age was between 20.024 years ± 9.4 (average control, period 16.3 months ± 8.3). No significant difference has been identified between the groups concerning their age, PJA and PCRA during pre-operative time. 31.7% of the Patients had developed a PJK, average value of PJA was 19.21! ± 4.6 in the PJK group and, $76° \pm 3.72$ in the non-PJK group ($p < 0.0001$). A significant difference of the PCRA value has been observed post-operative between the PJK group and the non-PJK group ($9.52° \pm 5.34°$ and $14.33° \pm 6.6°$, respectively $+ p = 0.008$). A PRCA under 10.05° signals a significant risk for PJK (Se = 80%, Sp = 73.7% $+ p =$ 0.023, OR 1.143, CI 1.019–1.283).
Conclusion: Patients with a PCRA angle under 10° after surgery do not present a risk to develop PJK. Insufficient arching of the proximal part of the rod is a PJK risk factor. Proximal part of the rod must be bend in order to respect local kyphosis.

FACTORS INFLUENCING SATISFACTION AFTER SURGERY OF ADULTS WITH SPINAL DEFORMATION ASD

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Introduction: The postoperative satisfaction is the main aim to achieve in any surgical operation, for functional surgery and ASD. The literature concerning this topic is not exhaustive and satisfaction seems to depend on several factors. The aim of this study is to identify independent clinical and radiologic parameters correlated to post-operative satisfaction with a 2 year set back.
Materials and methods: Retrospective evaluation of a prospectively filled data base of consecutive patients operated for ASD The

demographic parameters, complications, life quality scores and radiologic parameters have been correlated to post-operative satisfaction in the questionnaire SRS-22 with 2 year set back. Significantly correlated parameters for low satisfaction (SRS-22 < 4.0) were used for construction of two multi-varied models—one model with independent factors correlated to low satisfaction and a model with variation of parameters in relation to post operative (parameter 2 years—parameter post-operative).
Results: 442 patients have been included. Most life quality scores, coronal parameters and sagittal parameters have been improved in the 2 post-operative years. Satisfaction is mostly linked to the self-image after 2 years and moderately to prolonged upright position, pain and physical activity after 2 years. Paradoxically, correlation with demographic and radiographic parameters is weak. After multi-varied analysis, 4 parameters are independently correlated to a low satisfaction—upright position standing of ODI > 2 points, pain ODI > 2 points, SRS-22 self-image < 3 points and SVA > 5 cm. As for the preceding model, an improvement of < 30% of the standing position, < 50% of pain, < 5β% of self-image and a superior SVA in post-operative time are associated to low satisfaction.
Conclusion: 4 parameters allow to explain post-operative satisfaction. Improvement of these 4 parameters is primordial for the result of surgery and a lack of improvement of these parameters is independently correlated to surgical failure. The data are determined to better understand the surgical decision, even more so as radiographic criteria are not a big part of this work.

DEGENERATION OF ERECTOR SPINAE REDUCES THORACIC COMPENSATION OF ADULT PATIENTS SUFFERING FROM DEGENERATIVE RACHIS DEFORMATION

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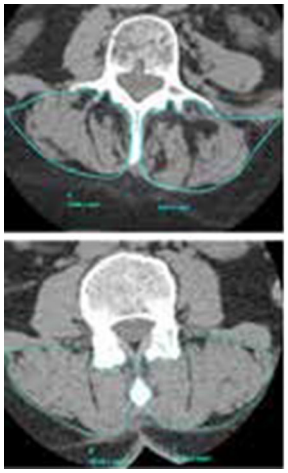
Introduction: Concerning deformation (adults), compensation by levelling of thoracic kyphosis has been well described as the most common for younger patients, compared to older patients. This was explained by a qualitative difference of erector spinae (ES). This study aims to investigate the link between muscular degeneration and thoracic compensation.
Materials and methods: Adult patients suffering from spinal deformation with PI-LL modified + or ++, no antecedent of thoracic arthrodesis and preoperative TDM have been included. Muscle analysis has been realised in T2, T10 and L3 (3 axial cuts per level) evaluating muscle surface of ES and fat infiltration, defined in Hounsfield units between − 190 and 0.) The max fat infiltration (MaxFat) has been identified as taking the level with the highest fat infiltration. After a Pearson correlation, 2 groups have been created—high infiltration HiFat and low infiltration LFat based on a threshold of 35% MaxFat. Demographic and radiographic parameters including thoracic kyphosis T4T12 and pelvic version PV have been compared in the two groups.
Results: 57 patients include (61 years, 5% women, IMC 28) of which 26% had a pre-existing lumbar arthrodesis. The sagittal alignment was severely altered with 90% PT modified at 75% SVA modified + or ++ T4T12 was significantly correlated to Fat 8r > 0.45 for all planes), MaxFat (r = 0.47) and muscle surface at T10 (r = 0.341). PT was significantly correlated to MaxFat (r = 0.333) and Fat, but only at T10 (r = 0.341). After creation of two groups, 31 patients were HFat and 25 LFat. HFat patients were older (64.2 vs. 56.3, $p = 0.047$), with a higher IMC (30.1 vs. 25, $p = 0.002$) in comparison two LFat+ No significant difference in sex or antecedents of lumbar fusion. HFat had a TPA (30.7° vs. 23.7°), T4T12 (− 34.6° vs. − 22.9°) et PT(30.1° vs. 25.2°) higher than LFat patients, without a difference in lumbar sagittal alignment.
Conclusion: Patients with ES degeneration used less thoracic compensation despite a similar lumbar sagittal alignment, they were forced to compensate in a more important way with pelvic retroversion with possible impact on walking.



Erector Spinae & Multifidus

Fat infiltration:

T2:	34.9% ± 15
T10:	30% ± 19
L3:	37.6% ± 18
MaxFat:	38.7% ± 18

Cross Sectional Area:

T2:	1332 mm² ± 271
T10:	1910 mm² ± 608
L3:	3915 mm² ± 1083

EVALUATION OF PRE-OPERATIVE PARAMETERS INFLUENCING THE RADIOLOGIC CORRECTION OF ADULT'S SPINAL DEFORMATION

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Introduction: Adult rachis deformation represents a surgical challenge with even more patients not completely corrected after operation and high rates of medico-surgical complications. The understanding of the sagittal equilibrium has shown the importance to realise an adequate surgical plan, specific for each patient and the recent development of spinal rods that are patient-specific PSR improving the transposition of the plan to the operation. The aim of this study is to analyse the radiologic results in 1 year after operation, using patient specific instrumentation and factors influencing these results.
Materials and methods: Adults having been surgically treated for spinal deformation with patient-specific rods in our center in 2014 and with a set back of 1 year have been included in this work. The radiologic parameters were compared in pre-operative until the last control, followed by a test T Student in combination with a Pearson correlation test.
Results: A total of 97 patients of 103 were included (average age 58, 72% women). On the average, 12 planes have been instrumented with

6 mm diameter rods (53.6% titanium and 46.4% CoCr). 79.4% of the patients were instrumented down to the pelvis and a transpedicular osteotomy was realised on 18.5% of the patients. The difference between PI-LL and SVA was significantly improved on last check ($p < 0.0001$). Age, PV, preoperative, PI-LL difference, SVA and TPA were significantly correlated to SVA at PI-LL and postoperative PT.

Conclusion: The PSR allows a satisfactory correction of SVA and PI-LL. Correlations of postoperative results with age, pre-operative SVA, VP, PI-LL and TPA confirm the importance to realise a pre-operative surgery plan integrating these parameters. The PSR are a promising tool for surgical correction of ASD in order to transpose best the plan to a postoperative reality.

	SVA (CM)		PI-LL (°)		PT (°)	
Preoperative	63.9±69.8		19.4±20.9		26.2±12.2	
Last follow-up	38.0±48.1		9.3±15.2		25.2±10.7	
p value	<0.0001		<0.0001		0.137	
Pearson correlation with postop values	r	p value	r	p value	r	p value
Age	0.41	<0.001	0.51	<0.001	0.63	<0.001
BMI	0.14	0.12	0.16	0.08	0.2	0.054
Preop SVA	0.57	<0.001	0.46	<0.001	0.34	0.0004
Preop PI-LL	0.55	<0.001	0.75	<0.001	0.67	<0.001
Preop PT	0.42	<0.001	0.67	<0.001	0.85	<0.001
Preop TPA	0.56	<0.001	0.65	<0.001	0.71	<0.001

OPTIMAL POST-OPERATIVE CORRECTION OF PATIENTS SUFFERING FROM SPINAL DEFORMATION BY RESTORATION OF DISTAL LUMBAR LORDOSIS

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Introduction: Different studies have shown the importance of a specific correction of lumbar lordosis of patients operated because of an adult spinal deformation, instead of a simple global lordosis adapted to the pelvic incidence PI. Te aim of the study was to evaluate the distribution of lumbar lordosis in relation to pelvic incidence and its influence on postoperative sagittal alignment.

Materials and methods: Patients suffering from a sagittal disequilibrium have been surgically treated by posterior arthrdesis using rods. These rods were patient-specific, right down to the pelvis and with a period of 1 year after operation these patients were included in this study. A stratification was realised based on the relation of pelvic lumbar lordosis IP-LL on the last check (aligned—&#8804+ 10° badly lined-> 10°). The lumbar lordosis LL has been measured between L1 And S1+, proximal lumbar lordosis PLL between L1 and L4+ and distal lumbar lordosis DLL between L4 and S1. Radiologic parameters were compared between the two groups using a test T Student.

Results: 77 patients of an initial group of 103 patients were included—35 patients "aligned" and 42 patients "badly aligned": The global LL in the aligned and badly aligned groups Were clearly different (50° vs. 38°, $+p < 0.001$) with a quite similar PLL (18° vs. 16°, $p < 0.05$). However, the DLL showed important modifications (31° vs. 22° $p < 0.001$). The lacking lordosis required for badly aligned Patients was more distal. The badly aligned patients needed more of a postoperative lordosis with a significantly higher PI (61! Vs. 52!, $p < 0.001$).

Conclusion: Understanding the relative contribution of each parameter is important for an appropriate and specific correction of each patient. An appropriate distal lordosis directly impact on the post-operative sagittal alignment status for surgical treatment of adult spine deformation. Patients with higher PI need more correction of L4–S1 segment, representing up to 2, 3 of their global lordosis. The restitution of the DLL must be taken into account, via low osteotomy (L4 or L5) or a first anterior approach.

	Postop PI-LL aligned	Postop PI-LL aligned	P value
LL	50°	38°	<0.001
PLL	18° (36%)	16° (37%)	0.4
DLL	31° (65%)	22° (63%)	0.003
PI-LL	2.3	22.8	<0.001
SVA	27mm	70mm	<0.001
PT	23°	32°	<0.001

SHAPE OF FUSIONED RACHIS IS ASSOCIATED TO SEVERE PJK CONCERNING ADULT DEFORMATION OF THE SPINE: A PRAGMATIC STUDY BASED ON VERTEBRAL-PELVIC ANGLES

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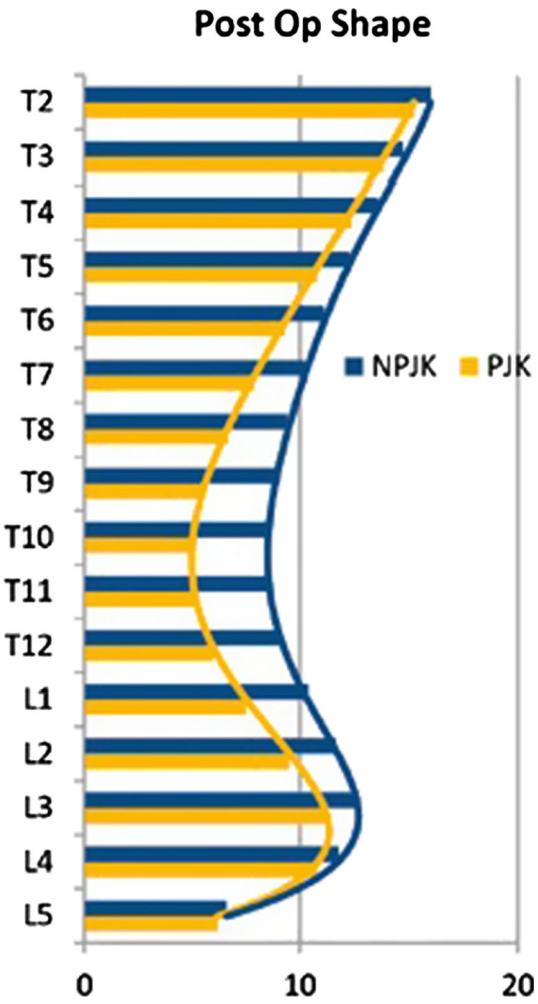
Introduction: The description of the sagittal alignment needs numerous parameters. The description of the complexity of the rachis shape is not always possible, this concerns also modifications during surgery. This study aims to describe the shape of the rachis in the context of arthrdesis T10-pelvis with a detailed approach exploring the application in the context of PJK.

Materials and methods: Adults suffering from a deformation treated with arthrodesis T10-pelvis have been included. The rachis shape has been modelised using successive vertebral-pelvic angles VPA-shape and were compared to the real shape of the rachis. Radiographic parameters including the VPA-shape of patients developing a severe PJK (Glattes criteria) (PJK) were compared with patients without PJK (NoPJK) A logistic regression allows to identify the independent PJK predictors amongst the VPA-shape components.

Results: 287 patients included (65 years + 72.4%F). VPA-shape was representative of the real alignment with an average error point-to-point of 1.2% à 2.5% and a length of the rachis between T10 and S1. At 6S the 102 patients with PJK (35.5%) had a smaller PI-LL (-2.3 ± 11.5 vs. 3.9 ± 12 $p = 0.000$) no difference in global alignment (SVA) or segementary lumbar alignment (Cobb between each vertebrae) but for VPA-shape the rachis was more towards the back between L3 and T7 (all VPA $p < 0.001$). The comparison of the difference of the VPA-shape curvatures of PJK patients vc non-PJK

patients has shown a similar progression of S1 and L4 being placed more in posterior than L3 to T11, and more anterior under T11, reflecting PJK. The logistic regression has shown that PI, L3PA (PJK = 11.2° vs. noPJK = 12.7°, $p = 0.047$), et T11PA (PJK = 5.1° vs. noPJK = 8.6°, $p = 0.047$) were the best independent PJK predictors and were sufficient for a prediction of the other PA (of L5 to T11, all r2 > 0.8), with a point-to-point error of alignment with the real rachis of 3.0% of the length between T10 and S1.

Conclusion: The VPa-shape allows a reproduction of the real form of the rachis, being independent from patient position, L§PA, T11PA and PI could be used for pre-op planing and pre-op reconciliation of T! = -pelvis arthrodesis.



PARTIAL TRANSPEDICULAR OSTEOTOMY OF L5 IN THE CASE OF STRONG PELVIC INCIDENTS, NEW TECHNIQUE OF RE-LORDOSIS DESCRIPTION AND FIRST RESULTS

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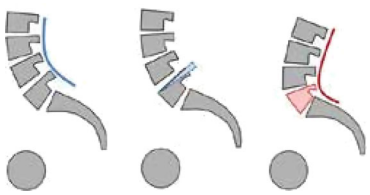
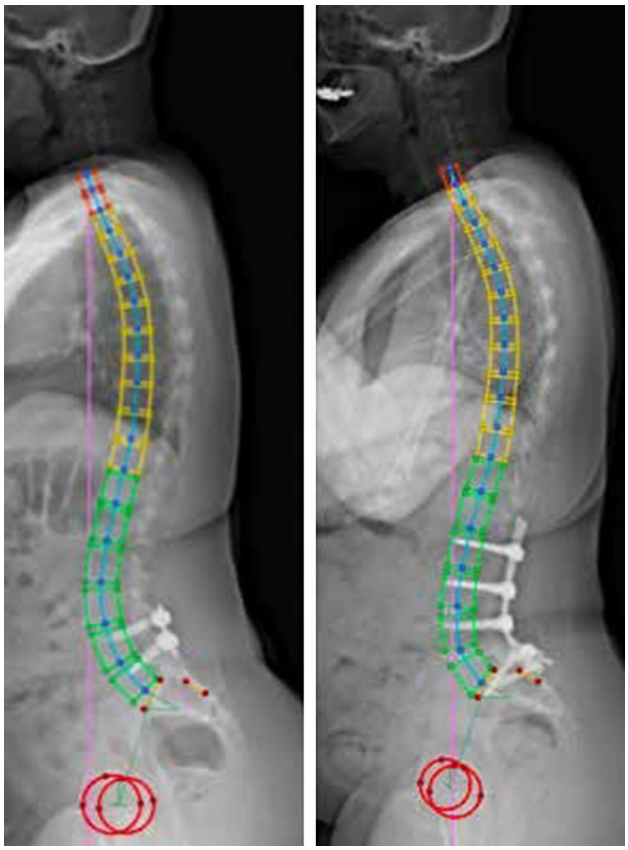
Introduction: Numerous corrective osteotomy techniques have been reported in lumbar surgery. Due to mechanical difficulties and reputation of higher neurological risk, L5 PSO was poorly used and described. Until now, there was no reported specific method of PSO in L5 in order to manage the shape of the lordosis with respect of local anatomy. The aim of this study was to describe a new minimal PSO technique in L5 in order to manage lordosis in high pelvic incidence patients + and to report on the clinical and radiological outcomes.

Materials and methods: The posterior arch of L5 is partially removed in front of the top of each pedicle. The spinous process of L4 and L5 are first removed. Then we perform a L4–L5 total bilateral arthrectomy in order to open the foramens. The transverse processes are separated from the pedicle at their basis. The inter-laminar space is open removing the ligamentum flavum. The upper laminar part of the target vertebra and the lower laminar part of the proximal vertebra are removed. The pedicle is identified by its medial side in the canal, the dura and the L5 root are gently retracted. Subsequently, the upper half of the pedicle is removed using an osteotome. The lower part remains and the L5S1 foramens remain intact. The vertebra is weakened by crushing the cancellous bone inside the vertebral body in the axis of the pedicle. The anterior cortex of L5 must be respected to avoid vascular tear anteriorly. If necessary, the L4–L5 disc is removed to give more flexibility and to prevent nonunion.

Results: The contouring of the rod is one of the key to close the osteotomy and to give an adequate shape to the lordosis. It should be very acute in the distal arch between L4 and S1 according to the SS value. The upper arch of the lordosis needs to be more progressive to be accorded to the kyphosis above (Fig. 2). One 5.5 mm titanium rod on each side are used. We use a lateral charging screwing system (Colorado, Medtronic). The system is tightened from the sacrum to the top. The osteotomy is closed using the progressive tightening of the screws and the compression between L4 screws and the sacral fixation. The exiting nerve root needs to be controlled in the foramens at the end during the closure. A lateral fluoroscopic view is used to control the given shape of the lordosis and the foramens.

Conclusion: L5 partial Pedicle Subtraction Osteotomy is considered to be a safe and reliable technique for patients with fixed sagittal imbalance. It's a new way to manage the shape of the lordosis in high pelvic incidence patients according to the Roussouly's classification.





	Pre-Op L5 PSO	Post-Op L5 PSO
PI	77	77
PT	17	18
SS	60	59
TK	37	40
Total LL	75	75
L4-S1 LL (% total LL)	44 (=59%)	58 (=77%)
SVA	59mm	36mm
Barrey ratio	172%	96%
Apex	L2-L3 disc	L3-L4 disc
Inflexion point	T11-T12	T11-T12
Roussouly	Unbalanced Type 4	Balanced Type 4

CORRECTION OF ADULT SPINE DEFORMATION BY BIPOLAR MICRO-INVASIVE ASSEMBLY WITHOUT PROSTHESIS: RESULTS AFTER 3 YEARS OF EXPERIENCE

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Introduction: Bipolar micro-invasive assemblies without prosthesis for adult deformation aim to reduce the ratio of complications. A preliminary study concerning 38 patients had given very early results for this technique. The aim of this new presentation is to report the complications ratio linked to this technology.

Materials and methods: A prospective monocentric study including patients showing an extended arthrodesis indication in the thoracic region above the pelvis. A bipolar micro-invasive assembly was realised associated two pediculolamair clamps on top and two ilio-sacral screws below, the assembly was reinforced by two big rods in CoCr of 5.5 diameter. Technical adaptations have been made over time—modification of pelvic fixation and assembly with 4 rods. A descriptive analysis of the test group has been realised and an analysis of each complication and surgical rework. Complications were classified in three groups—neurological, infectious and mechanical.

Results: 69 patients of an average age of 45 years (15–83) were included for a period of 39 months. The series was composed of cerebral palsy IMOC, 32 idiopathic scoliosis, 4 degenerative scoliosis and 6 deformations in the context of Parkinson disease. Angle of main curvature was on the average 62°. No medical complication has been identified. 13 patients have been operated again, 4 of them 2 times, this 31 follow up operations in a period of 23 months (1–39)—11 for sepsis and 20 for mechanical complications. The ratio of follow up operations for sepsis were, respectively, 26% and 7% in the IMOC sub-group and other etiologies. Concerning the mechanical complication, there were 20–24 follow ups. In 10 cases this was related to a broken rod and a disconnection of the ilio-sacral screw in 8 cases, three had no follow up. These two main mechanical complications have not been observed after the technique has been modified.

Conclusion: This technique allows reduction of morbidity. Rate of infectious complications is, however, high, especially for IMOC. Main mechanical complications are inferior disconnection and rod fracture. This has led to improvements of the techniques (modification of inferior connector and assembly with 4 rods), the efficiency will be evaluated at long term.

INFLUENCE OF DOUBLING OF STEMS AND INTERBODY TRANSPLANTS ON FORWARD FLEXION, LATERAL INFLEXION AND AXIAL TORSION OF LUMBAR-PELVIC INSTRUMENTATION

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Introduction: Surgery of spinal deformation with instrumentation at the pelvis presents risks of complications, especially breaking of implants associated to a pseudoarthrosis. Doubling rods, using interbody cages are the best possible strategies to limit this complication. The main hypothesis is that this methods limit micro-movements that might lead to a consolidation problem. The aim of the test is to measure residual mobility of the rachis L1–S1 and deformation of rods for each of these modifications.
Materials and methods: Six human anatomical specimen (T12-pelvis) were included. Each specimen is fixed in the cranial and caudal regions by tailor-made moulds and placed on a test bench. The specimen is put under different charges of flexion–extension, lateral inflexion and axial torsion. A instrumentation of L1 at the pelvis is realised and 4 configurations are tested (2 rods, 4 rods, 4 rods + cages and 2 rods + cages). Mechanical charges of flexion–extension FE, lateral inflexion LI and axial torsion AT are exerted on the cranial extremity in steps of 1.5 Nm up to 7.5 Nm. Mobilities are measured from L1 to sacrum using radio-opaque balls inserted in the bone structures and detected by acquisition of biplane radiographies after each charge. Deformation in the main rods in flexion is measured using deformation gauges.
Results: For the intact segment the average mobilities are 44.5° &#61531+ 27.5°–66° &#61533+ in FE, 36.6° &#61531+ 28.4°–51.8° &#61533+ in IL et 26.6° &#61531+ 10.4°–47.8° &#61533+ in TA. They are reduced in FE to, respectively 94%, 95% and 96% for two rod models ± cages, 4 rods, 4 rods + cages. For LI the mobility reduction is higher than 96% for all configurations. In TA the reduction is 85% for 2 rods and above 87% for 4 rods. Compared to the 2 rod model, the longitudinal deformation is reduced to 66–69% with 4 rods ± cages. It is increased by 15% in extension and reduced by 9% in flexion with 2 rods + cages.
Conclusion: These results seem to indicate the doubling of rods and use of interbody cages allows to reduce residual mobility in instrumentation of rods in a similar way. Doubling of rods limits further deformation of main rods as well as associated mechanical charges, more than a simple combination of interbody cages.

OPTIMISATION OF SPINAL FLEXIBILITY OF PATIENTS SUFFERING FROM MULTI-LEVEL DEFORMATIONS: PROSPECTIVE SERIES OF 82 PATIENTS OVER 24 MONTHS

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Introduction: The physiology of the spinal column and the flexibility and adaptability to everyday gestures. The spinal instrumentation of reference used for surgical treatment of layered deformations is metal (steel or titanium). This is rigid and introduced for its qualities, stiffening of the instrumented column can be a source of a handicap in everyday life. It favours, in some cases, problems of junction, breaking material, pseudoarthrosis and reinterventions. We propose a use of rods that are more flexible, in carbon composite. In association we combine a coordinated multidisciplinary approach aimimg to restore a better elasticity of the locomotive section using a re-educative load, postural and behavioural (preparation and pre- and postoperative support).
Materials and methods: At 12 and 24 months, we analyse in a prospective way 32 patients operated for multi-layered spinal deformation with rod instrumentation in composite fibres, long and containing carbon, with intrinsic characteristics that support the quality and elasticity of the bone fusion. Patients undergo a preoperative preparation program and postoperative support with easing, sensorimotric, proprioceptive, postural and behavioural education We analyse the number of follow up interventions, quality of reduction of deformations (Cobb angle, sagittal equilibrium) and quality of life (Oswestry questionnaire).
Results: Average set back is 2 years. Results are encouraging, showing a satisfactory quality of reduction, function of preoperative rigidity (reduction of Cobb angle by an average of 17°) an improvement of sagittal equilibrium (function of pelvic incidence), significant reduction of number of patients that must be operated again for mechanical complications compared to classic results with metal rods for this type of patients. (Less than 7% of reinterventions in a period o 2 years after operation).
Conclusion: Using rods in carbon composite combined to a multidisciplinary pre- and postoperative approach seems to be a promising alternative to classic metal instrumentation used in spinal surgery. A

long term control is planed and a multicentered project, to further verify the results.

TAILOR-MADE RODS FOR SURGICAL CORRECTION OF AIS: APPLICATION OF THE PRINCIPLES OF THE NEW SAGITTAL AIS CLASSIFICATION

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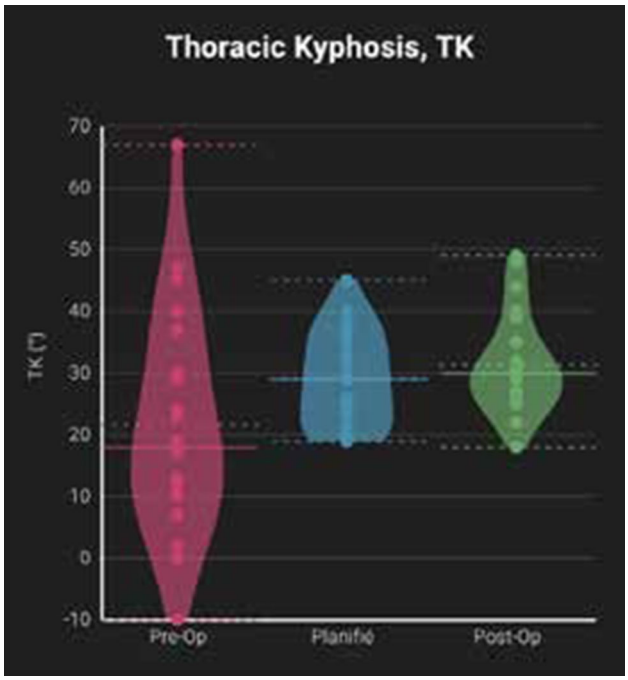
Introduction: Surgical treatment of idiopathic scoliosis aims to improve the spinal cord alignment and improving the aesthetic perception of the body. In order to avoid mechanical complications and early degenerative changes, a sagittal realignment based on spinal-pelvic parameters and an adequate restoration of thoracic kyphosis TK are essential.
Materials and methods: Sagittal corrections have been applied by 3D simulation with the following objectives CT $> 20°$ (ideally at 34°), junction TL neutral (T10L2 $< (-)$ 10°, ideally at $0° \pm 5°$), to adapt the point of inflexion. The surgeon proceeds to a computer simulation of the sagittal correction before transmitting to the rod manufacturer the recommendations with the surgical details (diameter and rod material, fusion level, estimated frontal correction rate) and calibrated frontal and profile radiographies.
Results: A total of 49 patients have been included in prospective way, suffering from scoliosis with an average Cobb of $54° \pm 10°$, corrected on the average by $21° \pm 8°$ (62%). All tailor-made rods have been implanted without modification. Each modification concerned only PI, as VP increased initially in the same way as the planing, concerning correction of an anteverted pelvis. At 6 months PO the VP became comparable to preoperative values. All patients have been maintain in their Roussouly back type. CT and lordosis have increased in post-operative phase. Improvement of CT was strictly identical to the preoperative plan of 19.9 ± 13 à 29.6 ± 8.3 on the last check (simulator value $- 30.7 \pm 10.1$), $p < 001$. The L4S1 ratio has initially decreased but was again comparable between preoperative and last check (66%). Distribution of T10L2 angles have been improved by $0.9° \pm 13.3°$ to $0.06° \pm 8.9°$.
Conclusion: All patients showed a pathological sagittal alignment and have been changed in type sagittal 1 by re-establishing the appropriate length and magnitude of the thoracic kyphosis. The new sagittal classification of idiopathic scoliosis has been conceived to refine all pathological forms present in the IS in order to guide the surgeon's strategy for sagittal correction. The strict application of recommendations coming from this classification using patient-specific rods allows an adequate and predictive restoration of sagittal alignment.



COMPILATION OF LECTURES: Paediatric surgery

BEHAVIOUR OF THE TRUNK WHEN WALKING FOR ADULT IDIOPATHIC SCOLIOSIS

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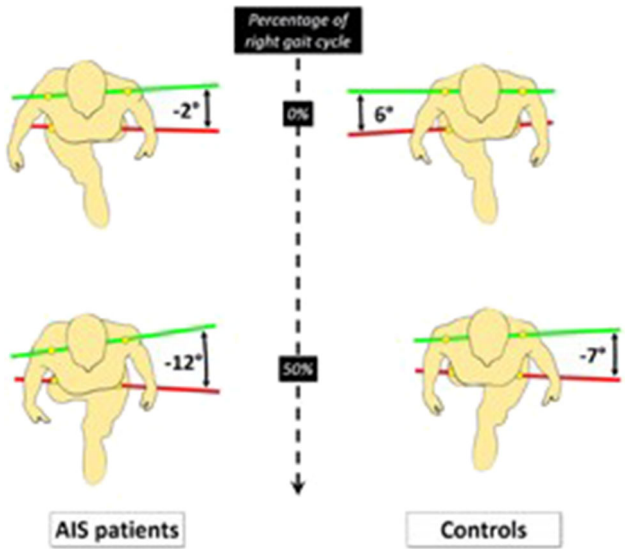
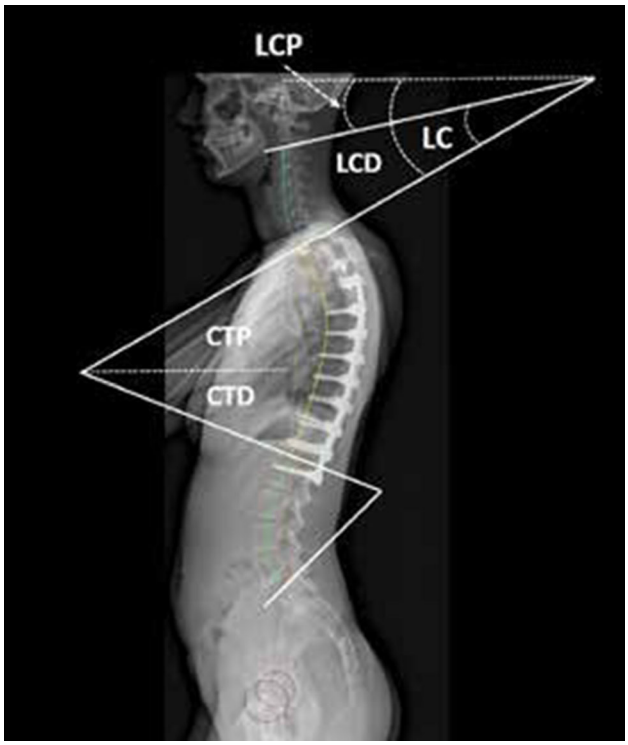
Introduction: Even though standard radiography is the usual method to evaluate spinal deformation in idiopathic scoliosis of the adolescent, the fact that it is realised in a constraint position and in a confined environment does not allow a complete analysis of the trunk's mobility. Thus, the spinal functions of adolescents suffering from idiopathic scoliosis is, today, still not well known. The aim was to compare trunk movements when walking for patients with scoliosis and a healthy population thanks to a quantified analysis of movement QAW.
Materials and methods: We have included patients with a right thoracic curvature (Lenke 1 and 2) for those with planed surgical correction. The day before the intervention, standard radiographies were realised and a QAW Amongst the different evaluated parameters, the SVA (Dyn-SVA), rotation of shoulder line (Gyn-E rotation) and pelvis (Dyn B rotation) and acromion pelvis angle (Gyn-APA) were evaluated. Patients with scoliosis were compared to a group of 25 voluntaries of same age.

Results: A total of 5 patients have been included (15 years, Cobb angle 55° average). Patients with Dyn-SVA less anterior (47 vs. 63 mm, $p = 0.01$). The Dyn-APA and Dyn-E rotations were negative (resp. − 6.4 vs. − 0.8° and 7.5 vx-0.4°, $p < 0.001$), this means that shoulders were turned to the left during the walking cycle. However, the pelvis was more turned to the right (1.1 vs. − 0.5, $p = 0.03$). There is no statistical correlation between radiographic Cobb angle and QAW anomalies.
Conclusion: One of the biggest series giving results concerning QAW for adolescents suffering from idiopathic scoliosis. We have shown that the walk of the patients was disturbed, with reduction of trunk inclination to the front and numerous anomalies on the transversal level. The walk anomalies were not correlated to radiographic parameters, showing that standard radiography does allow only a partial analysis of these patients.

	Groupe Scoliose		Groupe contrôle		p Moy	p Amp
	Moyenne	Amplitude	Moyenne	Amplitude		
Dyn-E inclinaison	0.2	4.9	0.1	3.0	0.851	<0.001
Dyn-B inclinaison	-0.1	7.6	-0.2	8.4	0.821	0.278
Dyn-CVA*	-1.1	26.9	-1	16.1	0.980	0.02
Dyn-Angle de Cobb	15.1	7.2	4.5	7.3	<0.001	0.524
Dyn-cyphose Th	28	5.1	28.1	3.1	0.953	0.003
Dyn-Lordose L	19.7	4.5	17.3	4.9	0.144	0.464
Dyn-VP	9.4	2.9	10.9	3	0.432	0.513
Dyn-SVA	47.0	26.9	62.9	25.4	0.012	0.445
Dyn-APA*	-7.5	11.6	-0.4	15.8	<0.001	0.003
Dyn-E rotation	-6.4	7.8	-0.8	8.9	<0.001	0.09
Dyn-B rotation	1.1	8.3	-0.5	11.0	0.026	0.01





THE BENEFITS OF THORACIC KYPHOSIS IMPROVE CERVICAL LORDOSIS IN CASE OF POSTERIOR ARTHRODESIS OF THORACIC IDIOPATHIC SCOLIOSIS OF ADOLESCENTS

L. Le Goff, F. Solla, O. Rosello, I. Oborocianu, V. Rampal, J.-L. Clement

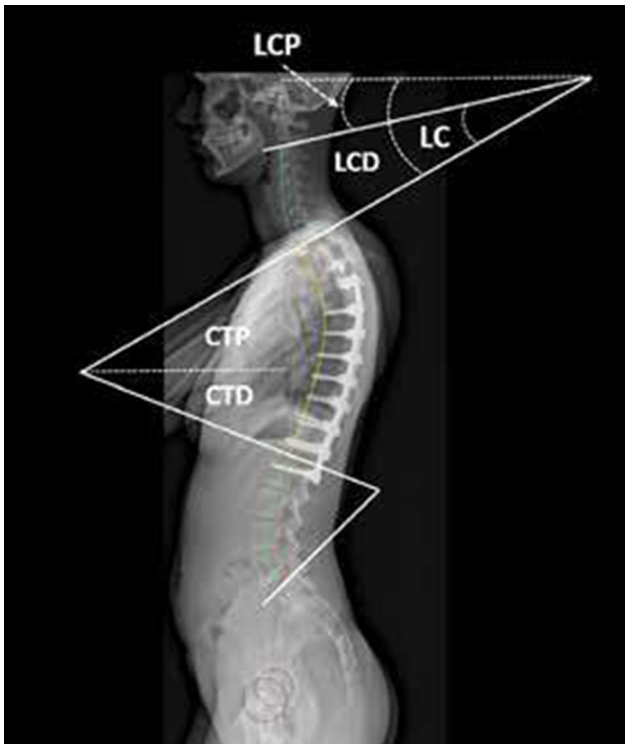
CHU Lenval, Nice

Introduction: Frequent long term cervical pain after surgical treatment of scoliosis was correlated to cervical kyphosis, improvement of cervical lordosis CL is one of the aims of posterior arthrodesis of idiopathic scoliosis of adolescents AIS. 40% of thoracic kyphosis TK linked to surgery are transferred to lumbar lordosis LL by increasing proximal lumbar lordosis (Ref.). The hypothesis is that the remaining 60% are transmitted to cervical lordosis via the intermediary of distal cervical lordosis DCL.
Materials and methods: We have included, prospectively, 113 SIA consecutively operated for posterior arthrodesis at least 2 years ago. The preoperative thoracic hyperkyphosis (> 50%) and incomplete dossiers have been excluded. 101 patients have been analysed and separated in two groups—hypokyphotic TK < 20°, n = 29) and normal kyphotic (TK > 20°, n = 72). We have measured with a Keops Analyser the global distal TK under the horizontal and the proximal TK PTK below and the LC divided also in LCD and proximal LC LCP (Fig. 1) Correlations have been explored by Pearson linear coefficients, averages by Student test.
Results: For the global series, the TK gain on checking was 19° (25° to 44!) (p = E-23) Gain for CTP and LCD (CTP = LCD) of 12° (10° à 22°)(p = E-18), gain of LC of 14° (− 9° to + 5°) (p = E-14). In the hypokyphosis group the gains for TK, LCD and LC were, respectively, 33° (7° à 40°), 22° (− 4° à 18°) and 27° (− 27° à 0°) ($p <$ E-

5). In the normal kyphosis group the gains for TK, LCD and LC were, respectively, 13° (34° to 7°), 7° (16° to 23°) and 9° (− 2° to + 7°) ($p <$ E-5) (Fig. 2). There is a strong correlation between CT and LCD (coefficient = 0.83) and between TK gain LCD gain (coefficient = 0.62) ($p < 0.001$). Regression equation was LCD Gain = 0.66° TK Gain. The TK, PTK and LCD between 2 months post operative and follow up were not significant. Coronal correction was 69%.

Conclusion: Increase of thoracic kyphosis during surgical treatment of adolescent idiopathic scoliosis led to an improvement of cervical lordosis linked to an increase of proximal cervical lordosis. Proximal cervicallordosis gain was close to 2, 3 of thoracic, lordosis gain.

Gains	CT	CTP = LCD	LC
Cohorte (n=101)	19°	12°	14°
Groupe Hypocyphose (n=29)	33°	22°	27°
Groupe Normocyphose (n-72)	13°	7°	9°



THE BENEFIT OF DE-ROTATION SCREWS AND SAGITTAL CORRECTION IN SURGERY OF IDIOPATHIC SCOLIOSIS OF ADOLESCENTS: TRANSDIMENSIONAL ANALYSIS OF RESULTS OF 41 CASES

S. Portet, T. Vendeuvre, N. Pointet, M. Abdollah Yassin, P. Pries

CHU, Poitiers

Introduction: Adolescent's idiopathic scoliosis is a deformation of the spinal cord in the three planes. When surgery is indicated, it is to restore the anatomy to correct the deformation. The implants used today are efficient in axial and frontal correction but lead to a flat back, often. For a short time now, de-rotation screws are available (25D) and sagittal correction screws (25S) proposing to exert a vertebral de-rotation, direct and while allowing to correct sagittal curvatures. The aim of our study is to show the efficiency of the 35D and 25S screws in correcting adolescent idiopathic scoliosis in the 3 planes based on 3D analysis (EOS system) of postoperative results in a series of 41 cases.

Materials and methods: 66 adolescents with idiopathic scoliosis were operated with 25D screws in the CHU Poitiers between December 2015 to January 2019. Amongst these patients 41 fulfilled the necessary inclusion criteria, 26 had 25D + polyaxial implants and 13 had 25D + 25S implants (Spineart). The use of these corrective screws allowed a so called low instrumentation density of these scoliosis. The results have been evaluated based on 3D EOS reconstructions on spinal re-equilibration in the 3 planes on the base of the following parameters—thoracic kyphosis T4T12 (TK, lumbar lordosis LL, central vertical sacral line CVSL, C7 plumb line, sagittal vertebral axis SVA and rotations of apical vertebrae.

Results: Our descriptive series of 25D screws showed a preoperative Cobb angle of an average of 54.5°. Our results on deformation correction of the spinal column show a significant reduction of the frontal Cobb angle ($p < 0.001$) and in the coronal level a significant de-rotation of apical vertebrae ($p < 0.001$): Our 25D + polyaxial and 25D + 25S were comparable and we could conduct this study in subgroups. We see a better sagittal correction in the series 25D + 25S with a significant correction of TK ($p = 0.013$) without perturbation of LL.

Conclusion: Our study suggests that the 25D screws and 25S screws are adapted to surgical treatment of adolescent idiopathic scoliosis. The 25D offer a new ergonomic means of vertebral de-rotation and their use in association with 25S allows to correct sagittal curvatures and thus to avoid problems linked to a flat back with a low density instrumentation.

Compilation of lectures: Lumbar degenerative

ANALYSIS OF A CONSECUTIVE SERIES OF 500 LUMBAR SURGERY FAILURES CONCERNING NON-TRAUMATIC LUMBAR PATHOLOGY

J. Allain

Clinique Geoffroy Saint Hilaire, Paris

Introduction: Analyse our failures, consequences of our errors is important in order to improve our approaches. We have analysed, prospectively and over 7.5 years, each file of consultants in case of a failed lumbar surgery in order to determine the origin. Incomplete files without operation report or preop radiographies, traumatic pathology and osteoporotic pathologies were excluded.
Materials and methods: The surgical failure is defined by an absence of improvement of preoperative symptomatology judged as significant by the operated after a postoperative delay of over 6 months (group 1) or an early degradation in the 3 years after the initial intervention after transitory improvement leading to situation judged by the operated as similar or worse than before the intervention (group 2). In the 2 cases, the ODI was above 40%.
Results: 500 failures, (202 group 1 and 298 group 2) have been included from over 2800 new consultants over a period of 7 years. Initial diagnosis lead to surgical indication of a herniated disc or recidivist, discopathy, canal narrowing, degenerative or isthmic spondylolisthesis, scoliosis or sagittal disequilibrium. The initial operation was disk decompression or and isolated bone 302 with arthrodesis with posterior decompression 134 or without (52) or arthroplasty (12). Indication of reintervention has been made for 202 of 500 consultants. 14 were finally operated again (23 refused or lost out of sight). Origin of failure was A manifest error of surgical indication (n = 77), technical error (n = 75), surgical complication) e.g. Infection or instability by isthmis fracture post-decompression) (n = 53), discogenic lombalgy after herniectomy for sciatic (47), degradation of adjacent planes (n = 42), a pseudoarthrosis (n = 4) or a recidivism or herniated disc (6) 159 failures with some patients expecting secondary benefits have either no explanation with images judged satisfactory or are linked to a pathology considered independent from the initial intervention 8e, g, 2nd herniated disc).
Conclusion: The analysis of our surgical errors in a traumatic lumbar pathology should help us to limit incidences. Actually, the first group of bad results is easily explained by manifest error of surgical indication or insufficient technique (about 1.3 cases) A second group corresponds to complications or pseudoarthrosis. 3Rd and 4th groups (continued spine degradation or unexplained failure) shows that we will never achieve % of good results in this field of surgery.

MEDICAL-ECONOMIC EVALUATION OF TOTAL REPLACEMENT OF LUMBAR DISK WITH THE LP-ESP (FH) PROSTHESIS IN RELATION TO POSTERIOR, ANTERIOR AND ANTERIOR–POSTERIOR LUMBAR ARTHRODESIS (360°)

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Introduction: Lombalgy is one of the most frequent problems and the growing lifespan leads to higher financial expenses for insurances. The aim of this study is to evaluate the medical-economic impact of intervertebral disc prosthesis compared to arthrodesis from a point of view of the health insurance system.
Materials and methods: The clinical data of the present analysis have been obtained via a clinical prospective multi-centric study of 83 (35M, 48F) patients with a lumbar disc replacement PDL, with viscoelastic lumbar prosthesis ESP (FH) in the context of a unisegmentary disc degeneration and using data from the Spine Tango register for arthrodesis of 151 patients (58M, 93F) having been treated with the techniques ALIF, PLIF and 360° (fusion) also in the context of monosegmental disc problems. Quality of life according to SF36 Mental and SF36 Physical scores have been evaluated in preoperative phase at 3, 6, 12 and 24 month after operation. (Wilson statistic test and Chi2 value p). Evaluation of medical-economic value based on QALY concept. Using the SF-6D algorithm, the SF-36 data have been aggregated in a Braser index SF-6D (SF-6D) and transformed in QALY calculation.
Results: The PDL group showed a significant improvement in SF 36 M, going from 42% up to 62% after 2 years, and also SF36 P with 27% in preoperation and 58% after 2 years in postoperation, contrary to the arthrodesis group with an SF 36 M rising from 29 to 43% after 2 years and a change in SF36P from 29% in preoperation to 37% after 2 years ($p < 0.0001$). Years of life adjusted based on quality (QALY s), the PDL had a significantly higher gain of 0.829 QALY after 2 years, compared to the arthrodesis group ($p < 0.0001$). Hospital fees have been calculated using the DRG product (Diagnosis Related groups). In Switzerland and Germany the costs of arthrodesis are higher than for disc prosthesis. The fees (revenue DRG) and QALY &#769+s have been compared to determine the cost-economic interest value. The cost–benefit-efficiency ratio is statistically significantly better in case of replacements of intervertebral disc than for prosthesis LP-ESP (FH), compared to arthrodesis (PLIF, ALIF, 360°).
Conclusion: This study of the lumbar disc prosthesis has not only shown that a reduction of costs for health insurance companies in German and Switzerland is possible compared o arthrdesis, but also a higher efficiency in improving quality of life and health.

OVERVIEW OF REVIEWS OF LUMBAR ARTHROPLASTY OF 48 PATIENTS

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Introduction: Lumbar disc prosthesis is particularly efficient in easing lumbar pain concerning a discopathy without posterior arthrosis of young patients. However, a non negligible risk of failure

exists concerning this technology, the origin is not well known. The aim of our study is to analyse the files of reworks of lumbar arthroplasty services in order to define risk factors for the failure of this operation.
Materials and methods: All patients of the rachis surgery service of the CHU Strasbourg from 1993 to 2018 have been included in this retrospective monocentric study concerning reworks of an arthroplasty. 2 strategies were analysed: Prosthetic replacement or anterior and posterior arthrodesis. The clinical-radiological factors analysed were mainly the degree of lordosis, pelvic parameters, size of the prosthesis, position of prosthesis, presence of a posterior arthrosis in the operated level, presence of a discopathy and/or a posterior arthrosis, over- or underlying. Efficiency of the surgical rework was judged using the functional Oswestry score before and after rework.
Results: 47 patients have been included. The main reason for reworks was the persistence of lumbar pain and/or radiculagies after disc replacement. 40 patients presented a posterior arthrosis in the operated level and 15 had a follow up operation on an «Adjacent Level». For 29 patients there is a positioning error of the prosthesis being to anterior for 22 of them. The two strategies in follow up operations have allowed to improve the score Oswestry ($p < 0.005$) but concerning morbidity, the posterior arthrodesis was superior compared to anterior follow up techniques (16% vs. 50% of complications in post operative, $p < 0.005$)
Conclusion: In total, the reasons for failure were positioning error or disc size. The posterior arthrodesis seems to produce results comparable to other rework techniques concerning functional score but improved post operative morbidity.

WILLHELM TELL: TECHNIQUE TO TREAT SPONDYLOLISTHESIS L5S1 BY ISTHMIC LYSIS USING A UNIQUE ANTERIOR APPROACH

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CHU Dijon

Introduction: There is no consensus concerning treatment of spondylolisthesis L5S1 by isthmic lysis of low grade. Circumferential arthrodesis by posterior approach type TILF or combined ALIF and posterior osteosynthesis are the most commonly used techniques. We wanted to evaluate the so-called Willhelm Tell technique with unique anterior approach. This combines an interbody arthrodesis with a transbody screw L5S1 by anterior approach.
Materials and methods: We have included patients operated for spondylolisthesis L5S1 low grade with Willhelm Tell technique between the 1st of January 2000 and 31st of January 2015. Quality of life was evaluated by analogic visual scale and Oswestry functional score. An EOS radiography has been realised to evaluate arthrodesis and the evolution in time.
Results: 67 patients have been included. 3 men and 30 women. Average age was 43 years (17–62). Average delay was 108 month (185–13). Duration of operation was on the average 90 min, fusion rate 97%. Oswestry score on the last calculation was on the average 14%, with a median of 12%. Lumbar EVA was 1.6, on the average. 61% have restarted work after 6 months, 79% after 1 year.
Conclusion: The Willhelm Tell technique seems to be an efficient alternative, safe and for treatment of spondylolisthesis with low grade isthmic lysis. Fusion rate seems similar to usual techniques.

COMPARISON OF OPEN POSTERIOR ARTHRODESIS WITH PERCUTANEOUS OSTEOSYNTHESIS WITH INTERBODY ANTERIOR CAGE WHEN TREATING SPONDYLOISTHESIS BY ISTHMIC LYSIS

A. Collinet, Y. Ntilikina, J.-P. Steib, N. Tuzin, Y.-P. Charles

CHRU Strasbourg

Introduction: The surgical treatment of spondylolisthesis by low grade isthmic lysis has quickly developed and today several operative techniques exist. The aim of this retrospective study is to compare clinical and radiologic results of patients who have received a posterior arthrodesis with posterolateral implant and decompression (group 1) vs. interbody implant by anterior and antelateral way with percutaneous osteosynthesis and indirect liberation (group 2).
Materials and methods: 35 patients (average age 67 years, 21–67 years, 19 women 16 men) have been reviewed after 1 year. 22 patients in group 1 and 13 in group 2. Measured radiographic parameters of telecolumn in profile (pre- and post-operative) were C7 Barrey ration and lumbar lordosis. The bone implant was verified by lumbar scanner after 1 year using the Lenke score. Lenke score 1 and 2 are considered as complete fusion and incomplete for Lenke 3 and 4. Clinical evaluation included EVA back, EVA legs, OI and SF12. A Student test compared evolution of clinical and radiographic parameters. Link between Lenke score and quantitative data were analysed in a Khi 2 test.
Results: In group 1 the average EVA was 3.1, EVA legs was 1, ODI was 24.1%, SF12 pcs 43 and SF12 mcs 48. In group with interbody implant the average EVA was 2.5, EVA legs was 2.5, ODI was 15.4%, SF12 pcs 48 and SF12 mcs 46. After 1 year the ODI was better in group 2 ($p = 0.01$). Lumbar lordosis reduced from 71° to 69° in post-operative for group 1 and increased from 61° to 66° for group 2 ($p < 0.05$). Repartition of Lenke for group 1 was − 1 and 2 (n = 19), 3 and 4 (n = 3). For group 2 it was—1 et 2 (n = 12) 3 et 4 (n = 1). The Odds ratio equals 0.54 corresponding to a better fusion rate in the group with interbody implant (NS). There is a significant relation of EVA3 back ($p = 0.009$) and ODI ($p = 0.06$). In multivaried analysis only EVA back was significant ($p = 0.02$).
Conclusion: There seems to be a slight advantage over lordosis and ODI but clinical results of quality of life and radiology seem to be similar. The low number of subjects limits this study. A bigger test group is necessary.

SPONDYLOLISTHESIS BY ISTHMIC LYSIS TREATED BY CIRCONFERENTIAL FUSION CORRECTION; FUSION AND INDIRECT DECOMPRESSION

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Introduction: Analyse of the results of circumferential arthrodesis (AC) with ALIF associated to a pedicular fixation in treatment of spondyolithesis by all grade isthmic lysis, without direct neurological decompression.
Materials and methods: A retrospective study including all operated spondylolisthesis by isthmic lysis in a center per AC after 1 year. Clinical scores were collected 1 year after operation—ODA EVA

lumbar and radiologic. Pelvic parameters, lumbar sacral angle LSA, lordosis at spondylolisthesis level, adjacent level and lordosis L4–S1 have been measured after operation (3 months) and at last check. Foraminal surface and cranial-caudal diameters and anterior-posteriro of foramen of conjugation have been measured on scanner after operation and on last check.

Results: 87 patients have been included. Average lumbar EVA was 2.3+ average radicular EVA 1 and average ODI 13.8%. Average lordosis at spondylolisthesis level changed from 6° to 18°, lordosis L4–S1 rose from 37° to 45° and ALS rose from 116° to 125° at follow up ($p < 0.0001$). Foraminal surface increased from 50 and 53 mm^2 to 70 and 69 mm^2 at last check up, mainly because of increase of superior-inferior diameter changing from 7.4 and 6.9 mm to 9.5 and 9.3 mm ($p < 0.001$). In the group with LSA < 90°, average correction was 20° at index level, 13° for the lordosis L4–S1 and 21° for LSA, vs. 11°, 8° and 8° respectively for the group LSA > 90° ($p < 0.001$). The fusion rate was estimated at 96.5%. An infection, a retrograde ejaculation and 5 sympathic dysfunctions, all resolutive, a wound on the iliac vein, one eventration, one lesion of the femorocutaneous nerve and two adjacent syndromes have been identified.

Conclusion: AC is an efficient and safe technique for the treatment of spondylolisthesis by all grade isthmic lysis. It allows a restoration of regional lordosis and an indirect foraminal decompression and thus allows to avoid additional intervention for decompression.

COMPILATION OF LECTURES: Spinal surgeons

WHY CONSULTING A SPINAL SURGEON? QUANTITATIVE ANALYSIS OF EXPECTATIONS AND PATIENT SATISFACTION DURING A FIRST CONSULTATION CONCERNING SPINAL SURGERY

R. Pietton[1], O. Hamel, A. Guillain, G. Boniface, P. Sabatier, B. Debono[2]

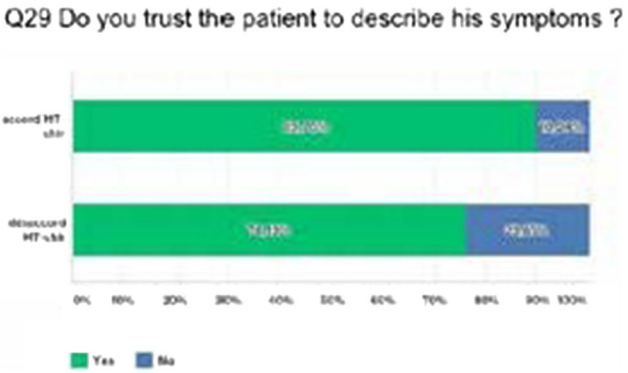
[1]Hôpital Trousseau, Paris; [2]Clinique des Cèdres, Cornebarrieu

Introduction: Identifying the patient's expectations in a first consultation is important in order to improve the surgical decision on an individual level and to improve the care for the population. The ai of this study is to identify expectations, satisfaction and adhesion to treatment proposed to patients consulting a spnal surgeon for the first time.

Materials and methods: We have conducted a prospective monocentric quantitative study of 250 patients using a questionnaire MC during a first consultation of a surgeon. The patients were invited to answer questions concerning symptoms, pathology and expectations before consultation. After consultation, a second questionnaire was filled out to improve patient satisfaction and their adhesion to the treatment. Finally, a 3rd questionnaire was filled out by the surgeon concerning patient symptoms, pathology and patient relationship. The sources of expectations, satisfaction and adhesion to treatment were evaluated by Odds ratio OR based on clinical and radiographic characteristics.

Results: 250 patients, 51% older than 55 years. 73% expected an experts statement or a potential evolutive opinion concerning their pathology. Only 32% asked for surgical solutions before consultation, this proportion stays stable for different pathologies identified by the surgeon or age of patient (Fig. 1). 90% of the patients were globally satisfied after consultation. Patients had expectations concerning their professional activities resulting in a rate of non-satisfaction of 12.68% (SD 1.36, OR 2.2) (Fig. 2). Discordance between treating doctor and specialist was an important source of non-satisfaction rising from 6 to 26%. (OR 3.4). No significant difference for adhesion to treatment with medicine and physiotherapy based on age. However, proposition of treatment by infiltration had lower adhesion for young patients 60% as for older (< 55 years) 75% OR 2.3.

Conclusion: Patients have several expectations but are looking for an experts advice, in general. Young age and discordance between treating doctor and expert are a source of non-satisfaction after a first consultation in spinal surgery.



SCIENTIFIC IMPACT OF FRENCH SPINAL SURGEONS: BIBLIOMETRIC ANALYSIS 2008–2017

B. Debono[1], L. Boissière[2], O. Hamel, P. Sabatier[1], G. Lonjon[3], J. Delécrin[4]

[1]Clinique des Cèdres, Cornebarrieu; [2]CHU Pellegrin, Bordeaux; [3]Clinique Saint Jean, Montpellier[4], CHU de Nantes

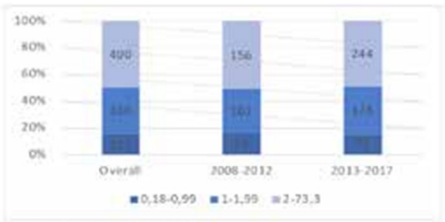
Introduction: Bibliometry is more and more used to evaluate quantity and quality of research results in science concerning numerous fields of research worldwide. However, bibliometric studies in the field of spinal surgery are rather rare. This qualitative and quantitative study aims to evaluate 10 years of French research in the spinal surgery sector and gibe surgeons and researchers and overview of research in this sector.

Materials and methods: Articles published in 2008–2017 were extracted from a Pubmed and Sco-pus data base. Letters to editors, clinical cases and commentaries have been excluded. The number of articles, quality of publications, nature and impact of revues (impact factor IF) in general, SRJ, index depending on prestige of the revue and citations have been analysed. Key words, collaborators and authors have been analysed in clusters.

Results: We included 839 articles in 120 revues. Three revues included 52% of the articles (European Spine Journal, OTSR and Neurochirurgie). Annual submissions rose in the analysed period, articles in French languages decreased (9.8% of the series). 117 articles or 15.1% were published in one revue in IF < 1, the average IF was 2.25 ± 3.99. Average SRJ was 1.05 ± 1.79. Analysed subjects evolved significantly in the analysed period, with an increase of articles treating scoliosis and deformation. Sagittal Equilibrium (18.7% of articles) represents a subject matter in constant increase (11.8% in 2008 an 22.6% in 2017). The average ratio of citations in

articles was 10.1×—245 articles were cited 10 times or more (29.2%) and 30 articles were cited over 50 times or more (3.6%), 19 of them concerned sagittal equilibrium. Study of key words showed a focus on traumatology, deformation, sagittal parameters. Study of co-authors and co-citations showed several national and international cooperation.

Conclusion: Productivity of French research increases in the last 10 years, but more than half of the articles are published in 3 revues, 2 of them French. Study of sagittal parameters and their application are a growing part of the topics treated as shown in the citations and key word analysis. Multicentric national and international cooperation exist, but should be encouraged.



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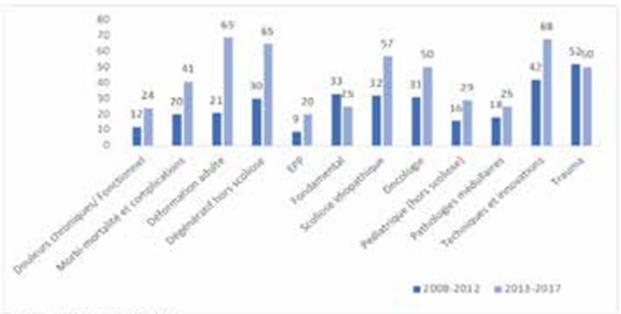
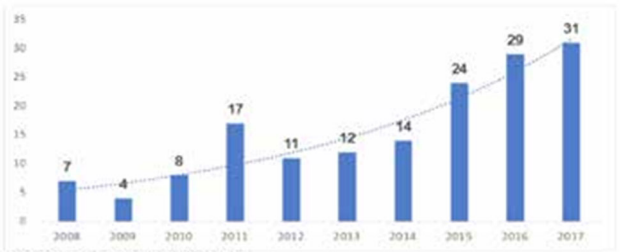
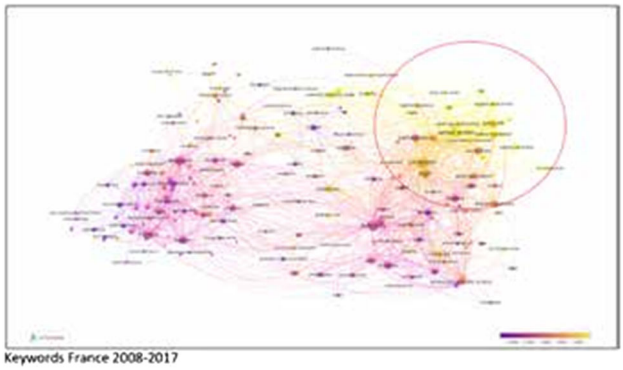


Topics articles 2008-2017



Trend Sagittal Balance 2008-2017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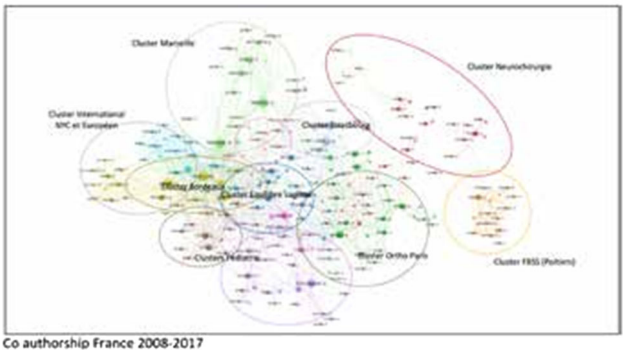

Co authorship France 2008-2017

THE SOS SPINAL CORD OPINION OF THE FRIDAY AFTERNOON CONCERNING TUMORAL EMERGENCIES: MYTH OR REALITY?

G. Lonjon[1], S. Knafo[2], B. Bouyer, P. Guigui[3]

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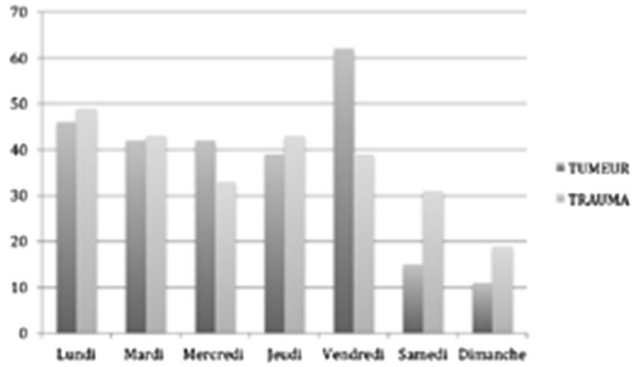
Introduction: Among spinal emergency cases regularly treated by SOS Rachis (trauma, degenerative, infectious, tumorous) the tumorous emergencies seem to rise in numbers before weekends. Examining the prospective data base of a French SOS rachis, we have tried to confirm this impression.

Materials and methods: All requests for an opinion received by SOS rachis at the Hôpital Européen Georges Pompidou (HEGP, Paris) were registered in a secured data base. (lestaff.com). All opinions registered between the 1, 11, 2016 and 1, 3, 2019, tumorous, metastasis or medullar compression have been included and classified per day and week and morning/afternoon. A χ^2 test has been used to compare percentages based on days. In comparison, a similar analysis has been realised for traumatic cases.

Results: Of 1690 requests 25 patients corresponded to an opinion concerning a tumoral emergency. The analysis by day showed that on Mondays there are 45 cases (17%), Tuesday 42 cases (16%), Wednesday 42 cases (16%) and Thursday 39 cases (15%), Friday 62 cases (24%), Saturday 15 cases (5%), Sunday 11 cases (4%). The difference in frequency is statistically significant ($p < 0.001$) and Friday is statistically the most frequent, compared to other days of the week ($p < 0.001$) and this also if only work days are considered. ($p = 0.04$). Opinions were requested the afternoon (noon-midnight in 192 cases (74%) and Friday afternoon was the half-day with most requests (24%, $p < 0.001$). For comparison, we have chosen randomly 25

cases of traumatic emergencies in the data base and this had no effect on Fridays (n1 = 39, $p = 0.8$).
Conclusion: The Friday opinion is not a myth concerning tumoral emergencies. This difference raises the question of the service organisation in medicine, mostly requesting these statements. Even though, many requests are based on a higher attention before weekends, a delay in treatment in some cases is probably also a reason. The SOS rachis service should organise itself in order to handle higher demands on weekends.



"ALWAYS ON A FRIDAY ?": SENDING PATIENTS WITH VERTEBRAL METASTASIS TO A SPINAL SURGEON BASED ON 250 CONSECUTIVE CASES

B. Debono[1], R. Pietton[2], G. Dutertre[3], P. Sabatier[1], C. Braticevic[4], I. Latorzeff[5], O. Hamel[1]

[1]Clinique des Cèdres, Cornebarrieu; [2]Hôpital Trousseau, Paris; [3]Institut Curie, Paris; [4]Institut Paoli-Calmettes, Marseille; [5]Clinique Pasteur, Toulouse

Introduction: Neurologic deficiencies and painful syndromes are possible complications of vertebral metastasis. A quick multidisciplinary oncologic treatment can reduce these risks. Or aim was to analyse the context of addressing and treating patients in our center, especially in the context of an emergency, to optimise the patient handling, organisation of oncological treatment and consequences for survival and life quality of patients. We have tried to analyse, if this sector has improved in two 5 year periods.
Materials and methods: We have retrospectively analysed data of 250 consecutive patients, treated surgically in emergency or not for spinal metastasis in our center (tertiary neurosurgical unit) between January 2008 and December 2017, separated in 2 groups of 5 years (period 1—2008–2012 and period 2—2013–2017, n = 128).
Results: Hospitalisation in emergency was more frequent in 2013–2017 (n = 83 + 64.8%) then 2008–2012 (n = 59 + 48.4%, $p = 0.009$). Friday sees highest frequencies in each period, 44.1% (2008–2012) and 47.0% (2013–2017). The Friday peak has not changed in a significant way in the two periods ($p = 27$). For emergency patients, 28 (2008–2012) and 41 (2013–2017) had a previously Known cancer, 14 patients (50% of patients in period 1) and 22 (53.7% of patients in period 2) with at least one spinal metastasis already identified. In the two subgroups 9 patients (32.1% of patients in period 1 with known metastasis) and 15 (36.6% of patients in period 2) with neurological deficiency on admission without previous surgical opinion. This distribution was not significantly different for the 2 periods ($p = 97$).
Conclusion: Too many patients with already identified spinal metastasis are sent to emergency, including neurological deficits. The optimisation of clinical evaluation, realisation of image examinations MRI and transfer to surgery is imperative in order to improve their treatment. Early implication o surgeons on discovery of the slightest image or symptom is primordial. The dedicated RCP.

E-REPUTATION CONCERNING SPINAL SURGERY

T. Le Van, R. Madkouri, R. Chapon, J. Beaurain, M. Grelat

CHU Dijon

Introduction: Interactive apps associated to notations are frequent in the web and concern also health services. That is why the e-reputation concept is developing more and more. We have evaluated the commentaries and opinions available in search engines and concerning French spinal surgeons. As no data concerning this topic are available, we have taken a look at e-reputation in spinal surgery in France.
Materials and methods: This is a transversal analytical study realised between December 2018 and February 2019 based on the public address book of the French Rachis society SFCR available in 2019 under www.sfcr.fr. We have identified 493 rachis surgeons. We have registered the note (number of stars of 5) the opinions and commentaries available on google (Google.fr) and doctoralia (http://www.doctoralia-fr.com). For statistical analysis we have used a linear regression model.
Results: Of the 438 surgeons available in the list of rachis surgeons of the SFCR 184 had an opinion posted on internet (42%). Most of the surgeons were orthopaedics (65% orthopaedics, 35% neurosurgeons) and worked in the private sector (70% private and 30% public). Of the 1588 opinions were accompanied by good or bad commentaries (66%). Average number of stars was of majority of commentaries concerned know-how of the surgeon (82%) and competences (79%). Surgeons working in public institutions had a significantly less higher number of stars. Surgeons of professor grade had a higher number of opinions and commentaries published. In a multivaried analysis, the professor status showed a correlation with the number of opinions and commentaries.
Conclusion: Each surgeon should know about the on-line content regarding his opinion. Internet has become an important source of information and can play a major role in patient decision making. We should create or promote independent web sites and integrate discussions with our patients.

Compilation of lectures: Lumbar degenerative

LINK BETWEEN L5S1 POST-OPERATIVE LORDOSIS AND ANTERIOR INTERBODY CAGE DIMENSIONS

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CHU Pellegrin, Bordeaux

Introduction: Aims of a lumbar arthrodesis by anterior approach are multiple—eliminate discal pain and execute complete discectomy, supply an indirect decompression of the foramen by restoring the disc height, increase lumbar lordosis in the context of a restoring of

sagittal equilibrium. It is possible to use cages of different sizes (lordosis angle, height).
Materials and methods: We have conducted a prospective study in order to evaluate restoration of the L5S1 lordosis after ALIF. Patients have been scanned in post-operative phase and a radiography of the entire rachis has been realised. Sagittal parameters have been measured in pre- and post-operative phase.
Results: We have included 40 patients. Two cage models have been used in this study. We have observed that the post-operative lordosis was always more important then the lordosis of the implanted cage. Increase of lordosis of the cage beyond 10° does not seem to modify post-operative lordosis.
Conclusion: Dimensions of ALIF cage do not seem to influence lordosis in L5S1 level beyond certain values. There is no interest in inserting the most angled and highest cage.

ANALYSIS OF THE VARIATION OF LUMBAR LORDOSIS AND DISCAL ANGLE L5S1 AFTER ALIF BY 3 CAGE TYPES: PROSPECTIVE STUDY

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[1]Clinique bel air CCER, Bordeaux; [2]CHU Pellegrin, Bordeaux; [3]Centre Aquitain du Dos, Mérignac; [4]Clinique Bordeaux Nord

Introduction: The Anterior Lumbar Inter Body Fusion (ALIF) is a surgical technique that allows to treat infectious discopathies at the origin of lumbago creating a handicap. ALIF aims to restore a post-operative lumbar lordosis close to the theoretical lumbar lordosis. The aim of our study is to analyse spinal parameters based on implant lordosis after ALIF.
Materials and methods: Prospective study with patients who have received an ALIF L5S1. Pre- and post-operative parameters have been measured and again after 2 years, they are lumbar lordosis L5S1 (measured between superior level of L5 and superior S1), discal angle L5S1 and pelvic parameters (PI, PT). Measurements realised on EOS full spine in profile using the software KEOPS. 3 different implants in peek have been analysed. Anterior Idys cage Clariance, France) de 6°, 10°, 14° ou 18°, with integrated cage. Anterior perimeter cage (Medtronic, Memphis, USA) of 8° and 12° and the cage statur-L (FbC Device, Danemark) with a mobility allowing a variant lordosis of 7° to 22°.
Results: No matter which implant is used, the post-operative lordosis is improved and almost identical to the theoretical lordosis calculated using recently published formula. No correlation between lordosis of implant and lordosis L5S1 nor between lordosis of implant and discal angle L5S1 has been observed for the three implants. In the three groups, the discal angle L5S1 and lumbar lordosis L5S1 remain constant during the following 2 years. No loss in disc height in time. Fusion rate of our study is 96%.
Conclusion: ALIF allows to restore disc height and free the foramen at the back. Cage lordosis does not have an influence on L5S1 lordosis or the post-operative discal angle. The study suggests that the anterior position of the case and the height allow to put on tension on the annulus again and the ligament structures, without decoaptation of articular facets. When the cage is anterior, this replaces the inter-vertebral rotation center close to the physiology allowing a spontaneous restoration of lordosis. The cage statur-L with variable lordosis allows a better fit of the implant on the levels but does not improve L5S1 lordosis. The Idys cage is fixed to the plate and must thus be positioned as much as possible to the anterior position.

DIAGNOSIS OF DEGENERATIVE SACROILIAC PAIN AFTER SACRED-LUMBAR ARTHRODESIS

Y. Pelletier, N. Bronsard, H. Darmante, T. Langlais, R. Bernard de Dompsure, F. De Peretti

CHU Pasteur, Nice

Introduction: The painful sacral-iliac degenerative syndrome is defined by painful joints, stable and handicapping after exclusion of infectious phenomena. This syndrome seems to be frequent with patients already operated for lumbar-sacral arthrodesis and the clinical and para-clinical diagnosis is not consensual. The aim of our study is to evaluate the clinical and para-clinical criteria in order to allow diagnosis if this syndrome.
Materials and methods: We conducted a prospective monocentric study. Inclusion criteria were patients with chronically handicapping lombalgia, present after 1 year of lumbar-sacral arthrodesis and wit positive infiltration test. We have evaluated clinical and para-clinical criteria in order to define their frequency or relevance for diagnosis. For each patient we have analysed 5 clinical parameters: Fortin test, presence of pain on palpitation and trochanterial insertion (IMTF), homolateral, presence of a pseudoradiculalgy, manoeuvres to raie sacral iliac pain, increase of mechanical constraints on sacral-illiac joint. Para-clinical parameters were analysis of lumbar-pelvic radiographies, scanner or MRI and a bone scintigraphy with technetium 99 m. Errance time.
Results: We have included 91 patients. 100% of the patients had a positive Fortin test and a pseudoradiculagy, 100& of patients had, by definition, increased mechanical constraints. 96% had palpitation pain of ITMF 97% had 3 of 5 clinical tests resulting in typical pain. In 93% of the cases, radiography did not result in diagnosis elements. 95% of patients had a negative scintigraphy despite 19% of sacral-iliac arthrosis shown on scanner or MRI. Errance diagnosis was on the average 35 months. Sitting position was the most painful for patients (Fig. 1).
Conclusion: Diagnosis of degenerative sacral-iliac pain is suspected based on several clinical elements and confirmed by infiltration test. Para-clinical examinations are often not a contribution.

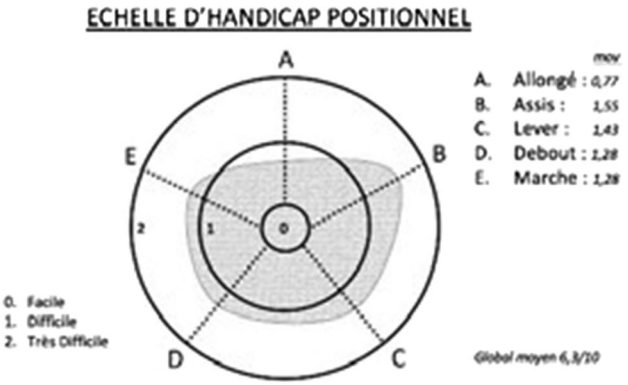


Figure 1 : Echelle de handicap positionnel

CONTRIBUTION OF DYNAMIC STABILISATION BY DYNESYS IN DEGENERATIVE SPINAL SURGERY

F. Devriese[1], F. Zadegan, C. Mazel[2]

[1]Hôpital Rebert Debré, Paris; [2]Institut Mutualiste Montsouris, Paris

Introduction: DYNESYS is a dynamic device for posterior stabilisation of lumbar rachis. Use of this device is subject of a controversy. Aim of this study is to analyse clinical and radiographic results after at least 2 years.

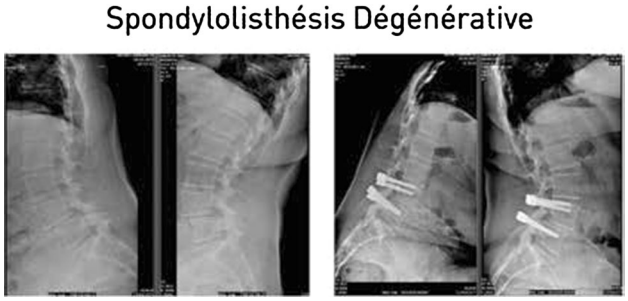
Materials and methods: Retrospective, monocentric study of patients operated between 2009 and 2016. 136 patients have been operated for 5 different etiologies, herniated disc, lumbar stenosis, rework of Neocharniere syndrome, spondylolisthesis, scoliosis. Clinical and radiographic evaluations have been realised. Post-operative scab was realised to analyse an eventual posterior fusion. Complications have been classified.

Results: 136 were operated—34 (25%) for lumbar stenosis, 19 (13.9%) for herniated disc, 29 (21.4%) for degenerative spondylolisthesis, 41 (30.1%) for rework of néocharnière syndrome, 13 (9.6%) for scoliosis. Average age is 56 years. Average clinical set back is 46 months. 109 (80.1%) DYNESYS simple level have been implanted and 27 (19.9%) DYNESYS double level (maximum). Clinical results show in post-operative phase an average lumbar EVA of 3, 0.10 and an average radicular EVA of 3, 01, 10. Post-operative average ODI score is 311.8%. We have a rework rate for all reasons of 11.8%, of which 6.6% (9 cases) for proximal junctional syndrome PJS. Average delay for rework of PJS is 40.8 months. 27 patients (19.9%) had a post-operative scan + of whom 66.7% showing spontaneous fusion of joints on DYNESYS level. We have only identified two cases (1.5%) of mobility chamber cases.

Conclusion: This series included the highest number of patients in literature. Clinical post-operative results are favourable and coincide with those found in literature (Hsieh 2016) The rework rate for any cause is similar to those published before (15% Kashkous 2016). Rework rate for PJS is less high then in literature (20–30%, St Pierre and Hoppe 2016). Mechanical complication rate of 1.5% is lower than in literature concerning DYNESYS (17% Schnake 2006) and also much weaker than the one for arthrodesis (3.6% Guigui 2008). And, the high fusion rate is surprising and deviates from the initial one in conception (G. Du-Bois). The DYNESYS allows to avoid certain limiting cases and should realise an arthrodesis with higher morbidity.

	sténose	Hernie discale	SPL	Néocharnière	scoliose
TOTAL	34 (25%)	19 (13,9%)	29 (21,4%)	41 (30,1%)	13 (9,6%)
AGE	68,4 (41 à 83)	45,6 (27 à 80)	70,3 (46 à 86)	65,1 (47 à 87)	70,8 (57 à 86)
ATCD chir rachis	4 (11,8%)	5 (26,3%)	1 (3,4%)	41 (100%)	5 (38,5%)
DYNESYS SIMPLE	28 (82,4%)	17 (89,5%)	26 (89,7%)	31 (75,6%)	7 (53,8%)
DYNESYS DOUBLE	6 (17,6%)	2 (10,5%)	3 (10,3%)	10 (24,4%)	6 (46,2%)
EVA lombaire	2,8	2,2	1,7	**4,3**	3,6
EVA radiculaire	2,5	2,4	2,5	**4,2**	2,5
ODI	32%	24%	27%	**35%**	40%
Brèche	2 (5,9%)	1 (5,3%)	5 (17,2%)	9 (22%)	1 (7,7%)
SIP	3 (8,8%)	1 (5,3%)	1 (3,4%)	**11 (26,8%)**	2 (15,4%)
Chb mobilité	0	1 (5,3%)	0	0	1 (7,7%)
Tx fusion au scanner	**66,7% (4/6)**	0 (0/4)	**83,3% (5/6)**	**88,9% (8/9)**	50% (1/2)
Tx de reprise	**5 (14,7%)**	2 (10,5%)	1 (3,4%)	**6 (14,6%)**	**2 (15,4%)**
Tx reprise pour SIP	2 (5,9%)	1 (5,3%)	1 (3,4%)	5 (12,2%)	1 (7,7%)

Tableau : récapitulatif des résultats fonction des étiologies (**en gras** les différences statistiquement significatives et les fortes tendances)



ANALYSIS OF REWORKS OF SHORT MICRO-INVASIVE ARTHRODESIS: ANALYSIS OF A SERIES OF 187 PATIENTS

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Introduction: Lumbar arthrodesis by micro-invasive approach are the most common procedures, offering the advantage of minimal dissection and early functional results, superior to standard operations. However, the complication ratio is known but modalities for surgical reworks of this technique need to be précised. The aim of this work was to define results of surgical rework by micro-invasive approach.

Materials and methods: A retrospective study of patients operated for micro-invasive arthrodesis from October 2014 to January 2019 in the same specialised medical center with specific and navigation (starting May 2016) was realised. All surgical reworks have been realised in micro-invasive approach. Preoperative surgical data, post-operative complications and surgical rework have been analysed. A descriptive analysis of the test group has been realised. Motives and delays of reworks have been detailed. Main judgement criteria was the clinical result after micro-invasive surgical rework.

Results: 187 patients operated, average age 62, years and an arthrodesis of 1–4 levels. 144 operated under navigation. 15 patients (8%) reworked, two of them twice − 9 for neurological reasons (compressive haematoma, bad positioning of symptomatic and meningocelic screw), 6 for mechanical reasons (disassembly of material, adjacent syndrome) and 2 for infection of site of operation. Complications treated in rework have been solved in 100% of the cases. The Early rework rate (under 1 month) was 5.9%, so 1% for infections, 1.6% haematorachis and 2.1 and bad screw position. Use of preoperative navigation decreased the last ratio from 4.5 to 1.4%.
Conclusion: #One of the biggest test groups for micro-invasive lumbar arthrodesis. Early rework ratio of this series was below figures in literature for conventional arthrodesis. The complications have however made it possible to consider the creation of treatment protocols. Surgical reworks, no matter what the indication, are possible with micro-invasive approach.

HIP POSITION AND OLIF TYPE ACCESSIBILITY: MORPHOMETRIC STUDY

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Introduction: To evaluate whether left hip positioning widened the access corridor using Oblique Lateral Inter- body Fusion (OLIF) approach during right lateral decubitus (RLD).
Materials and methods: Ten healthy adult volunteers underwent a T2 lumbosacral MRI (1.5 T) in the supine position, RLD position with left hip in extension then in flexion. L2–L3 to L5–S1 disc spaces were identified. At each level, left psoas surface (in cm^2), access corridor (in mm) and vessel movement were calculated in the three positions. Paired *t* test was used for comparison.
Results: The mean surface of the left psoas ranged from 7.83 to 17.19 cm^2 in the three positions ($p > 0.05$). From L2-3 to L4-5, in RLD, when the left hip shifted from extension to flexion, nor the access corridor nor vessels movement were significantly different. When the volunteers shifted from supine to RLD position with hip in extension, arteries moved 3.66–5.61 mm to the right ($p < 0.05$ at L2-3, L3-4 and L5–S1), while the venous structures moved 0.92–4.96 mm ($p < 0.05$ at L2-3) to the right. When the position shifted from supine to RLD with hip in flexion, the arterial structures moved 0.47–4.88 mm ($p < 0.05$ at L2-3 and L3-4) to the right, while the venous structures moved—0.94–4.13 mm ($p < 0.05$ at L2-3 and L3-4) to the right.
Conclusion: Hip positioning was not associated with a significant widening of the surgical corridor. To perform OLIF, we advocate for RLD position with left hip in extension to move away the vascular structures and reduce the psoas volume.

TREATMENT OF LOWER LUMBAR RADICULAGIES OF PATIENTS OVER 75 YEARS: IS A MICRO-INVASIVE LATERAL PRE-PSOATIC APPROACH POSSIBLE?

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Introduction: Non-randomised longitudinal prospective study of patients over 75 years old by lateral micro-invasive lumbar approach, prepsoatic LLIF with lateral cages without posterior fixation.
Materials and methods: 155 patients (September 2014 to December 2017) operated by one senior operator, 139 patients have been included with complete controls for 1 year. All patients had chronic lombalgia and radiculopathies for 6 months with at least 1 months of low epidural infiltration with corticoides (except if counter indications existed). The study analysed evolution of EVA and Oswestry questionnaire and collection of undesirable effects.
Results: Average age 81.9 years (75–96), 75% women, BMI 28.1 (18–46.8). Radiological diagnosis − 54 discopathies with loss of pure disc height, 50 deformations in the frontal plane and 35 degenerative spondyolisthesis. Accessibility left was 70%, number of levels operated by patient 2.02. VAS in pre-operative phase was 6.83 at 1 months—2.19 and in 1 year—1.3. ODI in po 43.15+ à 1 month—29.3+ and in 1 year—28. Complications—2 patients showed an immediate increase of their pain in PO and a neurological deficit (1 homolateral et 1 contro-lateral) needing laminectomy in 24 h, with complete disparition of deficit in 3 months. 32 patients (23%) showed a po psoïtis, of whom 14 were still painful at consultation of 1st month and non in 6 months, 1 fracture of vertebral sorpus 3 weeks after operation with a woman of 83 years treated by posterior fixation and laminectomy after 1 month ½, 7 decompressions considered insufficient (radicular pain after 3 months) of which 3 needed posterior decompression and 4 needed medical treatment by infiltration of corticoïds. Concerning radiology, 24 impacts of cages for 15 patients, none needed supplementary fixation.
Results: Accessibility by lateral approach, psoatic and micro-invasive by isolated lateral cage for subjects over 75 years of age has shown its usefulness and superiority compared to other techniques and its efficiency, low complication ratio and quick recovery of old and fragile patients.

EARLY CLINICAL RESULTS OF PATIENTS OPERATED BECAUSE OF AN ANTERIOR ARTHRODESIS L4–L5 WHAT IS THE EFFECT OF AN ASSOCIATED PERCUTANEOUS POSTERIOR FIXATION?

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Introduction: Lumbar arthrodesis by anterior approach ALIF has proven its efficiency in the treatment of discopathies. We suppose that the early results of an ALIF are improved in case of posterior stabilisation. The aim was to compare early clinical results of patients operated with ALIF L4L5 stand alone versus ALIF L4L5 with micro-invasive posterior fixation.

Materials and methods: Prospective monocentric study. Between September 201 and September 2018 10 patients have presented a L4L5 discopathy after failure of treatment with medicine they have been operated with ALIF followed by percutaneous posterior fixation. They were compared to 20 patients treated between December 2015 and December 201 with stand alone ALIF. Same operation technique has been used in both groups with retroperitoneal anterior approach and implant of anchored cage filled with autologuous spongious bone. The clinical scores ODI, EVA have been collected in pre-op at M1 and M3. Operation duration, hospitalisation duration and peri-operative complications have been analysed.
Results: Clinical pre-operative data were similar in both groups. In the group ALIF «stand alone», reduction of DI was 2 at M1 and 12 at M3. Reduction of lumbar' EVA was 1.3 at M1 and 1.8 at M3. In the group ALIF + fixation the reduction of ODI was 17 at M1 and 30 at M3. Reduction of lumbar EVA was 3.5 at M1 and 5 at M3. No other complications in the group with posterior fixation. Only duration of operation was longer.
Conclusion: Association of posterior fixation to ALIF L$4L5 seems to produce better clinical early results and suggests a reprisal of activities in a shorter time.

Communications: Spinal traumatology

FRACTURE OF THORACOLUMBAR SPINE: PURPOSE OF MRI

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Introduction: Fractures of thoracic and lumbar rachis are frequent. The treatment is not uniform but damaged disc or posterior ligament complex PLC are important elements for a 'decision. Radiography and scanner do not allow a precise study of these structures. An MRI facilitates the diagnostics and aplex (K = 0.716) and classification of the fracture AO (K = 0.707) were good. Constraint to the classification "Oner" (0.155). Precise discal-ligament analysis. Our hypothesis was to show importance of MRI in the severe phase of a fracture of the thoracic rachis or lumbar rachis and study the reproducibility of the analysis.
Materials and methods: This is an observational, prospective, monocentric study. We have included all fractures of the thoracic or lumbar rachis with complete imagery (radiography, TDM, MRI) Images were independently interpreted by an internal in orthopaedic, a senior in orthopaedic and a senior radiologist. All intervening personnel should make a statement concerning classification of the fracture (AO classification), lesions of ligament complex and status of cranial and caudal discs (Oner classification).
Results: The thoracic-lumbar pivot T11–L2 was concerned in half of the cases (49.6% Fractures have been included of 67 patients with an average age of years (17–92). The MRI could identify 36 fractures (29%) not diagnosed by scanner, damage to the PLC in 12 fractures (13%), a change of classification status for 11 fractures (9%). In 17% of the cases, discs were damaged. Inter-observer reproducibility for damages of the posterior ligament com.
Conclusion: MRI must become a systematic examination in case of thoracic lumbar fractures to identify associated fractures or ligament instability changing the treatment of the patient.

SPINEJACK® VERSUS ORTHOPAEDIC TREATMENT USING A CORSET WHEN TREATING TRAUMATIC VERTEBRAL FRACTURES OF TYPE A1 ET A3.1 PROSPECTIVE, MULTICENTRIC AND RANDOMISED STUDY INTERMEDIATE RESULTS

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Introduction: Thoracic lumbar fractures can be treated in orthopaedics by corset, osteosynthesis or vertebral increase. This study aims to compare the treatment by SpineJack(r) with orthopaedic treatment by corset for severe vertebral fractures, stable and traumatic of type A1 and A3.1 Magerl classification.
Materials and methods: 96 patients (63.5% male) with one or two severe and painful fractures have been randomised in two groups—SJ (n = 49) ou corset (n = 47). The clinical, radiologic and medical-econonomic parameters have been evaluated before surgery, 5 after and 1. 3, 12 and 24 months after.
Results: Intermediary analysis realised on 52 patients allowed to show a significant improvement of pain (VAS score) and functional capacity (ODI score). However, no statistically significant difference between the two groups has been identified in this phase of the study. SpineJack® allows a significant reduction of the kyphosis angle after 5 days, 1 month and 3 months. During the first year after operation correction of the traumatic regional angle was observed only in the SpineJack® group. Duration of stay in hospital was significantly shorter for patients in the SpineJack® group (4.6 days vs. 5.6 days). After 3 months complete ablation of the corset has been observed only for 46.7% of the patients. 11 patients in the SpineJack group (22.5%) and 3 in the corset group (6.4%) went back to work. Unwanted effects are more frequent after conservative treatment (36.2% vs. 26.5% of patients). No unwanted events have been observed in the SpineJack group.
Conclusion: This intermediary analysis shows that the evolution of the results in question (radiologic, duration of hospitalisation, time to return to work) were more advantageous for the SpineJack group.

RETROSPECTIVE MONOCENTRIC ANALYSIS COMPARING SPINEJACK CORPORECTOMY AS A COMPLEMENT TO POSTERIOR OSTEOSYNTHESIS FOR TRAUMATIC FRACTURES A3 AND A4

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CHU Besançon

Introduction: Fractures in compression are the most frequent, modifying, as a consequence, the rachis static in kyphosis or lordosis. The aim of this study was to compare retrospectively two patient groups with compressive fracture A3 or A4 treated by posterior transpedicular osteosynthesis and if they had been treated by vertebral increase by SpineJack or corporectomy with anterior arthrodesis. Rachis anatomy and post-operative life have been evaluated.

Materials and methods: This is a comparative retrospective, monocentric study comparing patients with A3 or A$ fractures treated by posterior transpedicular osteosynthesis and corporectomy with arthrodesis by lateral approach (group no. 1) or vertebral percutaneous increase by SpineJack (group no. 2) between November 2011 and august 2016 in the neurosurgery department of the CHRU in Besançon. We have calculated local and adjacent regional angles of the fractured zone in pre-op and in post-op, immediately and 6 months after last intervention. Residual pain and quality of life were analysed by analogic visual scale, Oswestry score and EQ-5D scale, at least 1 year after last surgery.
Results: 14 patients have been analysed. In group 1—The average pre-op regional rachis angle is 7.02° + 9.49° in post-op of osteosynthesis only + 3.14°, after corporectomy + 2.76° after 6 month. For group 2—The average pre-op regional rachis angle is 5.78° ± 4.04° in post-op + 9.53° after 6 months. Average quality of life EQ-5D is calculated at 71.5 din group No 1 and 76.25 in No 2. Post-op ODI after a year evaluated at 9.6 in group No 1 and 9 in group No 2. Average' EVA after 1 year in first group is evaluated at 2.95 versus 3.87 in group 2.
Conclusion: Results seem to indicate a tendency towards better correction of static rachis by posterior osteosynthesis with anterior corporectomy and a better stability in time. However, the evaluation of quality of life after 1 year is better with SpineJack, without difference in post-op pain for the two groups. The two techniques seem to be comparable concerning pain.

ABLATION OF PERCUTANEOUS OSTEOSYNTHESIS MATERIAL IN CASE OF THORACIC LUMBAR FRACTURES: COMPARATIVE STUDY OF PAIN AND FUNCTION

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HEGP, Paris

Introduction: Fractures of thoracic and lumbar rachis are frequent. More and more percutaneous osteosynthesis techniques are used allowing a good correction and a less traumatic approach. However, notion of discomfort with pain and stiffness stays frequent. If ablation of osteosynthesis material is not forcibly recommended in case of conventional surgery, scientific data converge and seem to indicate an interest for percutaneous surgery. Main aim of the study is to evaluate the function before and after early ablation of osteosynthesis material. Secondary aim is to show the absence of a loss of correction associated to this ablation.
Materials and methods: A prospective monocentric study including 32 patients treated by percutaneous osteosynthesis for fracture if thoracic or lumbar rachis with early ablation of material (AMO) (planed for the third months). Main judgement criteria were lumbar EVA and Oswestry scores + secondary criteria being vertebral kyphosis and regional kyphosis (VK and RK).
Results: We observe a significant improvement of EVA and functional average scores for matched series—improvement of 1.5 points of EVS and improvement of 4 points Oswestry. A loss of correction has been identified without being significant—loss of correction 3° for VK and 1.5 for RK.
Conclusion: An early ablation of osteosynthesis percutaneous material allows an improvement of pain and functional constraints in a significant way without loss of correction in the context of thoracic and lumbar rachis fractures.

CLINICAL RESULTS AND RETURN TO SPORTS AFTER ISTHMIC RECONSTRUCTION CONCERNING HIGH PERFORMANCE ATHLETES

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Introduction: In literature, 20% of athletes have an isthmic lysis in L5. Surgical isthmic reconstruction has been proposed as treatment for isthmic lysis with handicapping symptoms. Results of this technique have been evaluated in the general population but, as far as we know, only very little results have been analysed concerning high performance athletes. The aim of this work was to evaluate results of isthmic surgical reconstruction in a population of high performance athletes.
Materials and methods: This retrospective study includes 11 patients operated with Buck technique between October 2005 and June 2016. Average age at the moment of intervention was 21.6 years. Patients presented a symptomatic isthmic lysis, associated to a low grade spondylolisthesis or not. Average delay was 52.8 month (4.4 years). They were reviewed retrospectively. Clinical results (EVA and ODI) and bone fusion (scanner) were evaluated. Delay to pick up sports again and level of last check up were analysed.
Results: At last check up, 6 patients were practising high performance sports again (54.5%), 4 at the same level (36.4%) and 2 (18.2%) at an inferior level. Average delay was 6 months. 5 patients did not return to competitive sports. Average Oswestry score changed from 42% in pre-op to 7% in post-op. Average EVA changed from 6, 3, 10 in pre-op to 1, 5, 10 in post-op. One case of unilateral pseudoarthrosis identified.
Conclusion: Results concerning ODI and improvement of pain are good and correspond to literature. However, isthmic reconstruction allowed only about half of the patients to return to sports and at the same level of performance there were only 1.3 cases. Delay of return to sports was an average of 6 months. Isthmic reconstruction by direct screwing for high performance athletes allows a return to high performance sports in half of the cases with a delay of 6–12 months + an improvement of clinical functional scores with a satisfactory fusion rate.
Case no. 1 rugby player, very good clinical results.

Compilation of lectures: Cervical rachis

RETRO-PHARYNGEAL HAEMATOMA AFTER ANTERIOR CERVICAL ARTHRODESIS, DATE OF APPEARANCE AND FAVOURABLE FACTORS

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CHP St Grégoire

Introduction: The retro-pharyngeal haematoma is a serious complication in anterior cervical surgery. Usually, it appears in the first 12 h. Circumstances favouring this complication are described directly after mayor surgery for patients with important co-morbidity. Main aim of this study is the analysis of the precise date of appearance of the haematoma. The secondary objective is to look for factors of risk concerning the appearance. Work hypothesis is that a haematoma can appear any time and for any patient.
Materials and methods: A consecutive, monocentric and retrospective series of 499 patients operated between 2005 and 2017. Inclusion criteria were patients operated for herniated disc, uncarthosis or stenosis. Exclusion criteria were tumours, infections and trauma. Hour of appearance of premier symptoms and reprisal were specified. Different risk factors have been studies, isolated in groups—ASA, history of haemostatic problems, BMI, indication of intervention, number of operated levels, type of intervention (discectomy, corporectomy, osteosynthesis). Uni-varied and multi-varied studies were realised.
Results: 384 patients have been operated for herniated disc or uncarthosis, 115 for stenosis. 441 have been operated on one or two levels, 58 on three or four. All have had a osteosynthesis and drainage.
Conclusion: All haematoma arrived after 20 h, which is unusual given the data in literature. Usual risk factors (multi-level and ASA > 3) have not been found. Confirming the work hypothesis, a haematoma can appear well after operation, independent from complexity of surgery. Findings do not question outpatient surgery (12 h hospitalisation) but point out the necessity to inform the patient. Arrival of a retropharyngeal haematoma is unforeseeable and can appear well after surgery, even in case of simple procedures.

FEASIBILITY STUDY OF ANTERIOR CERVICAL DISCECTOMY IN OUTPATIENT CARE ACCORDING TO CHRONOLOGY OF UNDESIRED SERIOUS POST-OPERATIVE EVENTS

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CHU de Nantes

Introduction: Outpatient surgery (OS) increase on a national and international level. A national program of OS development with less than 12 h of hospitalisation and no over night stay has been set up in 2015 wit the aim to achieve a global rate of OS of 0% in 2022. Herniated discs and cervical discarthosis are part of the many pathologies treated in OS. The ACAL is the preferred surgical approach and can be associated to immediate post-op complications such as cervical haematoma or epidural haematoma. Even though such complications are very rare, a reprisal in surgery is necessary and urgent as they are life-threatening or can result in severe consequences. Despite many encouraging studies supporting OS of herniated disc and cervical discarthrosis by ACAL, many surgeons remain prudent. The aim of the study was to analyse the chronology of serious undesirable events in order to judge outpatient feasibility of a discectomy by ACAL.
Materials and methods: Retrospective survey of the chronology of undesirable events concerning patients operated between November 2014 and November 201 for herniated disc or cervical discarthrosis by ACAL, hospitalised in a conventional unit in the CHU of Nantes. Serious undesirable events compromising OS are to be identified.
Results: 140 patients have been included. Of which 54% (76) were male and average age was 48.3 ± 8.2. One, two or three disc layers have been operated in, respectively 74% (104), 24.3% (34) or 1.4% (2) of the cases. Average hospitalisation was 3.5 ± 1.1 h. Serious undesirable events (suffocating haematoma, dura mater breaches) appeared in 2.1% (3 patients) of cases in pre-op and post-op in less than 12 h and after this delay, no complications have been identified. 26.4% (37) of the patients have shown undesirable events that do not compromise OS.
Conclusion: ACAL discectomy seems to be possible in OS. The rate of critical undesirable events associate to this procedure is very low and these show up immediately in post-op.

THE INTEREST OF DYNAMIC PRE-OPERATIVE MRI IN CASES OF CERVICAL-ARTHROSIC MYELOPATHY: CONCERNING 99 PATIENTS

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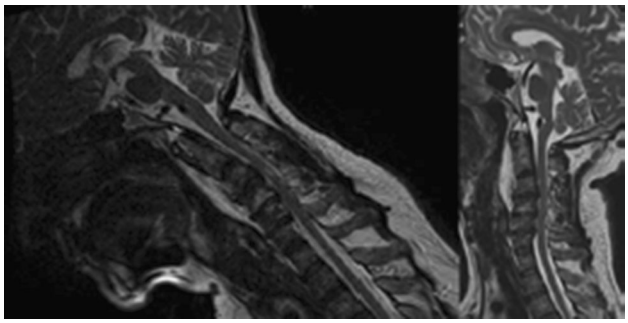
Introduction: Surgical treatment of cervical*arthrosic myelopathies is still difficult and the choice of the number of layers to be

decompressed is still a point of discussion. The ductal stenosis can be reinforced by dynamic phenomena, it seems to be logic to obtain dynamic MRI (neutral, flexion, extension). Aim of the study is to analyse the interest of dynamic pro-operative MRI and the influence on surgical treatment of cervical-arthrosic myeolpathies.

Materials and methods: A total of 99 patients operated for cervical-arthrosic myelopathies have been included prospectively and analysed retrospectively. For 35 patients a standard cervical MRI has been realised and for 64 dynamic MRI have been realised. For each patient, the presence of a modified or non-modified medullar hypersignal by position of cervical rachis has been identified and also the number of stenosis levels. The two groups were finally compared in terms of surgical strategy.

Results: 99 patients were included in the study with an average age of 63 years. The MRI standard group and dynamic MRI were comparable in age, sex, reparation of approach and clinical pre-op scores ($p > 0.05$). In the dynamic MRI group, 2,6 levels were decompressed on the average, for the standard MRI group 2 levels were decompressed on the average ($p = 0.008$),. In the dynamic MRI group the medullar hypersignal was more visible in flexion and the number of Sténosis levels was higher in extension. Amongst the 65 patients, 64% had a number of compressed levels that were higher in extension and 84% have received a decompression corresponding to the number of compressed levels in extension.

Conclusion: Dynamic MRI is important in the pre-operative analysis of a myeopathy concerning diagnostics and also treatment. Realisation of this examination allows to identify a level that is not in stenosis in neutral position, but is so in extension and could be responsible for a deterioration of the symptoms at long term.



RETROSPECTIVE MRI STUDY OF THE MORPHOLOGY OF THE CERVICAL RACHIS OF HIGH PERFORMANCE RUGBY PLAYERS

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[1]CHU Toulouse; [2]Clinique Médipôle Garonne

Introduction: High performance sports can lead to a remodelling of bones due to repeated constraints, sometimes supra-physiological. Even more so, if the sport has been practiced since young age. At our knowledge, no study has been realised to identify the impact of high performance sports on such an eventual remodelling of the cervical rachis. The aim f this study is to determine if specific morphologies exist concerning the spinal cord of rugby players.

Materials and methods: Retrospective, bicentric study comparing cervical MRI of high performance rugby players (pros and training centers) to MRI of patients from the general population never having played rugby. All subjects ate male between 15 and 35 years of age. The comparison concerns morphological criteria, dimensions of vertebral corpus, width of pedicules, inter-articular distance, distance between inter-articulary lines and center of vertebral body, odontoide height, ordontodie-clivus distance and odontoide posterior arch in C1. Degeneration of rachis was evaluated with the Matsumoto score. The size of the rachis canal was measured at all three discal levels between C2C3 and C7T1 by medullar-ductal index. Two groups of 35 subjects have been created with an average age of 21, years ± 5.51 (players) et 26.3 ± 4.95 (control) ($p < 0.001$).

Results: There are significant difference concerning nearly all of the analysed morphologic parameters. This can be attributed to the usually impressive build of rugby players but the analyse of height has shown a significant flattening of the vertebral body (Table 1). Study of ROC curvatures show that this phenomena of platyspondyly can be evoked for the relations between 0.56 and 0.7 concerning vertebrae in question (graphic 1, case shown in Fig. 1). Study of degenerative lesions show more serious discopathies in the control group (33 vs. 6 $p < 0.0001$), no difference in other degenerative parameters (foraminal stenosis, discal protrusion, loss of disc height). The players had a significantly narrower canal in C4C5.

Conclusion: This study suggests a bone remodelling of the cervical rachis of rugby players marked by a phenomenon of platyspondyly. Our control group showed more marked degenerative lesions, the narrow canal of the rugby players seems to be a result of morphologic adaptation

Table 1: morphologic parameters and medullar-ductal index of male rugby players versus control group.

Sujets masculins	JOUEURS Moyenne (variance)	SUJETS CONTROLES Moyenne (variance)	P test de Student
Index médullo-canalaire C4-C5	0,62 (0,0039)	0,57 (0,0039)	P = 0,0023
Rapport H/AP C3	0,64 (0,0125)	0,78 (0,0065)	P < 0,0001
Rapport H/AP C4	0,61 (0,027)	0,75 (0,0074)	P < 0,0001
Rapport H/AP C5	0,57 (0,0091)	0,75 (0,0032)	P < 0,0001
Rapport H/AP C6	0,54 (0,0127)	0,71 (0,0066)	P < 0,0001
Rapport H/AP C7	0,67 (0,0082)	0,84 (0,1824)	P=0,0060

EFFICIENCY OF CREATION OF A RAAC TREATMENT IN A HOSPITAL UNIT FOR RACHIS SURGERY

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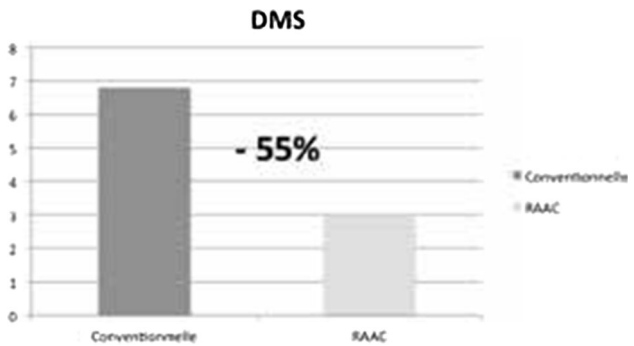
Introduction: The treatment of patients using the Réhabilitation Améliorée Après Chirurgie (RAAC) or improved rehabilitation after surgery model has been analysed and allows to reduce mortality and morbidity at a long term while reducing the duration of hospitalisation and associated costs. Numerous data exist in digestive, vascular or even orthopaedic surgery, only little for rachis surgery. None concerned public structures. Our aim was to evaluate the impact of a RAAC program on the average duration of hospitalisation and to assure the absence of an increase of the number of complications or re-hospitalisation.
Materials and methods: To measure the impact of RAAC in our department we have compared to close periods before (01 05 2017 to 31 10 2017) and after (01 05 2018 to 31 10 2018) introduction of RAAC in our structure. To start the RAAC program we have decided to select the simplest pathologies (anterior cervical arthrodesis + cervical laminectomy + lumbar herniated disc + lumbar liberation + posterior and anterior lumbar arthrodesis) and patients (ASA 1 and 2, autonomous). Based on the criteria, we have chosen patient files for two periods operated by the 2 same surgeons. Judgement criteria were DMS and re-hospitalisation rate in 3 months.
Results: 91 patients have been included of whom 49 were in the RAAC group. The groups were comparable in age, sex, history of rachis surgery and score ASA ($p > 0.05$). Instrumented surgery represented 59% of the sick In RAAC group and 39.5% in control group ($p = 0.11$). DMS was 3 days for RAAC group and 6.8 days for control group ($p < 0.001$). In 90 days there were two re-hospitalisations in RAAC group and 1 in the control group ($p = 1$).
Conclusion: Introduction of a RAAC program in our structure resulted in a drastic reduction of DMS for a pert of our patients without an increase in long term complications. Continuing the evaluation of our practices will allow us to judge, at long term, the efficiency concerning reduction of morbidity, only real aim of RAAC.



COMMUNICATIONS: Flash and innovations

FACETED ARTHRODESIS BY FFX CAGE: EVALUATION RESULTS AFTER 1 YEAR AND 130 IMPLANTS CONCERNING 35 PATIENTS

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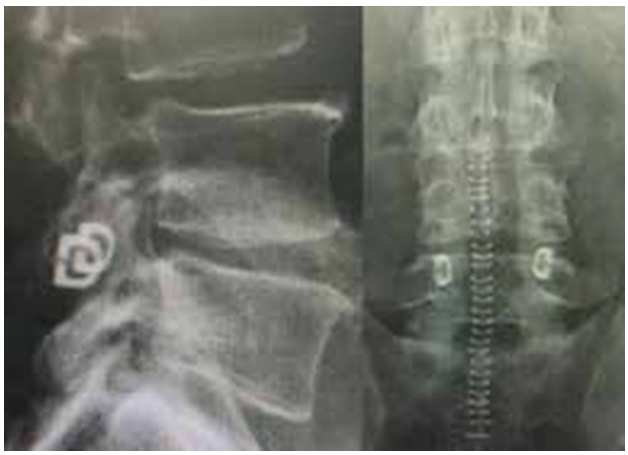
Introduction: The reference treatment for faceted degenerative troubles such as narrow lumbar ductus is decompressive laminectomy. This creates however a risk of instability of the rachis. Faceted osteosynthesis allows to prevent such a risk. The aim of this study is to evaluate realised osteosynthesis with a new faceted cage (FFX)
Materials and methods: 35 patients suffering from degenerative lumbar ductal narrowing have been analysed in this study, with a follow up of 1 year after intervention. All have been operated with FFX associated to decompressive laminectomy. Two surgeons have realised the interventions and the patients have been included after each of them had realised 5 operations with this device. The evolution of the patients has been evaluated in terms of invalidity level with Oswestry Disability Index ODI and felt pain with visual analgic scale EVA of back and leg pains. Scans have been realised to control the fusion rate and eventual migrations of cages. All evaluations have been realised by an independent evaluator.
Results: 18 men and 17 women have been included (average age 66.3 years) with FFX implanted on four lumbar levels (71% of patients operated on one or two levels). A total of 130 cages have been implanted. Patient pain was evaluated with EVA scores for legs (back) and have shown a significant improvement − 5.5 (5.5) on the average in pre-operative phase versus 1.5 (2.6) after 1 year ($p < 0.05$). The ODI scores have also shown a strong improvement changing from 43.0% in pre-op to 19.1% after 1 year ($p < 0.05$). Visual inspection after 1 year of scans have shown no migration of cages compared to images realised immediately in post-op. Fusion rates of facets were 83.8% (109 cages of 130) and 1 cage (0.8% of total) was considered by he evaluator as badly positioned. No pre-op complications and no surgical reprisals.
Conclusion: FFX associated to a decompressive laminectomy allowed a strong improvement of functional capacities and pain of patients operated for narrow lumbar canal, assuring at the same time a satisfactory facet fusion. This technique could be an alternative with less risks and quicker than osteosynthesis by pedicular screws for the treatment of faceted troubles of older patients.



PERCUTANEOUS HARMS TECHNIQUE FOR ODONTOID FRACTURE USING INTRA-OPERATIVE CT NAVIGATION SCAN

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Introduction: Odontoid fractures are the most common fractures in the upper cervical spine in the geriatric population. The development of minimally invasive techniques associated with intraoperative 3D imaging-navigation systems can lead to a better implant placement while reducing postoperative neck discomfort. We present here the technique and results of a percutaneous atlantoaxial fusion in these patients.
Materials and methods: This is a retrospective study of 5 patients suffering from post-traumatic odontoid type II fracture. They underwent a percutaneous posterior C1–C2 fixation with AIRO CT scan coupled to the BrainLab navigation system between January 2017 and December 2017.
Results: C1 lateral mass screws and C2 pars screws were successfully placed and considered acceptable. 18 screws (90%) were Grade 0 and 2 (10%) grade I. No intraoperative complication such as vertebra artery, spinal nerve root or spinal cord injuries were reported. No blood transfusion was needed. The mean follow-up was 15.2 months (6–29 months). At last follow-up, 4 patients (80%) exhibited a favourable clinical recovery and only 1 patient required occasional painkiller. Satisfactory evolution of the scar was noted in all patients. All patients exhibited radiological signs of fusion at last follow up. The mean radiation exposure for each patient was 4.83 mSV and 0 mSv for surgical staff.
Conclusion: Minimally invasive atlantoaxial osteosynthesis using an iCT system is a safe and an effective alternative to the conventional approach reducing post operative morbidity.

PRE-OPERATIVE 3D NAVIGATION FOR PERCUTANEOUS SPINAL SURGERY USING THE SURGIVISIO SYSTEM: A FIRST CLINICAL SERIES

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Introduction: The "all-in-one" Surgivisio system is a new generation of intraoperative 3D imaging technique used for pedicle insertion in minimal invasive spine surgery. The purpose of this study was to evaluate accuracy of pedicle insertion (screw placement) and the radiation exposure with the Surgivisio system. We suppose that our findings are comparable to the literature.
Materials and methods: Between January 2018 and December 2018, every patients operated for percutaneous spine surgery using the Surgivisio system were included in this prospective single center study. Accuracy of screw placement was assessed using the Heary and Gertzbein classifications. Operative time and radiation exposure were assessed.
Results: A total of 29 patients were included with 173 pedicle screws. Among them 112 were evaluable with high-resolution CT-scan. Using Heary and Gertzbein classification 95.5% (107, 112) were rated as acceptable. Only 4% of the whole screws had medial breach with less than 2 mm of cortical effraction without clinical consequences. The mean operative time was 29.3 min per vertebra. The mean dose area product was 8.07 Gy cm^2. The internal radiation exposure (E PCXMC ICRP 103) was 1.97 mSv per patient and the mean radiation exposure for each vertebra was 0.61 mSv.
Conclusion: The Surgivisio system is an efficient navigation tool for pedicle insertion in minimal invasive surgery. It improves the accuracy of screw placement for more safety with a low radiation exposure.

POSTERIOR PERCUTANEOUS FIXATION C1–C2–c2 AND T1–T7 WITH ROBOTIC ARM CIRQ FEASIBILITY AND LIMITS

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Introduction: Pedicle screw placement remains challenging in the cervicothoracic spine. We present our first experience of a percutaneous posterior C1–C2 and T1–T7 fixation for traumatic fractures.
Materials and methods: This is a case report of 2 non-neurological patients, the first harbouring a type III odontoid fracture and the 2nd a type B T3-4 fracture. They both underwent a posterior percutaneous fixation using Cirq® Robotic Assistance coupled to the AIRO iCT-Scan and BrainLab navigation system. Routine computed tomography was performed on postoperative day 2 to evaluate pedicle screw placement. The effective dose was calculated.
Results: The first patient underwent a C1-C2 posterior percutaneous fixation [cannulated VERTEX® Reconstruction System (MEDTRONIC®)] whereas the 2nd a T1–T7 posterior percutaneous fixation [CD HORIZON® LONGITUDE® II (MEDTRO-NIC®)]. Overall, 14 screws were placed. All of them were rated as acceptable (100%) according to the Heary classification. Radiation dose received by the first patient was 4.8 mSv and 15 mSv by the 2nd patient. Radiation dose received by the surgical staff was 0 mSv.
Conclusion: Posterior percutaneous fixation using Cirq® Robotic Assistance coupled with iCT navigation system is a major innovation that can improve pedicle screw positioning's accuracy with acceptable patient radiation and reduced surgical team exposure

SIMULATION ON SYNTHETIC BONES: A PEDAGOGIC TOOL FOR TEACHING THE AIMING OF THORACIC-LUMBAR PEDICULAR

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Introduction: Simulation in training of internals plays a more and more important role. The gold standard of theoretical training of the pedicular aim is done with anatomical subjects. Availability of the body represents a limit in this kind of training. The aim of the study s to verify if training on models in synthetic bone allows to improve teaching of placement of pedicular screws.

Materials and methods: 23 internals in orthopaedics or neurosurgery have received a theoretical raining concerning pedicular manual screwing. 7 internals had experiences with pedicular screws. After random draw, 11 internals have received training on synthetic bone (group 1) and 12 did not receive practical training (group 2). Afterwards, each student has placed 2 thoracic screws (T7–T11) and two lumbar screws (L1–L3). The corpses and the synthetic models were analysed by tomodensitometry to evaluate the trajectories of the screws concerning pedicular axis, as well as the effraction rate according to Gertzbein (grades 0 and 1 = good positioning, grades 2 and 3 = effraction > 2 mm).
Results: The pedicular axis on the average of the screw were, respectively, $10.0° \pm 2.6°$ et de $16.2° \pm 7.8°$ for thorax + $18.0° \pm 4.7°$ et de $25.8° \pm 9.5°$ for lumbar screws. Effraction grades 2 and 3 ratio was − 10 thoracic pedicules (45%) and 5 lumbar pedicules (23%) on synthetic bone, 17 thoracic pedicules (37%) and 11 lumbar pedicules (24%). By comparing the internals of groups 1 and 2 there was no significant difference concerning effraction rates on corpse ($p = 0.648$). Comparing 7 internals with experience in pedicular screws to 16 novice internals there was a significant difference ($p = 0.0403$).
Conclusion: The theoretical raining associated to a simulation model is interesting for the explanation of the surgical technique. However, the practical works seem to be insufficient to teach pedicular screwing and can not replace progressive training such as accompanying rachis surgery.

BIOMECHANICAL STUDY OF PULLOUT RESISTANCE OF SUB-LAMINAR LINK ON OSTEOPOROTIC SUBJECTS

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Introduction: Pedicular screws are the gold standard in lumbar arthrodesis. Other types of implants are also used, such as hooks (sublaminar or pedicular), sub laminar cables, sub laminar links, especially in surgery of idiopathic scoliosis. Each type of fixation has advantages and disadvantages based on the indications. Numerous studies have shown that the failure rate of assembly and especially pullout of screws is correlated to bone quality of the patient. The aim of our work was to compare, on vertebrae of human corpses with osteoporosis, the pullout resistance of a standard pedicular screw with assembly allowing to combine with minimum encumbrance, the pedicular screw and sub laminar link.
Materials and methods: We have used a system of pedicular screws, sub laminar link and an implant combining screw and band. Four groups have been created—screw only, link only, screw on link on same vertebrae, screw and link combined in one implant. 10 lumbar columns have been extracted from fresh frozen corpses and each lumbar vertebrae has been individualised and carefully cleaned of dead tissue. 30 vertebrae have finally been used for biomechanical tests. Each vertebrae has been covered in PMMA resin and was held by a screwdriver to maintain the axis of the pedicular screw in a vertical position in order to maintain this axis of traction. After instrumentation, each vertebrae has been radiographed to control implant position. Pullout tests have been realised. A universal test machine has been used for this. The vertebrae was tightly fixed at the base of the machine and the rod was fixed to the traction module.
Results: Analysis of Student tests have shown that the breaking load was significantly higher for the group combining screw and link. There is a significant correlation between bone material density and breaking force in the group "pedicular screws". No correlation has been identified between mineral bone density and breaking force in the group "sub laminar link".
Conclusion: Our results show that a combined assembly of pedicular screw and link on the same vertebrae increases pullout resistance. The implant allows to combine screw and link and is less cumbersome and gives the same results.

SCREW WITH SUPERIOR CHARGE VERSUS SCREW WITH LATERAL CONNECTION: IS THEIR AN IMPACT ON CORRECTION ON SAGITTAL LEVEL? RESULTS OF A BIOMECHANICAL STUDY

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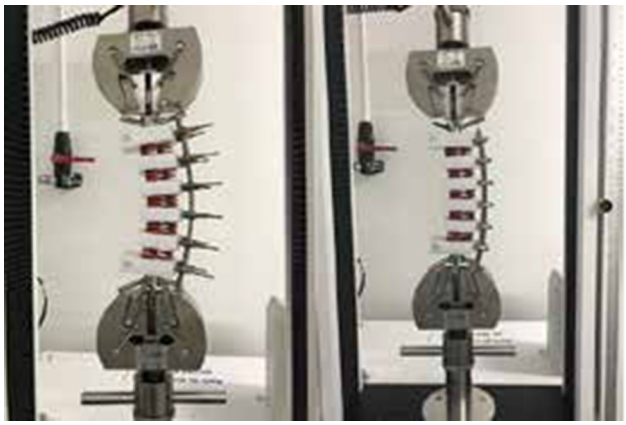
Introduction: Sagittal rachis disequilibrium is known to have a strong impact on patient's quality of life. Restoration of sagittal parameters is a key element in surgical treatment of patients with a bad alignment and includes usually a gesture of bone resection and posterior vertebral fixation. However, the flattening effect of rods in relation to the type of screw used is not well known. Aim of this study was to quantify the flattening effect of pre-bend rods in relation to connection type screw-rod-screw with superior charge versus screw with lateral connectors.
Materials and methods: Several series of mechanical tests have been realised in an axial compression machine on 3 assemblies using 2 fixed rods with fixation screw with superior charge and 3 assemblies using 2 fixed rods with screws with lateral connectors. Angles have been measured after application of load and after load removal. The main judgement criteria was the comparison of the average abgulation of each type of assembly at each step. For eh test, the rods used (6.5 mm) had an identical determined bend radius of 36.7°.
Results: Average angulation of assemblies with screws with superior charge at 500 N versus 18.6° versus 24.5° ($p < 0.05$) on the average for assemblies with screws with lateral connectors. The bend radius, average residual, of rods from assemblies with screws with superior charge after assembly was 25.7° versus 32.3° ($p < 0.05$) on the average for assemblies using screws with lateral connectors.
Conclusion: Using screws with superior charge leads to a flattening of the initial bend of the rod. This can be the cause for a less efficient correction on the sagittal level due to flattening (plastic phase). But, use of lateral connectors allows to reduce the flattening effect for the rod that stays elastic and can thus allow to obtain a better correction in the sagittal level. Surgeons must know about the flattening factor based on type of screw used and can allow a better choice of material based on desired correction.



	Vis à chargement supérieur	Vis à connecteur latéraux	*P value*
Angulation initiale	36,7°		
Angulation après verrouillage de la tige	18,7° [18,2°-19,2°]	24° [22,6°-25,4°]	p<0,0007
Angulation après remise en charge 500N	18.6° [18.1°-19.1°]	24.5° [23.1°-25.9°]	p<0,0003
Angulation après retrait de la charge (0N)	15,7° [15,2°-16,2°]	22,7° [20,6°-24,8°]	p<0,0006
Angulation après retrait du montage	25,7° [25,2°-26,2°]	32,5° [31,8°-33°]	p<0,0005

BIOMECHANICAL STUDY IN VITRO TO TEST A NEW FIXATION FOR LUMBAR FRACTURES TYPE A3

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Introduction: Thoracic-lumbar fractures in compression are frequent and their is no consensus concerning their surgical treatment. The aim of this study is to compare the displacement of a load of a fractured instrumented rachis segment in different ways, including a new fixation technology associating in one implant the pedicular hold connected to classic rods and a kyphoplastiy device of the type SpineJack (Stryker).

Materials and methods: Study realised in vitro on 7 rachis segments from corpses. Mineral bone density was measured using a calibrated CT scanner. A fracture type A3 was realised in L! Based on a published impaction protocol. The 3 types of instrumentation were − 1) rods and pedicular bilateral screws in T12 an L2 + 2) instrumentation 1 + SpineJack, bilateral, in L1 connected to rods without cement + 3) instrumentation 2+ cement insertion in L1. Pure moments were imposed to the specimen in an incremental way in flexion, extension, lateral inclination and torsion, up to 7.5 Nm. Relative displacements of T12 in relation to L2 were measured by EOs imagery.

Results: Two groups, group A with 5 specimen and group B with 2 specimen. Group B showed higher mobility amplitudes and an inferior mineral bone density and a maximum average effort to impact which was inferior. Significant reduction of motility for the three types of loads between instrumentation 1 and 2 and for all specimen—Extension flexion—average reduction of 51.7% in group A and − 27.9% in group B xnnnbv-Lateral inflexion—average reduction − 25% group A and − 5.6% group B—Torsion—average reduction − 37.2% group A and − 18.2% group B. No signification modification of mobility between instrumentation 2 and 3 in group A. In group B, modification of mobility between instrumentation 2 and 3 (− 0.3° in FE + 0.9° in IL and − 1.8° in torsion).

Conclusion: Significant reduction in mobility in all directions with addition of mixed fixation of type SpineJack + rods and pedicular screws at the level of the fractured vertebrae compared to a standard pedicular instrumentation − 1 + 1 only. Supplementary increase of assembly rigidity by adding cement in the fractured vertebrae with MBD at the lowest (little influence on specimen with MBD being highest).