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REVIEW ARTICLE

The Michel Benoist and Robert Mulholland Yearly European Spine Journal Review: A survey of the "medical" articles in the European Spine Journal, 2018

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Introduction

In the 2018 volume of the European Spine Journal, I have found a number of important "medical" papers, which have increased our knowledge in several aspects of spinal disorders. This year's production is characterized by the overall high scientific quality of the papers and by the variety of subjects treated in research and clinical studies as well.

Firstly, we were reminded in two papers analysed later [1, 2] that "the common goal in clinical research is to measure the probable effect of an intervention in clinical practice, and that appropriate statistical analyses are necessary for generalizing the results". Secondly, progress in MRI imaging, allowing quantification of intervertebral disc heterogeneity and more useful insights of the end plates is being developed. Thirdly, the rate of *Propionibacterium acnes* infection in the etiology of degenerative disorders is still a matter of debate, now focusing on the value of the different bacteriological procedures in order to find evidence of this role and the eventual therapeutic consequences. Finally, recent advances are revisited, concerning the hip-spine syndrome, the interest of full-body sagittal profiles classification (including the lower limbs) and the value of patients' self-rated outcome and assessment following spinal surgery. Also included in my review is a paper dealing with the use of the smartphone app in self-management of chronic LBP in order to maximize activity level and compliance to home-exercise programs.

Descriptive statistics and clinical significance

In a letter to the editor published in the May issue, Saltychev et al. [1] point out the difficulty in generalizing the results of a well-conducted, controlled trial with appropriate statistical significance to a different sample of the general population. The authors of this letter draw attention to a few statistical considerations, reminding for example that *p* value evaluates the presence of a statistical difference between two interventions, but not the size and the difference between the two groups. The authors give as examples the results of nine well-conducted RCTs, published in the European Spine Journal in 2017, with important objectives and impressive samples. They reported that out of the nine trials, only two employed 95% confidence intervals to describe the results. When dealing with rate of event (reoperation, adverse effects, etc.) only one study used a relative risk ratio (RR) and a 95% CI to describe the findings. The absence of reporting effects sizes creates an uncertainty as to whether the effect observed in a sample would also work in other populations. The authors also point out the difficulty for many clinicians who do not have a substantial statistical competence to correctly evaluate generalization.

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In the same issue, a remarkable Editorial is presented by Edwards [2]. All the subjects and others concerning generalizing the results are reviewed and discussed. The Editorial emphasizes the fact that incomplete statistical analyses may lead to incorrect conclusions with serious implications for patients.

Imaging

In the May issue of the Journal, the reader will find articles analysing new aspects of the capacity of MRI to evaluate spinal abnormalities.

The research paper by Waldenberg et al. [3] describes a technique allowing quantification of intervertebral disc heterogeneity by using regional variations in signal intensity across the IVD tissue. Forty-nine IVDs in ten LBP patients were examined with MRI. Histograms of well-hydrated IVD showed two clearly separated peaks (annulus and nucleus) whereas decreased separation was shown in degenerated discs with a good correlation with the Pfirrmann grading. The authors conclude that histogram analysis could be used for continuous classification of IVD degeneration. Hopefully, in the future, histograms could distinguish asymptomatic from symptomatic individuals.

Axial loading during MRI in low back pain patients and controls is discussed in an article by Hebelka et al. [4], published in the November issue. The paper aims to investigate whether LBP patients and controls show different image characteristics during load measured by T2-mapping. Twenty-four severe chronic LBP patients (120 IVDs), mean age 39 years, were examined with T2-mapping without loading and during loading, using a validated compression device, applying loading forces simulating in spine position those obtained in upright position. Twelve age-matched controls (60 IVDs), mean age 38 years, were recruited for comparison. The IVD-T2 value was obtained after 20 min of loading in five regions of interest, from anterior to posterior. Methods to calculate T2-values are exposed in detail in the paper. They were compared between loading states and cohorts. Disc degeneration was graded according to the Pfirrmann classification. Results concerning both T2-values of the entire IVD and of sub-regions of the IVD are reported in detail. As reported in the Conclusions, "the load-induced differences in T2-value between patients and controls probably indicate biomechanical impairment in the posterior IVD regions. Load-induced MRI combined with T2-mapping may offer a feasible clinical tool for biomechanical IVD characterization".

Diagnostic accuracy of MR-imaging for visualization of spondylolysis in children and young adults is discussed by Dhouib et al. [5], in the May issue. CT scanning is considered as the gold standard for diagnosis of spondylolysis in children and young adults. However, CT induces a significant dose of radiation which can be harmful in a young, still-growing population. The present article is the first systematic review and meta-analysis to determine whether MRI could be used to detect the past defect as a first-line technique, thus eliminating the risk of radiation. Out of 1300 initial identified studies, the authors selected six studies for qualitative synthesis, and four for quantitative synthesis. All patients had an MRI and a CT scan, used as a gold standard. The methodological quality was assessed using the QUADAS 2 tool. Two studies were excluded because of methodological bias. In total, four studies were included in the meta-analysis. The pooled sensitivity and specificity in a total of 1122 pars were, respectively, 81% (95% CI 54–94%) and (95% CI 98–100%). The authors conclude that because of the high diagnostic performance in detecting a pars defect in their meta-analysis, MRI could be used as a first-line technique.

EOS micro-dose protocol for the radiological follow-up of in-brace adolescent idiopathic scoliosis is presented in a prospective study by Morel et al. [6], published in the May issue, comparing the radiation dose, image quality and 3D parameter measurements of micro-dose versus low-dose EOS protocols. It has been shown that EOS low-dose images and 3D models are a useful tool for the radiological follow-up of AIS, decreasing the radiation exposure and providing a good image quality [7]. In the present study, 27 consecutive AIS patients (mean age 12 years) underwent an in-brace biplanar EOS radiograph in standing position, using both the conventional low-dose and micro-dose protocols. Radiation exposure as assessed by DAP (dose area product) was dramatically reduced with the micro-dose protocol by a factor of 5–7 as compared to the low-dose protocol. This is an important safety point. The image quality was reduced but, according to two senior radiologists, it was still adequately adapted for image quality and reliable clinical measurements.

Anterior cervical discectomy and fusion versus cervical disc arthroplasty

Which type of treatment is the most effective and safe? The debate is still ongoing. The article by Kelly et al. [8] published in June investigates short-term peri-operative complication rates and longer-term rates of subsequent cervical surgeries, following ACDA and ACDF, in a large administrative database: 52,395 cases identified with ACDF and 469 ACDA between 2003 and 2010. Using a multi-variate regression analysis, the authors found that peri-operative complications were similar between the two groups which used the same approach—decompression and interbody device placement. Subsequent cervical spine surgery was more common in the immediate peri-operative period in the ACDF group (within 90 days). However, at 1-, 3- and 5-years follow-up, rates of subsequent surgeries were similar between the two groups. The

authors conclude that the overall rate of reoperation was rare: 2.4 surgeries per 100 patient-years in this very large cohort, and that no protective benefit against secondary surgeries was found when comparing the two procedures. There is an interesting discussion and extensive review of the literature.

Decompression with or without concomitant fusion in lumbar stenosis due to degenerative spondylolisthesis

I recommend a careful reading of the paper by Dijkerman et al. [9], published in July, dealing with the still-controversial debate as to whether adding fusion to decompression in patients with lumbar stenosis due to degenerative spondylolisthesis achieves better results than decompression alone. This is a systematic review of 11 studies, with a total of 3119 patients, including two RCTs, two prospective-controlled cohort studies and seven retrospective-controlled cohort studies. The risk of bias, assessed by using Cowley's checklist, was low in two studies, medium in seven, and high in two. Since only two studies had a low risk of bias, and because of the heterogeneity of findings between studies, the quality of evidence is low. Multiple outcome measures were used in this review, leading to comparable results between the two procedures, especially regarding the most important outcome measure: the ODI. The absence of difference in ODI score outcome in two RCTs and three retrospective studies constitute a strong indicator that there is no difference in functional outcome between the two procedures. The authors conclude that decompression alone is more cost-effective and presumably with fewer complications. In the absence of sufficient evidence that adding fusion leads to better outcomes, they recommend treating patients with low-grade spondylolisthesis and predominant leg pain by decompression alone. In contrast, patients with high-grade spondylolisthesis, foraminal stenosis and vertebral instability should be treated with concomitant fusion. Concerning low back pain, four out of six studies, having measured improvement of back pain, found a significantly better outcome in the fusion group, with a low level of evidence.

Lumbar total disc arthroplasty

Two articles devoted to lumbar total disc replacement (TDR) were published in the March issue of the journal. The paper by Furunes et al. [10] aimed to identify patient characteristics, which could be predictors of favourable long-term outcome after total disc replacement. Eighty-two patients, aged 25–55 years, with chronic LBP and degenerative disc, who originally participated in an RCT comparing TDR with multi-disciplinary rehabilitation, were treated with TDR and follow-up during 8 years. Primary outcome measure was change in ODI; an improvement of over 15 points in ODI was defined as a minimal clinically important improvement. The secondary outcome measure was self-reported work status at 8-year follow-up. Various socio-demographic, clinical, psychological and radiological independent variables were modelled using logistic regression. The secondary outcome was expressed as probabilities. Seventy-one patients out of 82 achieved a follow-up of 8 years. Of these, 52 (63%) disclosed a clinically important improvement and 42% were employed at 8 years' follow-up. Out of all assessed baseline variables, only Modic changes (type 1 and/or 2) were significantly associated with an improvement of over 15 ODI points. Comorbidities, low level of education, long-term sick leave and high ODI score at baseline were associated with unemployment. There is an interesting discussion and pertinent review of the literature.

The paper by Plais et al. [11] analyses prospectively and at long-term follow-up the results of a cohort of patients operated by Maverick total disc replacement between 2002 and 2007. From an initial cohort of 87 patients, 61 were available at 10-year follow-up. Patients were examined preoperatively at 3 months, 2 years and at 10 years postop. The clinical outcome measures consisted of VAS and ODI. Imaging studies allowed measurements of range of motion, adjacent segment disease, and pelvic and lumbar parameters. Overall, a significant mean decrease of 21 ODI points was observed at 10-year follow-up. The lumbar pain VAS improved in an absolute value of 3.85. It is important to note that these results were obtained in different types of constructions. There were 54% single-level, 3.5% multi-level and almost half (42.5%) of hybrid constructions. The authors state that no difference in clinical outcome at long term was detected between the hybrid group and the single or multi-level groups. At 10 years, 62.9% of the patients had returned to work. Assessment of the surgical balance showed a great efficacy of TDR to maintain the sagittal balance. Mobility of the prothesis was preserved in 76% of the cases. Safety of the procedure is clearly described and classified. The overall rate of complications at 10 years is 27.2%. At long term, no breakage or subsidence of the device was observed. Adjacent segment degeneration was detected in eight out of 62 patients, indicating that TDR was not clearly protective against ASD.

Low back pain, Modic changes and low-grade infection in lumbar and cervical spine

Modic changes in MRI patients with chronic persisting low back pain suggest inflammation of the end plates and of the disc, as shown by the change of disc signal intensities. Moreover, the link between infection by *P. acnes* and low back pain and disc degeneration and herniations is still controversial. It is also unknown whether disc and bone marrow cells can respond to *P. acnes* and disc metabolites draining from infected discs.

In an in vitro study published in May, Dudli et al. [12] have co-cultured human disc cells with *P. acnes*, using lipopolysaccharide as a positive control. *P. acnes* had been isolated from discs adjacent to Modic changes from a human L4-L5 disc. Expression of IL1, IL8 and CCL2 was evaluated by a quantitative PCR. All disc cells responded to polysaccharide but only six out of 10 responded to *P. acnes* with an increased expression of inflammatory cytokines. The four non-responding cell lines were all from patients without lumbar Modic changes. Lipase activity also measured a virulence factor, secreted by *P. acnes*, and was increased independent of disc cell responsiveness. Human vertebral bone marrow mononuclear cells also responded with inflammatory activity, but only when cultured with supernatants from responding disc cell lines. The authors conclude that disc cell responsiveness is associated with the presence of lumbar Modic changes and that bone marrow cells yield an inflammatory response to the cocktail of disc cytokines and *P. acnes* metabolites.

In a letter to the editor published in the February issue, Capoor et al. [13] discuss the role of *P. acnes* infection in the etiology of degenerative disc disease. Direct evidence of *P. acnes* biofilm in degenerated disc tissue, as well as experimental induction of DDD in an animal model using *P. acnes*, and epidemiological evidence constitute for the authors of the letter solid evidence that *P. acnes* is emerging as an etiological factor for DDD and chronic low back pain. However, in a prior article published in the August 2017 issue of ESJ, Alamin et al. [14] failed to find evidence of any bacterial DNA from 44 LBP patients with radiculopathy due to a discal herniation treated by microdiscectomy. Analysis of the discal tissue consisted of a PCR/amplicon sequency assay used for the routine diagnosis of invasive infections and considered by Alamin et al. to be of higher sensitivity and specificity than the bacterial cultures used in previous studies.

In their letter, Capoor et al. critically examine the paper by Alamin et al., disputing their conclusions for methodological reasons. In short, the PCR assay used by Alamin et al. could work well for the diagnosis of invasive infections, but does not necessarily have the sensitivity required for the detection of low-virulent disc infection, thus leading to false negative results. In their answer to the letter, Alamin et al. [15] also raised methodological concerns and critically questioned Capoor et al's 2016 paper. Obviously, the debate between experts is still open.

The paper by Yuan et al. in the October issue [16] aims to determine whether latent infection by *P. acnes* in the intervertebral disc is associated with chronic inflammation, as demonstrated by quantification of cytokines and of neutrophils. Seventy-six degenerated disc samples obtained from patients operated for LBP and sciatica (70 disc herniations) were studied. Presence of *P. acnes*, identified using anaerobic culture and 16S rDNA PCR, was demonstrated in 15 samples, which were further studied in histology and defined as the *P. acnes*-positive group. Fifteen discs were also selected from the remaining 53 bacteria-free samples, forming the *P. acnes*-negative group. Seven of the 15 samples from the *P. acnes*-positive group had visible bacteria under microscopes, as shown in a figure. The two groups were matched for quantification of cytokines and neutrophils. There were significantly more neutrophils in the *P. acnes*-positive group. Concentration of IL-8 and MIP-alpha was significantly higher in the *P. acnes*-positive group. A subgroup analysis of seven of 15 *P. acnes*-positive samples, histologically positive, had the highest concentrations of IL-8, MIP-1 alpha, MCP-1, IP-10 and TNF-alpha and the greatest number of neutrophils. There was a trend with a higher proportion of Modic changes. The *P. acnes*-positive group had significantly lower height of the intervertebral disc. In addition, the increased cytokines also indicated that some isolated *P. acnes* samples were definitely from original growth rather than from contamination. In conclusion, the authors state that latent infection with *P. acnes* is associated with chronic inflammation and disc degeneration, and that targeting with *P. acnes* or activated inflammation may be a suitable alternative therapy method for the future.

Reports of the prevalence of low-virulence disc infection in the cervical spine are rare. For this reason, the article by Chen et al. [17] published in the October issue is particularly valuable. This is a prospective case series of 32 patients who underwent anterior cervical discectomy and fusion for degenerative cervical spondylosis or traumatic cervical cord injury. All patients underwent cervical X-ray, CT and MRI. Disc samples obtained under strict sterile conditions were cultured under anaerobic conditions, followed by identification of the resulting colonies, using the PCR method. Full description of the laboratory techniques is provided in the paper. A total of 66 discs were excised. Positive disc cultures were found in nine discs (13.6%). The muscle biopsy control cultures were negative in 28 patients and positive in four patients, three of whom had negative disc culture. Seven

discs were positive for coagulase-negative staphylococci and two discs were positive for *P. acnes*. None of the four trauma patients had positive disc cultures. There was a significant association between positive disc cultures and type of herniation. Positive disc cultures were detected in only one out of 30 discs (3.3%) with bulge or protrusion, but in eight out of 35 (22.9%) with disc extrusion or sequestration associated with complete annular tear. This latter association, as well as the younger age of the infected patients, leads the authors to conclude that the route of infection in cervical discs is predominantly through an annulus fissure.

Endplate lesions of the lumbar spine

The article by Brayda-Bruno et al. [18] published in the November issue introduces a new methodology for classifying endplate defects in a large population of chronic LBP patients (n: 996). This is a purely radiological assessment based on T2-weighted MRI imaging, without reference to clinical aspects. All intervertebral spaces were classified as: normal, wavy/irregular, notched, Schmorl's node and fracture. Lesions are well defined and illustrated in the text. Associations between endplate lesions and age, sex, disc degeneration (Pfirrmann classification) and Modic changes were also determined. Inter- and intra-observer reliabilities were validated. Interesting epidemiological data were disclosed. Lesions were more common in males than in females. In most patients, no endplate lesions were detected, with a significant difference between male (55.7%) and female subjects (67.9%). Overall, lesions were found to be associated with intervertebral disc degeneration. Severe endplates lesions (Schmol's node or fracture) were associated with Pfirrmann graded 4 and 5. There was a weak association of lesions with age, stronger in females than in males. The paper contains an interesting discussion and reference to the previous MRI-based classification systems, especially those supporting the concept of endplate defects as sources of pain. In the future, the use of standing MRI and development of MRI technology may bring more information and possibly additional radiological lesional features.

The paper by Liu et al. [19] published in the January issue is an interesting pilot study, aiming to determine whether discography and discoblock could identify the painful Schmorl's nodes (SN) and provide pain relief. Forty-six patients with LBP, non-responding to conservative treatment and with an MRI-scan demonstrating at least one SN with an oedematous rim in the cancellous bone on T1 and T2-weighted imaging, underwent a fluoroscopy-guided discography. If the patient experienced severe pain after injection of contrast medium reproducing his usual back pain, SN was defined as positive and a mixture of betametasone and ropivacaine was injected. Discography was performed on 60 discs, which were positive in 71% of cases. Clinical evaluation was performed 4 h after the procedure and at 1, 3, 6 and 12 months after the treatment. Outcome measures included VAS scores and ODI. Among the positive patients, 89% reported immediate improvement, persisting at long term. At 12-month follow-up, MRI evaluation showed no more evidence of bone marrow oedema and inflammation. These interesting positive results need to be confirmed in a larger sample of patients. The authors also suggest that painful NS appear to be caused by inflammation and pressure on nociceptors within the oedematous area.

The hip-spine syndrome

Offierski and Macnab [20] described this syndrome in which advanced stage of hip osteoarthritis causes flexion contractures of the hip, leading to compensatory changes of the lumbar spine. Interrelation between hip pathology and secondary sagittal spino-pelvic alignment changes is the subject of several interesting papers in ESJ this year.

The purpose of the study by Day et al. [21] published in the September issue is to examine the effect of hip osteoarthritis (OA) on spino-pelvic, global, regional and lower-extremity parameters in patients with a radiographic sagittal spinal deformity. The radiologic analysis compared the spinal parameters between patients with severe OA (SOA) and patients with limited OA (LOA). Hip severity was graded by Kellgren-Lawrence scale. All included patients underwent low-dose radiation: head to foot, biplanar, stereoradiographic images (EOS). Patients were matched for age and TPA (T1-pelvic angle). Numerous spino-pelvic and lower-extremity parameters were measured. They are described and illustrated in detail in the paper. One hundred and thirty-six patients meeting the inclusion criteria defined in the text were included in the study analysis, consisting of 68 LOA and 68 SOA. Conclusions of the study are: patients with coexisting spinal malalignment and SOA compensate by pelvic shift and thoracic hypokyphosis rather than by PT, likely as a result of limited hip extension, secondary to SOA. As a result, SOA have worse global sagittal spinal alignment than their LOA counterparts. Lower-extremity compensatory mechanisms are also compared between the two populations.

The paper by Piazzolla et al. [22] published in the January issue deals with the relationship between hip and spine disorders. More precisely, the authors intend to clarify the link between femoral neck anteversion (FNA), low back pain and spino-pelvic parameters in patients undergoing a hip prothesis for unilateral severe hip osteoarthritis (HOA). Ninety-one patients with severe although non-destructive osteoarthritis of the hip were studied. Patients were divided

into two groups: those suffering from low back pain (group A) and those not suffering from low back pain (group B). A preoperative CT scan of the hip evaluated femoral neck anteversion, acetabular anteversion and combined anteversion. Standing full-spine X-rays were preformed at baseline and 6 months post-operatively in order to evaluate the spino-pelvic parameters. VAS, ODI, Roland-Morris questionnaire and SF36 were used to evaluate health-related quality of life. Results are as follows: at baseline, a higher femoral neck anteversion was found at the arthritic hip compared to the contro-lateral normal hip, but no significant differences were found in FNA between the two hips in group B. The asymmetry between the two hips was strongly associated with LBP. This finding explains why a concomitant relief of both hip and back pain is observed in such patients after total disc replacement, and also why total hip replacement should be performed primarily. The study contains an interesting review of papers dealing with the interdependence between spine and pelvis.

The article by Morimoto et al. [23] published in the February issue investigates the sagittal spino-pelvic parameters in patients with rapidly destructive coxarthrosis (RDC), defined as an extreme destruction of the femoral head and/or acetabulum within 12 months. Several factors such as chondrocalcinosis, subchondral insufficiency, fractures and osteoclastogenesis of the synovium have been recognized as potential etiologic factors. The purpose of the study was to investigate the sagittal spino-pelvic alignment parameters of patients with RDC and analyse whether their static and dynamic values could play a role in the development of RDC. The study included 44 old female patients, with rapid destruction of one hip joint. They were compared with 70 female patients of similar age (over 70 years) with a non-destructive, limited, unilateral osteoarthritis of the hip (HOA). The population studied was sufficient to show the significance between the various SSPA parameters of the two groups, if any. The parameters analysed for comparison are defined and well illustrated in a figure. The RDC group showed a reduction in lumbar lordosis, sacral slope and lumbar range of motion, and a higher pelvic tilt and pelvic inclination angle in comparison with the HOA group. The discussion deals with how these findings may provide information on the pathogenic mechanisms of RDC.

Full-body sagittal profiles in asymptomatic patients

The study by Bao et al. [24] in the February issue aims to establish a full-body sagittal profile classification in an asymptomatic population using a full-body imaging, including the lower limbs. One hundred and sixteen asymptomatic volunteers underwent a full-body biplanar stereoradiographic imaging (EOS imaging). The article describes in detail the radiographic parameters, measured in the spine, the pelvis and the lower limbs. A schematic diagram of the parameters studied is provided. Grouping of patients is accomplished by a cluster analysis, based on each patient's imaging parameters. According to this analysis, comprising ten radiographic parameters, three types of full-body sagittal profiles were disclosed: hyperlordosis type (n:77), neutral type (n:28) and compensated type (n:11). An illustrative diagram of these three profiles is proposed. The authors conclude that this study indicates that in asymptomatic adults, significant changes are observed from the cervical region to the knee, indicating that subjects should be evaluated with full-length imaging. All three types exist, regardless of age, but the distribution may vary.

The value of patient global assessment in lumbar spine surgery

The paper by Parai et al. [25], published in March, compares the value of using a single-item question retrospectively at follow-up, with that of a prospective multi-item questionnaire, used pre- and post-operatively. The article explores the value of GA: ("How is your back/leg pain today as compared to before the surgery?") as an overall patient-reported outcome in a cohort of 94,132 patients, registered in the Swedish Spine Registry from 1997 to 2015. Three diagnostic groups were studied: lumbar disc herniation, lumbar spinal stenosis and degenerative disc disease. GA/back and GA/leg follow-up were correlated with the score changes of three other patient-reported outcome measures: VAS, ODI and EQ-5D (PROMs). GA was also correlated with item-specific domains within PROMs. The statistical analysis yielded the following results: GA correlates well with the condition-specific VAS and ODI, and with pain-specific items with the quality-of-life PROMs. GA can be an appropriate tool in the measurement of effectiveness of lumbar spine surgery and may work as a discriminating factor between success and failure in the validation of pain-specific PROMs. I recommend a careful reading of the discussion of this remarkable piece of work.

Patient-rated outcome changes over time after surgical treatment of degenerative spinal disorders

The article by Fekete et al. [26] published in the March issue examines the changes of health-related quality of life over time—up to 5 years post-operatively—of patients operated the first time for the most common degenerative thoracolumbar disorders. The study group included a large

number of patients (4287) with a Tango surgery form, operated for either spinal stenosis with or without degenerative spondylolisthesis, disc herniation, degenerative deformities, degenerative segment disease or uncategorized. Patients completed the Core Outcome Measures Index (COMI), a validated outcome instrument, preoperatively and at 3-months, 1 year, 2 years and 5 years follow-up. In total, the questionnaire was completed in 69% of patients at each of the five points. The COMI score decreased significantly from preop. to 3 months, and from three to 12 months, and then levelled off to 5 years. The course of change from three to 12 months depended on the pathology. The authors conclude that even in patients undergoing fusion, most of the improvement occurs by 3 months post-operatively. A minimum follow-up of 3 months is sufficient to evaluate the final result for non-fusion patients, and 12 months for fusion patients, as a slight progression of improvement may take place between three and 12 months. Thus, a "wait and see" policy in patients with a poor initial outcome at 3 months is not advocated.

Chiropractic care and risk for acute disc herniation

The paper by Hincapié et al. [27] published in the July issue is a well-written, self-controlled case series investigating a possible association between spinal manipulation and acute lumbar disc herniation. In other words, does a manipulation carried out in the acute prodromal low back pain present a subsequent risk of developing disc herniation and sciatica? Out of a population-based database, 195 cases of acute disc herniation, requiring emergency department visit and early surgical intervention, were identified. Healthcare visits to chiropractors and primary care physicians were the exposures of interest. The relative incidence of acute LDH with early surgery in exposed periods after chiropractic visit, relative to unexposed periods, was estimated within individuals and compared with the relative incidence of acute disc herniation, following primary care physician visits. Results are as follows: strong, positive associations were found between acute disc herniation and both chiropractic and primary care physicians. The risk of acute disc herniation associated with chiropractic visits was no higher than the risk associated with physician visits. The authors' conclusions were: we found no evidence of excess risk for acute LDH with early surgery associated with chiropractic care, compared with primary medical care. They very wisely discuss the strong limitations of their study and recommend future multi-centred, unbiased prospective studies.

Influence of pregnancy on women with adjacent idiopathic scoliosis

The literature concerning pregnancy in women with AIS is scarce and heterogeneous. The article by Dewan et al. [28], published in February, is a Prisma systematic review addressing three questions. (1) How does scoliosis affect timing and success of pregnancy? (2) Which spine-related changes occur during and after pregnancy? (3) Which anaesthetic and obstetric considerations are relevant to AIS mothers delivering a child? Twenty-two articles were included, representing 3125 AIS individuals, mostly retrospective and observational. Evidence was classified according to the Oxford Centre for Evidence-based Medicine appraisal tool. All studies concluded level B evidence or even lower. Despite these limitations, answers to the first question were as follows: women with AIS may be less likely to become pregnant than their age-matched controls and may be more likely to require fertility treatment. Answers to question two were: many patients can expect to experience non-disabling LBP during their pregnancy, which typically resolves following delivery. Some women will experience a minor curve progression, during and after pregnancy, but the clinical significance is not clear. Answers to question three were: spinal anaesthesia can be achieved with instrumented scoliosis, although failed attempts and minor reversible complications occur more frequently than in non-instrumented patients or controls. AIS patients can expect similar rates of caesarean as their controls. Perinatal complications are not elevated. The quality of evidence for these three questions was low. The authors conclude that in future research, registry-based or prospective cohort studies are needed to obtain a higher quality of evidence.

Adolescent idiopathic scoliosis: effect of deformity correction on psychiatric condition

The article by Duramaz et al. [29] in the September issue deals with the psycho-social aspects related to AIS and their evolution after corrective surgery. The study group included 41 consecutive patients, ages 12–18 who underwent posterior instrumentation and fusion. Patients were compared to a control group of 52 healthy patients regarding changes in the pre- and post-operative quality of life and psychiatric condition. Specific scales were used pre- and post-operatively to evaluate the patients' psychiatric status: Paediatric Quality of Life Inventory, Children's Depression Inventory, Body Cathexis Scale, Piers-Harris self-esteem questionnaire and

state-trait Anxiety Inventory for Children. A significant surgical deformity correction was obtained in the study group in all measurements. Post-operative Self-esteem Score and the Paediatric Quality of Life Score showed a significant improvement in the study group compared to the preoperative level, while no difference was found in the control group. Post-operative depression and anxiety inventory scores decreased significantly in the study group compared with the preoperative scores. Interestingly, it was observed that the anxiety score of the mothers decreased significantly after correction of the deformity. The authors conclude that possible psychological problems may accompany AIS. They may improve with correction of the deformity. In selected patients, psychiatric consultation and treatment, pre- and post-surgery, may contribute to the success of surgery.

Chronic low back pain and deformities in Parkinson's disease

The observational study by Galazky et al. [30] in the November issue deals with the prevalence of chronic low back pain and of deformities in 97 PD patients compared with a control group with other neurological non-PD patients. Presence and intensity of LBP evaluated in a VAS and ODI were significantly more frequent in PD compared to controls, with longer duration and higher pain intensity. The VAS and ODI scores were associated with higher PD stages and motor scores. PD patients with the hypo-kinetic type had significantly higher pain intensities than those with the tremor type. In terms of deformities, degenerative scoliosis was disclosed in 38.8% and degenerative spondylolisthesis in 24% of cases. The high incidence of deformities and of their relation with motor symptoms are in line with previous publications. Most patients of this series followed a conservative therapy, including adjustment or changes of the antiparkinsonian medications and physiotherapy. An interesting part of the treatment section concerns a treatment of the PD camptocormia by deep brain stimulation (DBS) of either the subthalamic nucleus or the internal pallidum. The paper provides useful information on this particular therapeutic aspect, with appropriate references.

Paget's disease of the lumbar spine

An interesting Grand Rounds case of Paget's disease, strictly localized in the lumbar spine, was presented in the December issue by Hofmann et al. [31]. The patient had a long history of lumbar Paget's disease, diagnosed by imaging and biopsy in 1978. He had been asymptomatic for 17 years, apparently following continuing bisphosphonate therapy during that period. Type, dosage and route of administration of bisphosphonate therapy are not described in the case report. Six months before surgery the patient developed severe low back pain and symptoms of neurogenic claudication, without neurological deficit. Imaging studies showed, in addition to typical signs of Paget's disease, a spinal canal stenosis at L3-L4 and L4-L5. Following an adequate operative procedure, the patient had a complete improvement in claudication and a progressive decrease on VAS and ODI pain scores. In summary, this is a typical and classical case of lumbar canal stenosis by Paget's disease.

An excellent Expert's Comment by Dunn [32] in the December issue highlights the epidemiological, genetic and environmental aspects of Paget's disease. The diagnosis and therapeutic aspects are updated as well.

Bisphosphonate therapy for spinal aneurysmal bone cysts

The paper by Kieser et al. [33] in the April issue deals with the use of bisphosphonate therapy for spinal aneurysmal bone cysts (ABCs), a rare benign tumour affecting the spine in approximately 10–30% of cases, usually in the posterior elements. ABCs can be painful and aggressive with bony destruction and carry the risk of neurological complications. The authors describe six patients, aged 7–22 years, with ABCs treated by bisphosphonates, either pamidronate (4 patients) or zoledronate (2 patients). The treatment strategy is provided in the article. Patients were followed clinically and radiologically. Two patients failed to respond to treatment and required surgery, one for progression of the lesions and one for development of neurological symptoms. Six patients responded to treatment and were followed for 6 years every 3–6 months, initially by X-ray and CT scan, and at three and 6 months by an additional MRI. Pain improved progressively and resolved completely after two treatment cycles. Reduction of peri-lesional oedema and increased ossification of the lesions were observed after 3 months. Raw data are presented for each patient with good illustrative imaging. No recurrence was observed within 6 years.

Tophaceous gout of the spine

The readership will find an interesting Ground Rounds concerning a case of tophaceous gout of the lumbar spine in the April issue. Ribeiro da Cunha et al. [34] report the 6-month history of a 77-year-old man who presented with a chronic low back pain, mostly at night, and with a progressive paraparesis. The patient had a history of gout, but the compliance of his allopurinol prescription was poor. MRI revealed a mass at the L3-L4 level, compressing the thecal sac posteriorly. The

MRI picture of the mass was isointense on T1, hypointense on T2, with a peripheral enhancement after gadolinium similar to a dural tail. Intraoperative findings revealed a white chalky mass compressing the dural sac. Histopathology of the mass confirmed the diagnosis of gout. An interesting review of the involvement of gout in the spine follows the case presentation, with a pertinent bibliography. The differential diagnosis is based on the history of gout and on the MRI findings, which are similar to those of a spinal meningioma, the differentiation being made on histopathology.

Lumbar epidural lipomatosis and metabolic disorders

Lumbar epidural lipomatosis related to an accumulation of fat tissue in the epidural space may compress the dural sac and generate symptoms similar to those observed in lumbar canal stenosis. It is a rare condition, generally observed in patients receiving steroids or in endocrine diseases with overproduction of steroids. Obesity is a frequent clinical feature; dietary restriction may improve the symptoms. There is an idiopathic form without any known pathogenesis. On the other hand, there is a metabolic systemic disorder, characterized by insulin resistance, abnormal lipid metabolism, hyperglycaemia, hypertension and increased visceral fat area. The purpose of the study by Morishita et al. [35] in the July issue was to investigate by imaging and laboratory data a possible relationship between idiopathic lumbar epidural lipomatosis (LEL) and the metabolic disorder systemic syndrome. Two hundred and eighteen consecutive patients with symptoms of lumbar canal stenosis underwent a lumbar MRI, abdominal CT scan and blood tests. Diagnosis of LEL was defined as epidural fat extending beyond a line connecting the inner edge of the lamina on T1-weighted sagittal views and compression of the dural sac by fat on axial T2-weighted images. According to this criteria, 58 patients were diagnosed LEL and were then compared to the non-LEL patients. Results are the following: the epidural fat/canal ratio was much greater in the LEL group, and visceral fat area on visceral CTs was also significantly greater in LEL patients. The laboratory tests data indicated greater uric acid, insulin and ferritin levels. These findings indicate that LEL may have a relationship with the metabolic systemic disorder syndrome. Moreover, and in addition to the dietary restriction, correction of these disorders may have a therapeutic effect on LEL.

Fixed cervico-thoracic kyphosis in patients with ankylosing spondylitis

The paper by Sabou et al. [36] in the July issue deals with the effect of surgical treatment of cervico-thoracic kyphosis on health-related quality of life in AS patients. As emphasized by the authors, back pain and postural deformity induce in advanced cases loss of horizontal gaze and difficulty in chewing and swallowing, severely interfering with quality of life. Such cases are rare and will probably diminish over time, due to progress of the medical treatment of the disease. The present paper reports the clinical and radiological results of cervico-thoracic osteotomy and instrumented fusion in 13 male AS patients, operated between 2006 and 2014, with a mean follow-up of 37.6 months. Surgical techniques and data are reported in detail. Clinical outcome based on VAS, EQ-5D-5L and NDI improved significantly, post-operatively. Preoperative chin-brow to vertical angle was on average 54° and post-operative 7°. There were no major complications. Note that the operations were performed in a tertiary referral spinal centre by two senior surgeons, with considerable experience with complex spinal pathologies. An illustrative pre- and post-treatment photograph showing improvement in CBVA is presented.

Unexpected positive histology in kyphoplasty

The article by Novak et al. [37] published in the April issue is an excellent reminder of the necessity of taking a biopsy when performing a vertebroplasty or kyphoplasty. Between 2007 and 2015, the authors performed 130 kyphoplasties. A biopsy was taken in 97 (74.6%) cases. In seven of these cases, histology disclosed an expected pathological fracture, revealing a metastatic infiltrate of a known primary cancer. However, in three patients, there was no known cancer in the patients' history and imaging, including X-ray and T1-weighted MRI. In all three patients, histology disclosed a lymphoma. It has been shown that MRI is unspecific for differentiation of lymphatic bony invasion versus osteoporosis, as illustrated by a figure in the article. In the discussion, the authors also note the possibility and interest of an intraoperative scrape cytology in addition to histopathology.

Smartphone app in self-management of chronic low back pain

The paper by Chhabra et al. [38] in the November issue addresses the problem of compliance with the treatment of chronic LBP. It is now admitted that adequate levels of physical activity and exercise programs alleviate pain and disability in chronic LBP patients. However, for many reasons, a substantial proportion of patients are not compliant with home exercises and with the recommended physical activity levels. The purpose of the present study was to examine the effect of using *Snapcare,* a smartphone app on pain and function in chronic LBP patients. Ninety-three adults were recruited with mechanical LBP, with or without radiculopathy, persisting for over 12 weeks. They were randomly allocated to either the conventional group, receiving a written prescription from the treating physician containing a list of prescribed medications and dosages as well as the recommended level of physical activity and home exercises, or to the app group, receiving *Snapcare* in addition to the written prescription. Both groups improved significantly in pain and disability after 12 weeks of treatment. However, the group receiving *Snapcare*, addressing increase in physical activity, daily improvement in function and increase in compliance, showed a significantly greater decline in disability. I strongly recommend reading this high-quality RCT, speaking in favour of this technology in the future and recognizing its present limitations and conflict of interest as well.

Compliance with ethical standards

Conflict of interest The author of this review declares that he has no conflict of interest.

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