

Appendix Evidence-Based Articles Related to Spine Surgery

Al Nezari NH, Schneiders AG, Hendrick PA. Neurologic examination of the peripheral nervous system to diagnose lumbar spinal disc herniation with suspected radiculopathy: a systematic review and meta-analysis. *Spine J.* 2013 Jun;13(6):657-74. Epub 2013 Mar 15.

A systematic review and meta-analysis of the literature was performed to determine the diagnostic accuracy of a neurologic examination in the setting of a lumbar disc herniation with radiculopathy. After an extensive literature search, fourteen studies were reviewed that each assessed three standard neurologic examination measures: sensory, motor, and reflexes. In each of these studies, the presence or absence of a disc herniation was confirmed either with surgery or spinal imaging (computed tomography, magnetic resonance imaging, or myelography). Overall, the accuracy of the pooled data demonstrated poor sensitivity, moderate specificity, and limited diagnostic accuracy of the physical examination with regard to the specific spinal level of the herniation.

Al-Shoha A, Rao DS, Schilling J, Peterson E, Mandel S. Effect of epidural steroid injection on bone mineral density and markers of bone turnover in postmenopausal women. *Spine (Phila Pa 1976).* 2012 Dec 1;37(25):E1567-71.

This was a prospective observational study evaluating the effects of epidural steroid injections on bone mineral density. Twenty-eight postmenopausal women with lumbar radiculopathy elected to have L4-L5 epidural injections. There was a 50% dropout rate. These patients had a significant decline in bone mineral density at six months as compared with age-matched control patients.

Auerbach JD, Anakwenze OA, Milby AH, Lonner BS, Balderston RA. Segmental contribution toward total cervical range of motion: a comparison of cervical disc arthroplasty and fusion. *Spine (Phila Pa 1976).* 2011 Dec 1;36(25):E1593-9.

One hundred and eighty-seven patients from a randomized trial with cervical total disc replacement were measured for cervical motion after surgery. Compensation for loss of motion at the operative level in anterior cervical discectomy and fusion was seen throughout the unfused segments. In the arthroplasty patients, there was an increase in cervical range of motion throughout the cervical spine at two years.

Alsaleh KA, Tougas CA, Roffey DM, Wai EK. Osteoconductive bone graft extenders in posterolateral thoracolumbar spinal fusion: a systematic review. *Spine (Phila Pa 1976).* 2012 Jul 15;37(16):E993-1000.

Using a meta-analysis, the authors found that bone-graft extenders combined with local bone had similar fusion success, clinical outcomes, fewer complications, but lower donor-site pain when compared with use of iliac crest bone graft. The study quality of the included studies was poor and there was significant study heterogeneity, indicating that these results have limited value.

Ammendolia C, Stuber K, de Bruin LK, Furlan AD, Kennedy CA, Rampersaud YR, Steenstra IA, Pennick V. Nonoperative treatment of lumbar spinal stenosis with neurogenic claudication: a systematic review. *Spine (Phila Pa 1976).* 2012 May 1;37(10):E609-16.

Nonoperative treatments are routinely used for spinal stenosis with neurogenic claudication. This meta-analysis showed that there is no moderate or high-level evidence for any nonoperative treatments, including medication, injections, and spinal manipulation. The authors correctly concluded that large-scale randomized trials to determine the role of nonoperative treatments are needed.

Bailey A, Araghi A, Blumenthal S, Huffmon GV; Anular Repair Clinical Study Group. Prospective, multicenter, randomized, controlled study of anular repair in lumbar discectomy: two-year follow-up. *Spine (Phila Pa 1976).* 2013 Jun 15;38(14):1161-9.

This multicenter randomized study demonstrated that anular repair reduced the need for reherniation surgery without increased risk. The results were not statistically significant.

Bracken MB. Steroids for acute spinal cord injury. *Cochrane Database Syst Rev.* 2012;1:CD001046. Epub 2012 Jan 18.

The use of corticosteroids in acute spinal cord injury has been an extremely controversial topic since its inception. A recent Cochrane Database systematic review looked at randomized controlled trials as far back as 1948 and found that high-dose methylprednisolone therapy administered within eight hours after injury was the only pharmacologic treatment shown to be efficacious in a phase-3 randomized trial. The effect is a significant recovery in motor function, independent of the timing of surgical intervention. This regimen of 30 mg/kg over fifteen minutes followed by a maintenance infusion of 5.4 mg/kg/hr for twenty-three hours if given within three hours after injury or for forty-eight hours if given within three to eight hours after injury

has also been shown to be effective in the treatment of symptoms associated with whiplash injuries. Interestingly, a modification of this protocol was shown to assist in recovery following surgery for lumbar disc disease. In contradistinction to commonly held fears with regard to corticosteroid treatment, the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS) trial data demonstrated that not using methylprednisolone was correlated with a higher rate of acute inpatient complications.

Braun J, Deodhar A, Inman RD, van der Heijde D, Mack M, Xu S, Hsu B. Golimumab administered subcutaneously every 4 weeks in ankylosing spondylitis: 104-week results of the GO-RAISE study. *Ann Rheum Dis.* 2012 May;71(5):661-7. Epub 2011 Oct 19.

This was a randomized study of golimumab subcutaneous injections for patients with ankylosing spondylitis assigned to either placebo, golimumab (50 mg), or golimumab (100 mg) every four weeks. At week 16, patients in either the lower dose or placebo group with less than 20% improvement were entered early into the low or higher dose of golimumab, respectively. At week 104, 60% to 70% of those in either golimumab group had at least 20% improvement in assessments and about 30% were in partial remission. The clinical response was sustained throughout the course of treatment.

Brooks C, Kennedy S, Marshall PW. Specific trunk and general exercise elicit similar changes in anticipatory postural adjustments in patients with chronic low back pain: a randomized controlled trial. *Spine (Phila Pa 1976).* 2012 Dec 1;37(25):E1543-50.

This randomized controlled trial in sixty-four patients was designed to compare changes in self-rated disability, pain, and anticipatory postural adjustments between specific trunk exercise and general exercise in patients with chronic low back pain. Patients were randomized to a specific exercise group (SEG) or a control group with general exercise (i.e., only seated cycling exercises for an eight-week period). Disability was significantly lower in the SEG group, and pain was reduced in both groups but was lower for the SEG group.

Cepoiu-Martin M, Faris P, Lorenzetti D, Prefontaine E, Noseworthy T, Sutherland L. Artificial cervical disc arthroplasty: a systematic review. *Spine (Phila Pa 1976).* 2011 Dec 1;36(25):E1623-33.

A review of eighteen studies, including four randomized trials, concluded that weak evidence exists that artificial cervical disc replacement may be superior to fusion for treating neck and arm pain. In most studies, at two years the effectiveness appears to be similar to that of cervical fusion.

Cho SK, Lu Y, Lee DH. Dysphagia following anterior cervical spinal surgery: a systematic review. *Bone Joint J.* 2013 Jul;95-B(7):868-73.

This article explains that dysphasia is a common complication following anterior surgery of the cervical spine. There are many risk factors, and the management of the complications postoperatively is not entirely clear and straightforward.

da C Menezes Costa L, Maher CG, Hancock MJ, McAuley JH, Herbert RD, Costa LO. The prognosis of acute and persistent low-back pain: a meta-analysis. *CMAJ.* 2012 Aug 7;184(11):E613-24. Epub 2012 May 14.

Symptoms of acute or persistent low back pain improve dramatically in the first six weeks of presentation. In a meta-analysis of episode-inception cohort studies with patients presenting with either acute or chronic-persistent low back pain, patients presenting with acute low back pain experienced a time course of pain and disability that occurred more predictably than the time course of patients with chronic-persistent low back pain, whose fifty-two-week pain scores were slightly worse than the disability scores.

Diab AA, Moustafa IM. The efficacy of forward head correction on nerve root function and pain in cervical spondylotic radiculopathy: a randomized trial. *Clin Rehabil.* 2012 Apr;26(4):351-61. Epub 2011 Sep 21.

A posture corrective exercise program, when combined with ultrasound and infrared radiation, demonstrated a significantly positive effect on forward head posture correction in patients with lower cervical spondylotic radiculopathy. Pain, craniocervical angle, and dermatomal somatosensory evoked potentials in the C6 and C7 distribution improved dramatically with the exercise program.

el Barzouhi A, Vleggeert-Lankamp CL, Lycklama à Nijeholt GJ, Van der Kallen BF, van den Hout WB, Jacobs WC, Koes BW, Peul WC; Leiden-The Hague Spine Intervention Prognostic Study Group. Magnetic resonance imaging in follow-up assessment of sciatica. *N Engl J Med.* 2013 Mar 14;368(11):999-1007.

This is a study of 283 patients in a randomized trial in which surgical treatment was compared with prolonged conservative care for sciatica and lumbar disc herniation. At the one-year follow-up, magnetic resonance imaging (MRI) assessment of the disc

herniation did not distinguish between patients having a favorable outcome and those with an unfavorable outcome. This is another paper that suggests that MRI studies in clinical practice are somewhat over-ordered and over-analyzed.

Ezhevskaya AA, Mlyavykh SG, Anderson DG. Effects of continuous epidural anesthesia and postoperative epidural analgesia on pain management and stress response in patients undergoing major spinal surgery. *Spine (Phila Pa 1976)*. 2013 Jul 1;38(15):1324-30.

This was a prospective randomized study of the use of combined epidural and endotracheal anesthesia with postoperative epidural analgesia with ropivacaine, fentanyl, and epinephrine (group E) as compared with the use of general endotracheal anesthesia and postoperative epidural analgesia with fentanyl and systemically administered opioids (group G). Pain, nausea, mobility, and satisfaction were measured along with intraoperative and postoperative levels of interleukin-1 (IL-1) beta, IL-10, cortisol, and glucose. All subjective and objective assessment measures significantly favored group E. Of note, group E was also associated with significantly less intraoperative and postoperative blood loss, similar to results reported in the total joint arthroplasty literature.

Fineberg SJ, Oglesby M, Patel AA, Pelton MA, Singh K. The incidence and mortality of thromboembolic events in lumbar spine surgery. *Spine (Phila Pa 1976)*. 2013 Jun 1;38(13):1154-9.

This was a retrospective analysis of a population-based database to identify the incidence, risk factors, and mortality of thromboembolic events after lumbar spine surgery. The incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) was 2.4 and 1.0, respectively, for lumbar decompression surgeries, and 4.3 and 2.6, respectively, for lumbar fusion cases per 1000 cases. Preoperative pulmonary circulation disorders, fluid and/or electrolyte disorders, anemia, black ethnicity, and teaching hospital status were predictors for the development of both DVT and PE. Preventative measures in these at-risk patients may decrease the incidence of thromboembolic events.

Gao Y, Liu M, Li T, Huang F, Tang T, Xiang Z. A meta-analysis comparing the results of cervical disc arthroplasty with anterior cervical discectomy and fusion (ACDF) for the treatment of symptomatic cervical disc disease. *J Bone Joint Surg Am*. 2013 Mar 20;95(6):555-61.

This is a meta-analysis comparing cervical arthroplasty to anterior cervical fusion. A total of twenty-seven randomized clinical trials were included. The authors found that the fusion group had shorter operative times and less blood loss as compared with the arthroplasty group; however, other outcome measures, including the length of stay, neck and arm pain scores, range of motion, adverse events, and secondary surgical procedures were superior or equivalent in the arthroplasty group as compared with the outcomes in the fusion group.

Ghai B, Vadaje KS, Wig J, Dhillon MS. Lateral parasagittal versus midline interlaminar lumbar epidural steroid injection for management of low back pain with lumbosacral radicular pain: a double-blind, randomized study. *Anesth Analg*. 2013 Jul;117(1):219-27. Epub 2013 Apr 30.

In this article, a parasagittal interlaminar approach for epidural injection is described. The authors describe more effective pain relief and fewer complications with this approach as compared with the more traditional midline interlaminar approach. The authors theorize that this was because of "better" ventral epidural spread of the pharmaceutical agent.

Gnanenthiran SR, Adie S, Harris IA. Nonoperative versus operative treatment for thoracolumbar burst fractures without neurologic deficit: a meta-analysis. *Clin Orthop Relat Res*. 2012 Feb;470(2):567-77. Epub 2011 Nov 05.

This meta-analysis showed that operative management of thoracolumbar burst fractures without neurologic deficit may improve residual kyphosis but does not appear to reduce pain or improve function at an average of four years after injury and is associated with higher complication rates and costs.

Gornet MF, Burkus JK, Dryer RF, Peloza JH. Lumbar disc arthroplasty with Maverick disc versus stand-alone interbody fusion: a prospective, randomized, controlled, multicenter investigational device exemption trial. *Spine (Phila Pa 1976)*. 2011 Dec 1;36(25):E1600-11.

In this study, 405 investigational and 172 control patients were randomized and followed for twenty-four months. Compared with the fusion group, the disc replacement group demonstrated statistical superiority on outcomes, including improved physical function, reduced pain, and earlier return to work.

Guilfoyle MR, Mannion RJ, Mitchell P, Thomson S. Epidural fentanyl for postoperative analgesia after lumbar canal decompression: a randomized controlled trial. *Spine J*. 2012 Aug;12(8):646-51. Epub 2012 Aug 25.

To reduce postoperative pain following spinal stenosis decompression, the authors evaluated a single epidural injection of 100 µg fentanyl. The results of a placebo-controlled randomized controlled study showed that patients receiving fentanyl had lower pain scores in the recovery room but that no difference was noted at all later times. Urinary catheterization was needed more often in the fentanyl group. This, combined with only marginal pain relief, suggests that this technique offers little benefit.

Haladay DE, Miller SJ, Challis J, Denegar CR. Quality of systematic reviews on specific spinal stabilization exercise for chronic low back pain. *J Orthop Sports Phys Ther.* 2013 Apr;43(4):242-50. Epub 2013 Jan 14.

This systematic literature review evaluates stabilization exercises for chronic low back pain and concludes that there is benefit provided by stabilization exercise programs for patients with nonspecific chronic low back pain.

Jacobs W, Van der Gaag NA, Tuschel A, de Kleuver M, Peul W, Verbout AJ, Oner FC. Total disc replacement for chronic back pain in the presence of disc degeneration. *Cochrane Database Syst Rev.* 2012;9(9):CD008326. Epub 2012 Sep 12.

Six studies were identified that compared the outcomes of total disc replacement with the outcomes of fusion for chronic low back pain. Patients who had total disc replacement had more improvement in Oswestry disability and pain scores, but it did not reach a predefined level of a clinically important difference. The authors concluded that, since long-term harms are as yet unknown, surgeons should be prudent in adopting this technology of total disc replacement in the presence of disc degeneration.

Jimbo S, Kobayashi T, Aono K, Atsuta Y, Matsuno T. Epidemiology of degenerative lumbar scoliosis: a community-based cohort study. *Spine (Phila Pa 1976).* 2012 Sep 15;37(20):1763-70.

This was a twelve-year prospective study of 144 female volunteers to study preexisting and de novo degenerative lumbar scoliosis in a community. Preexisting scoliosis was found in forty-two patients (29.2%), and eleven of those patients (26%) showed more than 5° of progression. De novo scoliosis developed in thirty patients (29.4%) among those without baseline scoliosis. Risk factors for progression of scoliosis were younger age, smaller L4 size, lower lumbar lordosis, greater scoliosis angle, and L4 tilt. Smaller L4 size, unilateral osteophyte formation, and lateral disc-wedging were risk factors for de novo lumbar scoliosis.

Jindal N, Sankhala SS, Bachhal V. The role of fusion in the management of burst fractures of the thoracolumbar spine treated by short segment pedicle screw fixation: a prospective randomised trial. *J Bone Joint Surg Br.* 2012 Aug;94(8):1101-6.

Patients who had a thoracolumbar burst fracture that was treated with short-segment pedicle screw fixation fared no better (from a functional, neurologic, or radiographic perspective) if a concomitant fusion was performed or not. As expected, perioperative blood transfusion requirements and duration of surgery, two parameters known to be detrimental to patient outcome, were significantly higher and longer, respectively, when an adjunctive fusion was performed.

Kang J, An H, Hilibrand A, Yoon ST, Kavanagh E, Boden S. Grafton and local bone have comparable outcomes to iliac crest bone in instrumented single-level lumbar fusions. *Spine (Phila Pa 1976).* 2012 May 20;37(12):1083-91.

This was a prospective, randomized, multicenter clinical trial of forty-one patients undergoing single-level instrumented lumbar fusion. The patients were randomized to either autologous iliac crest bone graft (ICBG) (thirteen patients) or Grafton demineralized bone matrix (BioHorizons) with local bone (twenty-eight patients). At the final, two-year follow-up, the Grafton group achieved an 86% overall fusion rate and improvements in clinical outcomes that were comparable with that of the ICBG group.

Lakemeier S, Lind M, Schultz W, Fuchs-Winkelmann S, Timmesfeld N, Foelsch C, Peterlein CD. A comparison of intraarticular lumbar facet joint steroid injections and lumbar facet joint radiofrequency denervation in the treatment of low back pain: a randomized, controlled, double-blind trial. *Anesth Analg.* 2013 Jul;117(1):228-35. Epub 2013 Apr 30.

In this randomized, controlled, double-blind trial, the authors found identical outcomes when comparing intra-articular facet joint injections to radiofrequency denervation procedures for the treatment of chronic lumbar back pain. This might suggest there is no real advantage to a radiofrequency denervation procedure.

Lamb SE, Gates S, Williams MA, Williamson EM, Mt-Isa S, Withers EJ, Castelnuovo E, Smith J, Ashby D, Cooke MW, Petrou S, Underwood MR; Managing Injuries of the Neck Trial (MINT) Study Team. Emergency department treatments and physiotherapy for acute whiplash: a pragmatic, two-step, randomised controlled trial. *Lancet.* 2013 Feb 16;381(9866):546-56. Epub 2012 Dec 19.

This was a randomized study to compare active management versus usual care in the treatment of acute whiplash. In step one, patients were assigned to receive active management (2253 patients) or usual care (1598 patients), and the neck disability index

score did not differ between groups. In step two, patients were assigned to receive either a package of up to six physiotherapy sessions (300 patients) or a single advice session (299 patients). The physiotherapy patients showed a modest benefit at four months, but not at eight to twelve months. In the end, active management did not show additional benefit and was not deemed cost-effective.

La Touche R, París-Aleman A, Mannheimer JS, Angulo-Díaz-Parreño S, Bishop MD, López-Valverde-Centeno A, von Piekartz H, Fernández-Carnero J. Does mobilization of the upper cervical spine affect pain sensitivity and autonomic nervous system function in patients with cervico-craniofacial pain?: A randomized-controlled trial. *Clin J Pain.* 2013 Mar;29(3):205-15.

Chronic craniofacial pain including upper cervical and temporal mandibular pain and autonomic dysfunction is thought to be relieved by anteroposterior upper cervical mobilization. Results of this technique in thirty-two patients showed promise, as decreased pain sensitization and intensity was seen as compared with that seen in controls. The mechanism of action was hypothesized to be an immediate nociceptive modulation in the trigeminocervical complex.

Lee SH, Kim KT, Suk KS, Park KJ, Oh KI. Effect of retropharyngeal steroid on prevertebral soft tissue swelling following anterior cervical discectomy and fusion: a prospective, randomized study. *Spine (Phila Pa 1976).* 2011 Dec 15;36(26):2286-92.

The authors found that twenty-five patients randomized to receive retropharyngeal steroids at the time of cervical discectomy and fusion experienced reduced prevertebral soft-tissue swelling and odynophagia as compared with the results seen in controls.

Licciardone JC, Minotti DE, Gatchel RJ, Kearns CM, Singh KP. Osteopathic manual treatment and ultrasound therapy for chronic low back pain: a randomized controlled trial. *Ann Fam Med.* 2013 Mar-Apr;11(2):122-9.

This is a randomized controlled trial exploring osteopathic manual and ultrasound treatment for the treatment of chronic low back pain. The control groups were sham manual and sham ultrasound treatment arms. Ultrasound did not show differences between sham and treatment groups. On the other hand, osteopathic manual treatment showed moderate responses to treatment as compared with the response seen in the sham group at the twelve-week follow-up as well as a lower need for prescription pain medication. The authors concluded that osteopathic manual treatment is safe, moderately effective, and well accepted by patients.

Longo UG, Loppini M, Denaro L, Maffulli N, Denaro V. Conservative management of patients with an osteoporotic vertebral fracture: a review of the literature. *J Bone Joint Surg Br.* 2012 Feb;94(2):152-7.

The authors performed a review of conservative treatment (e.g., bed rest, analgesic medication, physiotherapy, and bracing) of patients with vertebral compression fractures. The review revealed a paucity of data on conservative treatment which makes comparison with cementoplasty also challenging.

Macedo LG, Wang Y, Battié MC. The sedimentation sign for differential diagnosis of lumbar spinal stenosis. *Spine (Phila Pa 1976).* 2013 May 1;38(10):827-31.

The authors showed that the sedimentation sign on magnetic resonance imaging is more prevalent in patients with central or combined stenosis than it is in patients with lateral stenosis only or posterolateral disc herniation.

Marshall PW, Kennedy S, Brooks C, Lonsdale C. Pilates exercise or stationary cycling for chronic nonspecific low back pain: does it matter? a randomized controlled trial with 6-month follow-up. *Spine (Phila Pa 1976).* 2013 Jul 1;38(15):E952-9.

This is a randomized controlled trial comparing Pilates exercise and stationary cycling for chronic nonspecific back pain. The author enrolled sixty-four patients in the study who were randomly assigned to one of the activities, and eight-week and six-month assessments in back-pain reduction were performed. Both activities resulted in a reduction of back pain, with most of the improvement noted by eight weeks. There was no additional benefit noted at six months, although the improvements in back pain reduction were sustained.

Michaleff ZA, Maher CG, Verhagen AP, Rebeck T, Lin CW. Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review. *CMAJ.* 2012 Nov 6;184(16):E867-76. Epub 2012 Oct 09.

In an effort to determine the most efficacious approach to cervical spine (C-spine) evaluation in patients with blunt cervical trauma, the diagnostic accuracy of the Canadian C-spine rule and the National Emergency X-Radiography Utilization Study (NEXUS) criteria underwent a systematic literature review. Though the sensitivity of both diagnostic criteria hovered around 80% to 100%, the specificity and accuracy of the NEXUS criteria trailed behind the Canadian C-spine rule. This relatively high sensitivity

portends excellent prognostication value in that both criteria are capable of informing a clinician of the low probability of a clinically relevant C-spine injury when the test results are negative.

Michielsen J, Sys J, Rigaux A, Bertrand C. The effect of recombinant human bone morphogenetic protein-2 in single-level posterior lumbar interbody arthrodesis. *J Bone Joint Surg Am.* 2013 May 15;95(10):873-80.

This randomized controlled trial showed no clinical difference in outcomes with regard to the use of recombinant human bone morphogenetic protein-2 (rhBMP-2) as compared with the use of local bone after instrumented single-level posterior lumbar interbody fusion (PLIF). Computed tomography at one year showed that seven of nineteen BMP cases had ectopic bone and that the rhBMP-2 group had lower bone mineral density than the control group did. This study, although limited by its small sample size, did not show any benefit from rhBMP-2 use in PLIF and in fact shows a high rate of ectopic bone and poorer quality bone.

Morone G, Iosa M, Paolucci T, Fusco A, Alcuri R, Spadini E, Saraceni VM, Paolucci S. Efficacy of perceptive rehabilitation in the treatment of chronic nonspecific low back pain through a new tool: a randomized clinical study. *Clin Rehabil.* 2012 Apr;26(4):339-50. Epub 2011 Sep 28.

Examining only patients with chronic-persistent (at least a three-month duration at presentation) nonspecific low back pain, the authors of this single-blinded, randomized controlled trial evaluated the efficacy of a perceptive rehabilitative approach at reducing pain and disability. The study was comprised of three groups with twenty-five subjects in each group and evaluated patients with use of the visual analog scale (VAS), the McGill Pain Questionnaire, the Oswestry Disability Index, and the Waddell Disability Index. With use of a new tool called "Surface for Perceptive Rehabilitation," patients were asked to perform perceptive exercises while lying on a rigid surface with an overlay of deformable cones of various dimensions. This method was compared to the well-known Back School program and a group of control patients who received the same medical and pharmacological baseline treatment as the other groups. Although pain scores were significantly reduced in both the Back School program and the Surface for Perceptive Rehabilitation Group at long-term (twenty-four weeks) follow-up, the Perceptive Rehabilitation Group demonstrated an immediate positive effect that was not seen with the Back School program.

Moustafa IM, Diab AA. Extension traction treatment for patients with discogenic lumbosacral radiculopathy: a randomized controlled trial. *Clin Rehabil.* 2013 Jan;27(1):51-62. Epub 2012 Jun 08.

This was a randomized controlled study of sixty-four patients with unilateral radicular symptoms with a L5-S1 disc herniation and a lumbar lordotic angle of $<39^\circ$. These patients were randomly assigned to a control group (thirty-two patients) receiving hot packs and interferential therapy or to an experimental group (thirty-two patients) receiving lumbar extension traction in addition to hot packs and interferential therapy. There was a significant difference between the traction group and the control group in terms of absolute rotatory angle, Oswestry Disability Index, back and leg pain, modified Schober test, latency and amplitude of H-reflex, and intervertebral movements. The findings were the same at the time of the final six-month follow-up.

Nunley PD, Jawahar A, Kerr EJ 3rd, Gordon CJ, Cavanaugh DA, Birdsong EM, Stocks M, Danielson G. Factors affecting the incidence of symptomatic adjacent-level disease in cervical spine after total disc arthroplasty: 2- to 4-year follow-up of 3 prospective randomized trials. *Spine (Phila Pa 1976).* 2012 Mar 15;37(6):445-51.

A review of three prospective randomized controlled trials across two institutions assessing adjacent level disease following cervical total disc arthroplasty compared with anterior cervical decompression and fusion found that the risk of developing adjacent level disease was equivalent at an average of thirty-eight months after surgery. Patients had single or two-level disease and were followed up at six weeks and then at three, six, twelve, twenty-four, thirty-six, and forty-eight months postoperatively. Notably, osteopenia and concurrent lumbar degenerative disc disease significantly increased the risk of adjacent level disease.

Phillips FM, Lee JY, Geisler FH, Cappuccino A, Chaput CD, DeVine JG, Reah C, Gilder KM, Howell KM, McAfee PC. A prospective, randomized, controlled clinical investigation comparing PCM cervical disc arthroplasty with anterior cervical discectomy and fusion. 2-year results from the US FDA IDE clinical trial. *Spine (Phila Pa 1976).* 2013 Jul 1;38(15):E907-18.

This is a randomized controlled trial examining the results of cervical disc arthroplasty with the PCM device as compared with the results of anterior cervical fusion in the treatment of symptomatic cervical spondylosis. The authors included 342 patients, with 189 patients randomized to the arthroplasty group and 153 patients randomized to the fusion group. At the time of the two-year follow up, the arthroplasty group demonstrated superior outcomes with respect to neck disability index scores, dysphagia, and overall patient satisfaction. The rates of adverse events and revision operations were similar between groups.

Phillips FM, Slosar PJ, Youssef JA, Andersson G, Papatheofanis F. Lumbar spine fusion for chronic low back pain due to degenerative disc disease: a systematic review. *Spine (Phila Pa 1976).* 2013 Apr 1;38(7):E409-22.

The authors performed a systematic review of studies that documented outcomes following fusion for axial low back pain secondary to degenerative disc disease, including randomized and nonrandomized trials. A clinically important difference in pain and function from baseline was observed universally after surgery. However, this improvement, although greater than that seen in patients who underwent nonoperative care, was only marginally better than that seen in the nonoperative treatment arms of the randomized controlled trials, and thus any conclusions should be viewed cautiously.

Rebolledo BJ, Gladnick BP, Unnanuntana A, Nguyen JT, Kepler CK, Lane JM. Comparison of unipedicular and bipedicular balloon kyphoplasty for the treatment of osteoporotic vertebral compression fractures: a prospective randomised study. *Bone Joint J.* 2013 Mar;95-B(3):401-6.

This is a prospective randomized controlled study comparing a unipedicular to a bipedicular approach to balloon kyphoplasty in the treatment of osteoporotic compression fractures. A total of fifty-six kyphoplasties were performed in the study. The authors found that the unipedicular approach provided similar corrections, restoration of height, and outcomes at the one-year follow-up, with shorter operative times compared with those seen with the bipedicular approach.

Rhyne AL, Blumenthal SL, Frank EH, Hsu KY, Kim KD, Youssef JA, Wang JC, Arnold P, BenDebba M, Block KM, Juarez TG, Chiacchierini RP, Ehmsen RJ, Krelle JS, diZerega GS; Oxiplex Clinical Study Group. Oxiplex reduces leg pain, back pain, and associated symptoms after lumbar discectomy. *Spine (Phila Pa 1976).* 2012 Apr 15;37(8):631-41.

This was a prospective, randomized, blinded clinical trial looking at the effectiveness of a gel for reducing pain and associated symptoms in patients undergoing a lumbar discectomy. Patients were randomized to either the gel (177 patients) or surgery alone (175 patients) and were evaluated at six months. The patients receiving the gel had greater reduction of pain and symptoms (leg and back pain) and were more satisfied with their surgery. The study showed improvements in clinical outcome with the use of the gel at six months following the discectomy surgery.

Ringel F, Stüer C, Reinke A, Preuss A, Behr M, Auer F, Stoffel M, Meyer B. Accuracy of robot-assisted placement of lumbar and sacral pedicle screws: a prospective randomized comparison to conventional freehand screw implantation. *Spine (Phila Pa 1976).* 2012 Apr 15;37(8):E496-501.

In a direct, side-by-side, randomized controlled study comparing robot-assisted implantation of lumbar and sacral pedicle screws to the conventional freehand technique, the accuracy of the freehand technique was significantly greater. The SpineAssist system (Mazor Surgical Technologies, Caesarea, Israel) was previously studied in cadaveric specimens and cohort studies but never before in a randomized controlled trial. Difficulty with attachment of the robot to the spine and slippage at the implantation cannula starting point interface resulted in the majority of malpositioned screws. Ten screws placed via the robot-assisted technique required conversion to the freehand technique. Surgical time was significantly shorter for the freehand technique.

Schaafsma FG, Whelan K, van der Beek AJ, van der Es-Lambeek LC, Ojajarvi A, Verbeek JH. Physical conditioning as part of a return to work strategy to reduce sickness absence for workers with back pain. *Cochrane Database Syst Rev.* 2013;8:CD001822. Epub 2013 Aug 30.

This is a Cochrane Systematic Review on randomized controlled trials examining the efficacy of physical conditioning as part of a return-to-work strategy for patients with back pain. The author concluded that there is no evidence at this time to suggest that physical conditioning will have any effect on the duration of absence due to sickness.

Shi MM, Cai XZ, Lin T, Wang W, Yan SG. Is there really no benefit of vertebroplasty for osteoporotic vertebral fractures? A meta-analysis. *Clin Orthop Relat Res.* 2012 Oct;470(10):2785-99. Epub 2012 Jun 23.

The effectiveness of vertebroplasty for treatment of osteoporotic compression fractures has been controversial. In this and other meta-analyses, vertebroplasty was associated with greater pain relief and functional improvement and no difference in secondary fractures when compared with nonoperative care. However, no differences between sham and vertebroplasty were present. This meta-analysis justifies the use of cement augmentation for selected patients with painful osteoporotic compression fractures.

Shin JS, Ha IH, Lee J, Choi Y, Kim MR, Park BY, Shin BC, Lee MS. Effects of motion style acupuncture treatment in acute low back pain patients with severe disability: a multicenter, randomized, controlled, comparative effectiveness trial. *Pain.* 2013 Jul;154(7):1030-7. Epub 2013 Mar 15.

This is a randomized controlled trial comparing the use of motion style acupuncture with the use of nonsteroidal anti-inflammatory injections in the treatment of low back pain. A total of fifty-eight patients were enrolled and randomized. The authors

concluded that the acupuncture was superior to the injection in the short term (less than four weeks) with respect to low back pain scores, leg pain scores, Oswestry Disability Index, lumbar range of motion, and range of straight-leg raise.

Verhagen AP, van Middelkoop M, Rubinstein SM, Ostelo R, Jacobs W, Peul W, Koes BW, van Tulder MW. Effect of various kinds of cervical spinal surgery on clinical outcomes: a systematic review and meta-analysis. *Pain*. 2013 Nov;154(11):2388-96. Epub 2013 Jul 18.

This was a systematic review and meta-analysis of thirty-nine randomized controlled trials in which patients received various cervical spine surgeries in an effort to assess the benefits and harms of these techniques. The authors found low-quality evidence for no difference in effectiveness between various surgical techniques for anterior discectomy. There was a small, clinically irrelevant benefit on recovery and pain in favor of prosthetic disc surgery when compared with fusion techniques, but these authors were deemed to have a clear conflict of interest. The difference in harms and benefits between different surgical techniques is small.

Yagi M, King AB, Boachie-Adjei O. Incidence, risk factors, and natural course of proximal junctional kyphosis: surgical outcomes review of adult idiopathic scoliosis. Minimum 5 years of follow-up. *Spine (Phila Pa 1976)*. 2012 Aug 1;37(17):1479-89.

This was a retrospective case series of surgically treated adult scoliosis patients that was designed to evaluate the incidence, risk factors, and natural history of proximal junctional kyphosis. There were seventy-six consecutive patients having long instrumented spinal fusions with an average follow-up of 7.3 years. Proximal junctional kyphosis was identified in seventeen patients and 76% occurred within three months after surgery. Preexisting low bone mineral density, posterior spinal fusion, fusion to the sacrum, inappropriate global spinal alignment, and greater sagittal vertical axis change were significant risk factors for proximal junctional kyphosis.

Yin S, Yu X, Zhou S, Yin Z, Qiu Y. Is cervical disc arthroplasty superior to fusion for treatment of symptomatic cervical disc disease? A meta-analysis. *Clin Orthop Relat Res*. 2013 Jun;471(6):1904-19. Epub 2013 Feb 07.

This meta-analysis concludes that cervical disc arthroplasty provides better function, a lower prevalence of reoperation, and a lower complication rate when compared with fusion. However, it did not reduce the reoperation rate attributable to adjacent segment degeneration as compared with the rate after fusion. These conclusions are based on follow-up from one to five years.

Zhang X, Zhang X, Chen C, Zhang Y, Wang Z, Wang B, Yan W, Li M, Yuan W, Wang Y. Randomized, controlled, multicenter clinical trial comparing BRYAN cervical disc arthroplasty with anterior cervical decompression and fusion in China. *Spine (Phila Pa 1976)*. 2012 Mar 15;37(6):433-8.

This randomized controlled trial of 120 patients compared the results obtained with the Bryan cervical disc (Medtronic Sofamor Danek) to the results obtained with fusion. The clinical results showed no differences between groups, but the range of motion was maintained in the arthroplasty group. These results were similar to those previously published. Although it was a small study and subject to type-2 error, the study was unique in that it was not industry-sponsored. ■