The Michel Benoist and Robert Mulholland yearly European Spine Journal Review: a survey of the “surgical and research” articles in the European Spine Journal, 2009

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Introduction

This has been an exciting year in the Journal with some important innovations. Reporting single interesting cases has always been popular with readers though not with editors, often considered to have too little science, and too much anecdote. The series of *Grand Rounds* published this year [13, 21, 41] meet these criticisms, and whilst improving the readers diagnostic and management skills, have an attractive immediacy about them, and are well worth reading. The Editorial by Aebi [1] emphasises the educational and teaching value of what in the UK we often refer to as “bedside teaching” of which *Grand Rounds* is an example, hallowed by many years of use in medical training.

The other two innovations, the creation of a *Chinese Section* Editorial Board [2] and the translation and

publication of papers in the Italian literature during the year, both expand in a valuable way the range of intellectual content in the Journal. The *Supplements* have been of great interest and will be referred to below, but Supplement 2 is unique as it is available electronically only, and contains single case reports. It makes very interesting internet browsing, instructing us in some difficult diagnostic and management problems.

Vertebroplasty and kyphoplasty

At the beginning of the year the paper by Suzuki et al. [18] which reported the very significant degree of pain and disability experienced over a year by 107 consecutive patients with osteoporotic vertebral fractures, and hence showed that so-called conservative, non-interventional treatment of these fractures was most unsatisfactory. In the previous 3 years various papers [6, 30, 31, 38, 52] had demonstrated the undoubted success of either vertebroplasty or kyphoplasty in producing immediate pain relief, but use of these techniques was commonly countered by the view that patients got better anyway, and such interventions were unnecessary. This paper established the very real degree disability that these fractures produce and make a powerful argument for vertebroplasty or kyphoplasty. This year there were further important papers on this subject. Perhaps the most important was the Editorial by Aebi [1] refuting the much publicised paper by Buchbinder [8] which on the basis of what was described as a prospective randomized study of vertebroplasty suggested that such treatment was ineffective and inappropriate. Aebi comprehensively destroys the nature of the trial, exposing very clearly the major faults in its design, and the errors in the conclusions drawn. It is a matter of regret that the extensive publicity given to the Buchbinder paper in the media, will not be given to the elegant and

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damming critique of the paper by Aebi. However, there were a number of useful papers on the subject during the year. The paper by Krueger et al. [24] concerning pulmonary cement embolism is of particular value. It identifies the risk of embolism, and gives clear direction concerning treatment. Vertebroplasty has a higher risk, and the risk is greater in treating malignant collapse—owing to loss of cortex in many cases. Asymptomatic embolism, which may be detected by CT imaging of the lungs, needs no treatment, symptomatic embolism should be treated with anticoagulants for 6 months, by which time the cement will be endothelialized, and further extension will not occur. There is no place for embolectomy, which carries a high risk of a fatal outcome. The paper by Lovi et al. [29] which provides an Algorithm for the treatment of osteoporotic fractures, which uses both kyphoplasty and vertebroplasty and has the merit of logic. They advise conservative treatment for a month, and then kyphoplasty if deformity of 30° and between 1 and 3 months after fracture, and vertebroplasty if no deformity or if diagnosis is after 3 months, both groups do well. Kyphoplasty is associated with less extravasation, but the superiority of one technique over the other is not established.

The paper by Schmelzer-Schmied et al. [42] concerning the use of vertebroplasty in thoracolumbar Type A fractures as compared with brace treatment alone, establishes that there is benefit from vertebroplasty in the first 3 months as regards pain and function compared with the use of a brace alone. However, at a year there is no difference in the two groups. Whether such a gain is of value, when the patient is left with a lump of cement in his bone, and also had the risk of cement embolism is questionable. Cement did appear to prevent further deformity occurring, which braces did not, but the clinical benefit of this was not established. One might ask why we brace these types of fracture at all if we believe them to be stable as far as neurological risk is concerned, and braces do not prevent collapse.

The value of cement augmentation in treating sacral insufficiency fractures was reviewed by Barley et al. [4]. These fractures are very painful and produce much disability. The authors conclude that cement augmentation is of value, but would like to see more robust evidence supporting its use, I hope they do.

Adjacent segment degenerative change

The concept that fusion causes accelerated adjacent segment degeneration is one basis for the increasing use of disc replacement and so-called flexible stabilization. The paper by Eckman et al. [11] reports on the degree of adjacent segment degeneration occurring in a group of patients treated with exercises, and a group of patients who were fused (both instrumented and uninstrumented). The

authors show that the fusion group had indeed a greater degree of adjacent disc degeneration, especially if they also had a laminectomy. One presumes that the exercise group had a degree of mobility at the spondylolisthesis, so it is also likely that the instrumented group were in part reduced. One must therefore be uncertain whether the findings in this group can be applied to all fusions in general. However, it was of interest that the clinical impact in terms of disability produced by the adjacent disc degeneration was minimal and hardly a justification for specific surgery to prevent it occurring.

The paper by Lee et al. [27] defines adjacent segment disease, as the situation where a segment adjacent to a fusion becomes sufficiently symptomatic to require surgical treatment. In a series of 1,069 patients who had fusions there were 28 patients (2.62%) in which this occurred. However, in looking for what they termed risk factors, it is clear that none of the 28 had a normal disc before surgery. Facet degeneration was the most significant as a predictor, but always in the presence of disc degeneration. The message I got from this paper was that if one identified the symptomatic segment, then the presence of changes in the adjacent segment was not a reason to prophylactically extend the fusion, as there was only 2.62% chance of it becoming symptomatic. This paper also indicated that in the short term of this study—9 months to 125 months, a normal disc above a fusion would not develop ASD. This paper again does not justify surgery to prevent ASD.

One therefore approached the paper by Korovessis [23] with some suspicion. This paper asked the question “Does Wallis implant reduce adjacent segment degeneration above lumbosacral instrumented fusion?” and rather to my surprise it does have a modest effect. It did not appear to be truly a prospective randomized study, insofar as the control group were selected subsequently and matched with the group who had a Wallis implant inserted above a fusion. It is also a small number of patients. It is not clear why the control group did not have the implant. The incidence of symptomatic ASD in the control group is high as a percentage, 14% but is in fact some three patients. It does not appear that the assessors of the results were blinded, but on the other hand, the assessment instruments used (SF36 and the Oswestry) are observer independent. One always enjoys a paper that challenges one's own prejudices. However, the paper by Schulte [43] published some 2 years ago in the *Journal* which established that after 10 years there was ASD above a fusion, but it was not of clinical significance reassured me.

Surgical technique

Fibrin glue has been increasingly used for sealing inadvertent dural leaks occurring during surgery combined

usually with surgical repair. It seems a very logical prophylactic addition, hence the paper by Jankowitz [20] in a retrospective review which showed that in fact it did not significantly reduce the incidence of a persistent dural leak post-operatively is important. When they quoted that the cost of fibrin glue annually in Japan was 160 million dollars, and the cost of 2 ccs was nearly \$2000 dollars, one appreciates that their conclusion that their findings do not support the prophylactic use of glue when a primary repair is deemed adequate is important.

Lumbar disc replacement

During the year there were four papers dealing with surgical aspects of disc replacement, and a number of other papers dealing with biomechanical aspects. It is useful to read them as a group, as a clearer picture of the role of this surgery is established.

The paper by Berg et al. [5] reporting the results of a prospective randomized trial from one centre, over 2 years with 100% follow up comparing disc replacement with spinal fusion was most instructive. Disc replacement is somewhat better than fusion, as at 2 years 30% of the fusion group were totally pain free, compared with 15% in the fusion group. Apart from this at 2 years the clinical outcome of both procedures was the same. Disc replacement patients get better quicker. However, in terms of patient satisfaction at 2 years, 71% of the replacement group were satisfied, compared with 67% of the fusion group. Why the failures? The authors were unable to predict those that failed, or explain why. The role of the facet joints as a cause of failure is not established. It is useful to revisit the paper by Siepe [44] published last year which analysed failures by studying pain sources with fluoroscopically guided anaesthetic injections, and established the role of sacroiliac pain, related to failure to achieve appropriate sagittal balance. The average age of the patients was similar to those in the study by Siepe [45] concerning the use of disc replacement in athletes, where a 94% of patients were satisfied or highly satisfied. The reason for failure in some 30% of patients in any prospective randomized trial remains unknown and this unpredictability remains bar to disc replacement replacing fusion, where the failure rate is about the same as the intervention of choice,

Di Silvestre et al. [10] looked at the results of two level disc replacement, and found that they were associated with a higher complication rate than one level, but the difference in results at 2 years was not significant, a conclusion they share with Berg. The paper by Sinigaglia et al. [44] comparing results of disc replacement at 5/1, with those at 4/5 showed that there were more complications, largely access related at the 4/5 level, but results otherwise at both levels were similar.

Back pain

Nearly one-third of the population have Schmorl's nodes and most are entirely asymptomatic. However, the paper by Baogan Peng [34] describes a group of 21 patients with disabling back pain in whom this abnormality was established as a pain source using discography. Discography reproduced the pain complained of, and the contrast flowed into the bony defect. It is not clear from the paper unfortunately what was the degree of disc degeneration, and some patients (who were excluded from the study) also had pain when contrast entered annular tears. However the pain pattern did seem rather unusual, pain being commonly referred to the thighs diffusely as well as the lower back. However, the results of fusion were good. Interbody fusion was most commonly used, but was not essential as posterolateral fusion associated with discectomy was successful, which surprised me.

The paper by Wand et al. [55] confirmed what we all suspect that in getting patients to complete disability scores such as the Oswestry, or the SF 36, then if they are depressed this strongly skews their perception. It would seem appropriate if one is using these self-reported measures, a depression score should also be recorded. The paper by Mannion [14] again proves something that we all suspect. The benefits of rehabilitation depended to a large extent on the patient's exercise behaviour outside of the formal physiotherapy sessions. Hence, more effort should be invested in finding ways improve patients' motivation to take responsibility for the success of their own therapy, perhaps by increasing exercise self-efficacy.

The paper by Sinikallio [46] again confirmed what surgeons suspect that those patient who before surgery for spinal stenosis are depressed, and also are dissatisfied with their life, do less well. To what extent these factors can be addressed before surgery and hence improve results is not established in this paper. However in counselling patients before surgery, as to likely outcome, such information is of value.

The paper by Tafazal [51] built on earlier paper by the same group, and established that peri-radicular injections for sciatica were effective in the short term, but local anaesthetic alone was as effective as a combination of steroid and local anaesthetic. The authors suggest that peri-radicular infiltrations also effective in terms of the need for further intervention in the form of surgery with only 18% requiring surgery at a minimum of 1 year. Whilst the latter conclusion may be true, as there was no control group in this series, it was difficult to ascribe the low rate of surgery to the injection treatment, as it may have been low in any control group, because the surgeons were very non-interventionalist.

The paper by Peul et al. [35] gives valuable help to the surgeon treating sciatica. The authors previous papers [36, 37] had established that surgery speeds up the recovery from sciatica, and at the end of a year, the result of surgery is the same as conservative treatment. However, during the year, the patient being treated conservatively has more disability, and a number will opt for surgery after suffering for many months. What the surgeon and patient wish to know is how rapidly will the patient improve, or what is the likelihood at onset that there will be little improvement, and indeed surgical treatment will be eventually sought. None of the expected clinical and radiological features were predictive, only sciatica induced by sitting. Surprisingly neither grossly restricted SLR or a large protrusion, were predictive of failure to resolve with conservative treatment.

The study by Franke et al. [12] which compared the results of a minimally invasive discectomy with the standard procedure using a microscope, found that at the specialist centre developing the technique there was some benefit in terms speed of recovery, but this was not the case in the associated non-specialist centre where the surgeons had been taught the technique. However, even in the specialist centre, there was no benefit from the technique at final follow up. The concept of minimal intervention is good; as it has certainly made us all aware of access related complications, and standard disc surgery now is much less invasive than it was is partly due to the concept of minimal invasive approaches.

Spinal stenosis

This is a disorder of the elderly in the main, and in this group minimal surgery is very attractive. The paper by Pao et al. [33] reports very satisfactory results, although a 10% Dural tear rate was somewhat high. They authors comment on the degree of pre-operative co-morbidities was high near 70%, which make this type of operation particularly valuable. It is therefore useful to compare their results with those of Kuchta et al. [25] using a distraction device (X-Stop) Unfortunately the two populations are not the same, the ODI in the decompressive group was 64.3% and improved to 16%, whereas in the distraction device group the pre-operative ODI was only 32.2% preoperatively, improving to 20.3%, a very modest improvement in a not very disabled population compared with that achieved in the decompressive group. The same group [47] looked at the change in radiological parameters, produced by three different distraction devices, and found that what was achieved differed amongst the implants, but this did not correlate with clinical outcome. The question must therefore be asked, is it the restriction of movement that these

devices achieve more important than the distraction? The biomechanical study using sheep, by Gunzburg [16] in which a segmental segment had been surgically destabilized, producing a spondylolisthesis, showed that an interspinous device, with a tension band, reduces the movement overall by 43% and quotes the view of Christie et al. [9] “That it favourably alters the movement and load transmission of the spinal segment”. This study perhaps in part validates the use of interspinous devices with a tension band for back pain rather than spinal stenosis only.

The importance if one is operating albeit minimally, of removing the ligament flavum is confirmed by the elegant MRI study by Hansson et al. [18] which demonstrated that using MRI images under load, whilst both disc and flavum were factors in reducing the size of the canal the flavum was more significant.

Spine supplements

The August supplement made fascinating reading, educating surgeons in the art and philosophy of spinal surgery today. The tone of the supplement was set by the paper by Grob and Mannion [14]. We have to be able to fully inform patients about outcomes because “the basis of trust and faith has diminished and given way to increased scepticism and demands for accountability on the part of the patient. Information they gain from the internet frequently represents “personal opinion at best, or marketing tools at worse” [7]. All the articles in the supplement merit reading, and some can be dipped into as they frequently contain gems of information and philosophy very relevant to the practicing spinal surgeon. Space only permits me to draw attention to a few.

Brox’s paper on “The contribution of RCT’s to quality, and management and their feasibility in Practice,” gives a very succinct account of the history of RCT’S and then quotes a number of the important ones in spinal surgery over the years. He draws attention to the Consort statement, a checklist of items to include when reporting a randomized trial. He emphasises their value, but also the problems of their applicability in spinal surgery. Because of these problems Registries can provide information about success of therapy, which maybe more realistic than the sometimes rather artificial situation produced by a RCT. The papers by Stromqvist et al. [50] concerning their Swedish Spine Register, and that by Röder et al. [40] dealing with Spine Tango, the European wide registry, should encourage all spinal surgeons to join up to Tango, as a valuable complementary to RCT’s and on occasion the practical alternative. The value of a spine registry was demonstrated in the paper by Porchet [39] when it was used to compare microdiscectomy with standard discectomy, which demonstrated that there was no

difference in the result, apart from the greater blood loss in the standard discectomy group. One weakness of the registry is revealed, as there was a great disparity of numbers in the two groups (36 standard discectomy compared with 225 microdiscectomies).

The paper concerning “The Patient’s perspective on complications after spinal surgery” of Grob [15], highlighted the fact that complications to the patient were often events that the surgeon did not regard as complications, and that as far as the patient was concerned they were a cause of dissatisfaction. It was clear that in any post-operative assessment complications should be assessed from both the patients’ and surgeons’ perspective, to better understand reasons for dissatisfaction. Another paper Lattig (again using the Tango registry to recruit patients) [26] dealt with the assessment of surgical success and the degree of agreement between surgeons rating of the success of an operation, and the patient’s rating. There was agreement in half of the cases, and disagreement in the other half, where surgeons gave better ratings than the patient in about a quarter of the patients, and in the other quarter, the surgeon gave a worse rating. Senior surgeons tended to over-rate, especially in patients with a poor self rated outcome. Clearly in any assessment a surgical and patient assessment should be done and the assessments not averaged, as otherwise these disparities may not be identified.

Spinal fractures

The paper dealing with the use of ultrasound to diagnose disruption of the posterior structures in acute burst fractures to assess their instability Vordemvenne et al. [54], which established a sensitivity of 0.99 and a specificity of 0.75, whilst confirming that MRI evaluation was clearly superior, yet in certain circumstances, especially if for some reason an MRI could not be done, then this could be an useful investigation. Eighteen patients were in the series, ultrasound was over sensitive, as there were three false positives, that are the ultrasound predicted posterior rupture, and at exploration the posterior complex was intact. It is unfortunate that out of the 18 patients, a pre-operative MRI assessment was not done in six, the exploration being carried out to fix the fracture irrespective of suspected instability. Posterior pressure pain is not a reliable guide to posterior ligamentous rupture, although the one patient with a gap had indeed ruptured his posterior complex.

The hazards of missing a fracture in a patient with ankylosing spondylitis and now DISH, is well known to orthopaedic surgeons, but may be less well recognized by physicians and general surgeons and junior staff involved in running accident units. The paper by Westerveld [56] is timely as it draws our attention to the fact that these

commonly occur in the neck, are low energy, diagnosis is commonly delayed due to doctor and patient factors, 62% of ankylosing spondylitis, and 40% of DISH patients had neurology on admission, which commonly deteriorated, and both groups had a mortality in the region of 20% in the first 3 months. The authors comment that DISH may well become a commoner problem, due to association with late onset diabetes. Orthopaedic surgeons are aware that these are commonly undisplaced—hence may be missed radiologically, and very unstable, displacing very easily, with profound neurological consequences. The hazards should be fully conveyed to patients, as well as doctors in A&E departments. The reviewers comment of Kandziora [22] criticizing the authors for advocating surgical fixation as indicated in most fractures, and pointing out that stable fractures did not need fixation, did not to my mind address the issue that stability in these fractures, especially in the cervical spine is very difficult to evaluate.

The GIS Supplement is a most valuable development. It is obvious that the English speaking world is frequently denied access to valuable papers published in another language, not a new problem Mendel’s work lay unnoticed for years. In this supplement we see some very valuable papers. The papers by Lovi [29], Silvestri and Sinigaglia have already been alluded to. The paper by Barbagallo [3] presenting the results of treating multilevel cervical disc disease with a combination of fusion and disc replacement. The decision as to what to do at each level is decided during surgery, following an selection criteria detailed in the paper. The results are presented as a graph of overall improvement, which unfortunately may hide spectacular successes, and dismal failures. In a small series like this, only 24 patients, it would be so much more useful to have scores before and scores after for each patient. All the patients were reported as having a radiculopathy, or a myelopathy as well as neck pain, so good results may be due to the decompressive element in the surgery. I am not confident that the “Facet syndrome has been unanimously accepted as specific entity as stated by Missaggi [32]. The symptoms he describes may be due to the facets, but unfortunately they may be also present in many patients with back pain due to other causes. The study is a retrospective one, and assessment of the result of neuroablation with pulsed radiofrequency was not independent. The work up was excellent, and if this work now became a prospective study, with a dummy ablation, this study would be of great value. Unfortunately the likelihood to getting patient consent to such a study would be very small.

The paper dealing with techniques for reducing artefacts in CT and MRI by Stradiotti [49] is valuable to the surgeon insofar as he can draw the attention of his radiological colleagues to it, and presented with a patient with implants who needs imaging the surgeon will realize that valuable information can still be gained despite the implants.

The paper by Vaga et al. [53] examining the effect of dynamic stabilization on the discs in ten patients. By means of sophisticated MRI imaging, which pictorially assessed the concentration of glycosaminoglycans (GAGs) in the discs 6 months after fixation. They concluded that in the segment dynamically stabilized, the GAGS went up, a good thing, and discs outside the fixation they went down, a bad thing. I must say I did not find the beautifully coloured plates really supported their conclusions, and on the standard MRI the discs in the spanned segment looked worst.

Supplement 3 (October 2009)

This supplement, which dealt with “Whiplash Injuries: Diagnosis and early Management” was short and much focussed. Whereas last years supplements on this important subject were very comprehensive, valuable, but a bit indigestible, this supplement could be easily read at one sitting, and left some very clear and useful messages. Much of it is of course based on the much more extensive papers in last year’s supplements. I particularly liked the paper on Psychological and Psychiatric Aspects, and the paper on Early Management, work-up and examination methods. As the authors point out the protocol for use at initial medical consultation recommended by the Quebec Task Force [48] was far too wide ranging for routine health care, the one recommended in this paper is a far cry from what usually happens in A&E departments and GP’S surgeries in the UK. In view of the importance of the initial consultation should we have dedicated whiplash clinics in our A&E departments where the principles spelt out in this paper could be applied?

Tumours

The paper dealing with outcome of excisional surgeries for patients with spinal metastases by Li et al. [28] suggests that there is benefit of en bloc procedures as local recurrence is less likely, but little difference in survival rates. En bloc surgery is much more major and this paper would suggest that it is seldom justified in treating metastasis.

Identifying the primary tumour when a patient presents with a metastatic lesion in the spine is a common clinical problem. The paper by Yoichi Lizuka et al. gives valuable advice. Before subjecting the patient to an invasive needle biopsy, carefully carry out laboratory analysis. CT guided biopsy had a low determination rate in the final analysis in comparison to a laboratory analysis (tumour markers), protein electrophoresis for haematological tumours and CT scanning for solid tumours elsewhere in the body [19].

Percutaneous radiofrequency ablation is the treatment of choice for osteoid osteomas of the appendicular skeleton, but its use in the spine is less well accepted, owing to the difficulties of precise location, and the risk to neural elements. The paper by Hadjipavlou [17] which deals with two minimally invasive techniques, percutaneous core excision and radiofrequency thermo-coagulation, although reporting only seven cases gives valuable advice on which technique may be most appropriate depending on the site of the lesion in the spine. The minimal morbidity and effectiveness of these techniques and the fact that one or other will be found to be possible, are much superior to open operation for these lesions.

Once again it has given me great pleasure to do this review, my opinions may be idiosyncratic, and I can only hope that they may stimulate readers to look at the papers themselves, as well as all the others, which time and space prevent me reviewing.

References

1. Aebi M (2009) 2009: the year of innovations-third innovation. *Eur Spine J* 18:1077–1078. doi:[10.1007/s00586-009-1113-7](https://doi.org/10.1007/s00586-009-1113-7)
2. Aebi M, Dai LY (2009) 2009: the year of innovations in the European Spine Journal. *Eur Spine J* 18:585. doi:[10.1007/s00586-009-1015-8](https://doi.org/10.1007/s00586-009-1015-8)
3. Barbagallo GM, Assietti R, Corbino L, Olindo G, Foti PV, Russo V, Albanese V (2009) Early results and review of the literature of a novel hybrid surgical technique combining cervical arthrodesis and disc arthroplasty for treating multilevel degenerative disc disease: opposite or complementary techniques? *Eur Spine J* 18(Suppl 1):29–39. doi:[10.1007/s00586-009-0978-9](https://doi.org/10.1007/s00586-009-0978-9)
4. Bayley E, Srinivas S, Boszczyk BM (2009) Clinical outcomes of sacroplasty in sacral insufficiency fractures: a review of the literature. *Eur Spine J* 18:1266–1271. doi:[10.1007/s00586-009-1048-z](https://doi.org/10.1007/s00586-009-1048-z)
5. Berg S, Tullberg T, Branth B, Olerud C, Tropp H (2009) Total disc replacement compared to lumbar fusion: a randomised controlled trial with 2-year follow-up. *Eur Spine J* 18:1512–1519. doi:[10.1007/s00586-009-1047-0](https://doi.org/10.1007/s00586-009-1047-0)
6. Bouza C, Lopez T, Magro A, Navalpotro L, Amate JM (2006) Efficacy and safety of balloon kyphoplasty in the treatment of vertebral compression fractures: a systematic review. *Eur Spine J* 15:1050–1067. doi:[10.1007/s00586-005-0048-x](https://doi.org/10.1007/s00586-005-0048-x)
7. Brox JI (2009) The contribution of RCTs to quality management and their feasibility in practice. *Eur Spine J* 18(Suppl 3):279–293. doi:[10.1007/s00586-009-1014-9](https://doi.org/10.1007/s00586-009-1014-9)
8. Buchbinder R, Osborne RH, Ebeling PR, Wark JD, Mitchell P, Wriedit C, Graves S, Staples MP, Murphy B (2009) A randomized trial of vertebroplasty for painful osteoporotic vertebral fractures. *N Engl J Med* 361:557–568. doi:[10.1056/NEJMoa0900429](https://doi.org/10.1056/NEJMoa0900429)
9. Christie SD, Song JK, Fessler RG (2005) Dynamic interspinous process technology. *Spine* 30(Suppl 16):S73–S78
10. Di Silvestre M, Bakaloudis G, Lolli F, Vommario F, Parisini P (2009) Two-level total lumbar disc replacement. *Eur Spine J* 18(Suppl 1):64–70. doi:[10.1007/s00586-009-0982-0](https://doi.org/10.1007/s00586-009-0982-0)
11. Ekman P, Moller H, Shalabi A, Yu YX, Hedlund R (2009) A prospective randomised study on the long-term effect of lumbar fusion on adjacent disc degeneration. *Eur Spine J* 18:1175–1186. doi:[10.1007/s00586-009-0947-3](https://doi.org/10.1007/s00586-009-0947-3)

12. Franke J, Greiner-Perth R, Boehm H, Mahlfeld K, Grasshoff H, Allam Y, Awiszus F (2009) Comparison of a minimally invasive procedure versus standard microscopic discectomy: a prospective randomised controlled clinical trial. *Eur Spine J* 18:992–1000. doi:[10.1007/s00586-009-0964-2](https://doi.org/10.1007/s00586-009-0964-2)
13. Gahr P, Tschoke SK, Haschtmann D, Heyde C (2009) Multiple revisions of a L2 burst fracture in a suicide jumper: a retrospective analysis of what went wrong. *Eur Spine J* 18:927–934. doi:[10.1007/s00586-009-1027-4](https://doi.org/10.1007/s00586-009-1027-4) discussion 935–927
14. Grob D, Mannion AF (2009) The changing face of quality in spine surgery. *Eur Spine J* 18(Suppl 3):277–278. doi:[10.1007/s00586-009-1090-x](https://doi.org/10.1007/s00586-009-1090-x)
15. Grob D, Mannion AF (2009) The patient's perspective on complications after spine surgery. *Eur Spine J* 18(Suppl 3):380–385. doi:[10.1007/s00586-009-1005-x](https://doi.org/10.1007/s00586-009-1005-x)
16. Gunzburg R, Szpalski M, Callary SA, Colloca CJ, Kosmopoulos V, Harrison D, Moore RJ (2009) Effect of a novel interspinous implant on lumbar spinal range of motion. *Eur Spine J* 18:696–703. doi:[10.1007/s00586-009-0890-3](https://doi.org/10.1007/s00586-009-0890-3)
17. Hadjipavlou AG, Tzermiadianos MN, Kakavelakis KN, Lander P (2009) Percutaneous core excision and radiofrequency thermocoagulation for the ablation of osteoid osteoma of the spine. *Eur Spine J* 18:345–351. doi:[10.1007/s00586-008-0791-x](https://doi.org/10.1007/s00586-008-0791-x)
18. Hansson T, Suzuki N, Hebelka H, Gaultz A (2009) The narrowing of the lumbar spinal canal during loaded MRI: the effects of the disc and ligamentum flavum. *Eur Spine J* 18:679–686. doi:[10.1007/s00586-009-0919-7](https://doi.org/10.1007/s00586-009-0919-7)
19. Iizuka Y, Iizuka H, Tsutsumi S, Nakagawa Y, Nakajima T, Sorimachi Y, Ara T, Nishinome M, Seki T, Takagishi K (2009) Diagnosis of a previously unidentified primary site in patients with spinal metastasis: diagnostic usefulness of laboratory analysis, CT scanning and CT-guided biopsy. *Eur Spine J* 18:1431–1435. doi:[10.1007/s00586-009-1061-2](https://doi.org/10.1007/s00586-009-1061-2)
20. Jankowitz BT, Atteberry DS, Gerszten PC, Karausky P, Cheng BC, Faught R, Welch WC (2009) Effect of fibrin glue on the prevention of persistent cerebral spinal fluid leakage after incidental durotomy during lumbar spinal surgery. *Eur Spine J* 18:1169–1174. doi:[10.1007/s00586-009-0928-6](https://doi.org/10.1007/s00586-009-0928-6)
21. Jiang L, Liu ZJ, Liu XG, Ma QJ, Wei F, Lv Y, Dang GT (2009) Upper cervical spine chordoma of C2–C3. *Eur Spine J* 18:293–298. doi:[10.1007/s00586-009-0907-y](https://doi.org/10.1007/s00586-009-0907-y) discussion 298–300
22. Kandziora F (2009) Reviewer's comment concerning "Spinal fractures in patients with ankylosing spinal disorders: a systematic review of the literature on treatment, neurological status and complications" (L. A. Westerveld et al. Ms-no: ESJO-D-08-00152R1). *Eur Spine J* 18:157. doi:[10.1007/s00586-008-0838-z](https://doi.org/10.1007/s00586-008-0838-z)
23. Korovessis P, Repantis T, Zacharatos S, Zafiropoulos A (2009) Does Wallis implant reduce adjacent segment degeneration above lumbosacral instrumented fusion? *Eur Spine J* 18:830–840. doi:[10.1007/s00586-009-0976-y](https://doi.org/10.1007/s00586-009-0976-y)
24. Krueger A, Bliemel C, Zettl R, Ruchholtz S (2009) Management of pulmonary cement embolism after percutaneous vertebroplasty and kyphoplasty: a systematic review of the literature. *Eur Spine J* 18:1257–1265. doi:[10.1007/s00586-009-1073-y](https://doi.org/10.1007/s00586-009-1073-y)
25. Kuchta J, Sobottke R, Eysel P, Simons P (2009) Two-year results of interspinous spacer (X-Stop) implantation in 175 patients with neurologic intermittent claudication due to lumbar spinal stenosis. *Eur Spine J* 18:823–829. doi:[10.1007/s00586-009-0967-z](https://doi.org/10.1007/s00586-009-0967-z)
26. Lattig F, Grob D, Kleinstueck FS, Porchet F, Jeszenszky D, Bartanusz V, O'Riordan D, Mannion AF (2009) Ratings of global outcome at the first post-operative assessment after spinal surgery: how often do the surgeon and patient agree? *Eur Spine J* 18(Suppl 3):386–394. doi:[10.1007/s00586-009-1028-3](https://doi.org/10.1007/s00586-009-1028-3)
27. Lee CS, Hwang CJ, Lee SW, Ahn YJ, Kim YT, Lee DH, Lee MY (2009) Risk factors for adjacent segment disease after lumbar fusion. *Eur Spine J* 18:1637–1643. doi:[10.1007/s00586-009-1060-3](https://doi.org/10.1007/s00586-009-1060-3)
28. Li H, Gasbarrini A, Cappuccio M, Terzi S, Paderni S, Mirabile L, Boriani S (2009) Outcome of excisional surgeries for the patients with spinal metastases. *Eur Spine J* 18:1423–1430. doi:[10.1007/s00586-009-1111-9](https://doi.org/10.1007/s00586-009-1111-9)
29. Lovi A, Teli M, Ortolina A, Costa F, Fornari M, Brayda-Bruno M (2009) Vertebroplasty and kyphoplasty: complementary techniques for the treatment of painful osteoporotic vertebral compression fractures. A prospective non-randomised study on 154 patients. *Eur Spine J* 18(Suppl 1):95–101. doi:[10.1007/s00586-009-0986-9](https://doi.org/10.1007/s00586-009-0986-9)
30. Masala S, Ciarrapico AM, Konda D, Vinicola V, Mammucari M, Simonetti G (2008) Cost-effectiveness of percutaneous vertebroplasty in osteoporotic vertebral fractures. *Eur Spine J* 17:1242–1250. doi:[10.1007/s00586-008-0708-8](https://doi.org/10.1007/s00586-008-0708-8)
31. Mehbod A, Aunoble S, Le Huec JC (2003) Vertebroplasty for osteoporotic spine fracture: prevention and treatment. *Eur Spine J* 12(Suppl 2):S155–S162. doi:[10.1007/s00586-003-0607-y](https://doi.org/10.1007/s00586-003-0607-y)
32. Misaggi B, Gallazzi M, Colombo M, Ferraro M (2009) Articular facets syndrome: diagnostic grading and treatment options. *Eur Spine J* 18(Suppl 1):49–51. doi:[10.1007/s00586-009-0987-8](https://doi.org/10.1007/s00586-009-0987-8)
33. Pao JL, Chen WC, Chen PQ (2009) Clinical outcomes of microendoscopic decompressive laminotomy for degenerative lumbar spinal stenosis. *Eur Spine J* 18:672–678. doi:[10.1007/s00586-009-0903-2](https://doi.org/10.1007/s00586-009-0903-2)
34. Peng B, Chen J, Kuang Z, Li D, Pang X, Zhang X (2009) Diagnosis and surgical treatment of back pain originating from endplate. *Eur Spine J* 18:1035–1040. doi:[10.1007/s00586-009-0938-4](https://doi.org/10.1007/s00586-009-0938-4)
35. Peul WC, Arts MP, Brand R, Koes BW (2009) Timing of surgery for sciatica: subgroup analysis alongside a randomized trial. *Eur Spine J* 18:538–545. doi:[10.1007/s00586-008-0867-7](https://doi.org/10.1007/s00586-008-0867-7)
36. Peul WC, van den Hout WB, Brand R, Thomeer RT, Koes BW, Leiden—The Hague Spine Intervention Prognostic Study G (2008) Prolonged conservative care versus early surgery in patients with sciatica caused by lumbar disc herniation: two year results of a randomised controlled trial. *BMJ* 336:1355–1358. doi:[10.1136/bmj.a143](https://doi.org/10.1136/bmj.a143)
37. Peul WC, van Houwelingen HC, van den Hout WB, Brand R, Eekhof JA, Tans JT, Thomeer RT, Koes BW, Leiden—The Hague Spine Intervention Prognostic Study G (2007) Surgery versus prolonged conservative treatment for sciatica. *N Engl J Med* 356:2245–2256. doi:[10.1056/NEJMoa064039](https://doi.org/10.1056/NEJMoa064039)
38. Ploeg WT, Veldhuizen AG, The B, Sietsma MS (2006) Percutaneous vertebroplasty as a treatment for osteoporotic vertebral compression fractures: a systematic review. *Eur Spine J* 15:1749–1758. doi:[10.1007/s00586-006-0159-z](https://doi.org/10.1007/s00586-006-0159-z)
39. Porchet F, Bartanusz V, Kleinstueck FS, Lattig F, Jeszenszky D, Grob D, Mannion AF (2009) Microdiscectomy compared with standard discectomy: an old problem revisited with new outcome measures within the framework of a spine surgical registry. *Eur Spine J* 18(Suppl 3):360–366. doi:[10.1007/s00586-009-0917-9](https://doi.org/10.1007/s00586-009-0917-9)
40. Roder C, Staub L, Dietrich D, Zweig T, Melloh M, Aebi M (2009) Benchmarking with Spine Tango: potentials and pitfalls. *Eur Spine J* 18(Suppl 3):305–311. doi:[10.1007/s00586-009-0943-7](https://doi.org/10.1007/s00586-009-0943-7)
41. Sansur CA, Early S, Reibel J, Arlet V (2009) Pharyngocutaneous fistula after anterior cervical spine surgery. *Eur Spine J* 18:586–591. doi:[10.1007/s00586-009-0951-7](https://doi.org/10.1007/s00586-009-0951-7)
42. Schmelzer-Schmied N, Cartens C, Meeder PJ, Dafonseca K (2009) Comparison of kyphoplasty with use of a calcium phosphate cement and non-operative therapy in patients with traumatic non-osteoporotic vertebral fractures. *Eur Spine J* 18:624–629. doi:[10.1007/s00586-008-0880-x](https://doi.org/10.1007/s00586-008-0880-x)
43. Schulte TL, Leistra F, Bullmann V, Osada N, Vieth V, Marquardt B, Lerner T, Liljenqvist U, Hackenberg L (2007) Disc height reduction in adjacent segments and clinical outcome 10 years after lumbar 360 degrees fusion. *Eur Spine J* 16:2152–2158. doi:[10.1007/s00586-007-0515-7](https://doi.org/10.1007/s00586-007-0515-7)

44. Siepe CJ, Korge A, Grochulla F, Mehren C, Mayer HM (2008) Analysis of post-operative pain patterns following total lumbar disc replacement: results from fluoroscopically guided spine infiltrations. *Eur Spine J* 17:44–56. doi:[10.1007/s00586-007-0519-3](https://doi.org/10.1007/s00586-007-0519-3)
45. Siepe CJ, Wiechert K, Khattab MF, Korge A, Mayer HM (2007) Total lumbar disc replacement in athletes: clinical results, return to sport and athletic performance. *Eur Spine J* 16:1001–1013. doi:[10.1007/s00586-006-0257-y](https://doi.org/10.1007/s00586-006-0257-y)
46. Sinikallio S, Aalto T, Koivumaa-Honkanen H, Airaksinen O, Herno A, Kroger H, Viinamaki H (2009) Life dissatisfaction is associated with a poorer surgery outcome and depression among lumbar spinal stenosis patients: a 2-year prospective study. *Eur Spine J* 18:1187–1193. doi:[10.1007/s00586-009-0955-3](https://doi.org/10.1007/s00586-009-0955-3)
47. Sobottke R, Schluter-Brust K, Kaulhausen T, Rollinghoff M, Joswig B, Stutzer H, Eysel P, Simons P, Kuchta J (2009) Inter-spinous implants (X Stop, Wallis, Diam) for the treatment of LSS: is there a correlation between radiological parameters and clinical outcome? *Eur Spine J* 18:1494–1503. doi:[10.1007/s00586-009-1081-y](https://doi.org/10.1007/s00586-009-1081-y)
48. Spitzer WO, Skovron ML, Salmi LR, Cassidy JD, Duranceau J, Suissa S, Zeiss E (1995) Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining “whiplash” and its management. *Spine Phila Pa* 20:1–73
49. Stradiotti P, Curti A, Castellazzi G, Zerbi A (2009) Metal-related artifacts in instrumented spine. Techniques for reducing artifacts in CT and MRI: state of the art. *Eur Spine J* 18(Suppl 1):102–108. doi:[10.1007/s00586-009-0998-5](https://doi.org/10.1007/s00586-009-0998-5)
50. Strömqvist B, Fritzell P, Hägg O, Jönsson B, Swedish Society of Spinal Surgeons (2009) The Swedish Spine Register: development, design and utility. *Eur Spine J* 18(Suppl 3):294–304. doi:[10.1007/s00586-009-1043-4](https://doi.org/10.1007/s00586-009-1043-4)
51. Tafazal S, Ng L, Chaudhary N, Sell P (2009) Corticosteroids in peri-radicular infiltration for radicular pain: a randomised double blind controlled trial. One year results and subgroup analysis. *Eur Spine J* 18:1220–1225. doi:[10.1007/s00586-009-1000-2](https://doi.org/10.1007/s00586-009-1000-2)
52. Taylor RS, Fritzell P, Taylor RJ (2007) Balloon kyphoplasty in the management of vertebral compression fractures: an updated systematic review and meta-analysis. *Eur Spine J* 16:1085–1100. doi:[10.1007/s00586-007-0308-z](https://doi.org/10.1007/s00586-007-0308-z)
53. Vaga S, Brayda-Bruno M, Perona F, Fornari M, Raimondi MT, Petrucci M, Grava G, Costa F, Caiani EG, Lamartina C (2009) Molecular MR imaging for the evaluation of the effect of dynamic stabilization on lumbar intervertebral discs. *Eur Spine J* 18(Suppl 1):40–48. doi:[10.1007/s00586-009-0996-7](https://doi.org/10.1007/s00586-009-0996-7)
54. Vordemvenne T, Hartensuer R, Lohrer L, Vieth V, Fuchs T, Raschke MJ (2009) Is there a way to diagnose spinal instability in acute burst fractures by performing ultrasound? *Eur Spine J* 18:964–971. doi:[10.1007/s00586-009-1009-6](https://doi.org/10.1007/s00586-009-1009-6)
55. Wand BM, Chiffelle LA, O’Connell NE, McAuley JH, Desouza LH (2009) Self-reported assessment of disability and performance-based assessment of disability are influenced by different patient characteristics in acute low back pain. *Eur Spine J*. doi:[10.1007/s00586-009-1180-9](https://doi.org/10.1007/s00586-009-1180-9)
56. Westerveld LA, Verlaan JJ, Oner FC (2009) Spinal fractures in patients with ankylosing spinal disorders: a systematic review of the literature on treatment, neurological status and complications. *Eur Spine J* 18:145–156. doi:[10.1007/s00586-008-0764-0](https://doi.org/10.1007/s00586-008-0764-0)