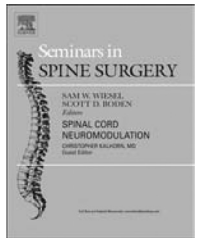
Available online at www.sciencedirect.com
ScienceDirect
www.elsevier.com/locate/semss



Spinescope

Scott D. Boden, MD

Emory University School of Medicine, Atlanta, GA

1. Ten-year outcomes of cervical disc replacement with the BRYAN cervical disc

September, 2019

Cervical disc arthroplasty is a potential alternative for anterior cervical discectomy and fusion. The hope with arthroplasty is that the maintenance of motion may decrease the likelihood of adjacent segment disease. Lavelle et al. reported on the 10-year safety and efficacy data from the BRYAN cervical disc arthroplasty series.

A prospective, randomized multicenter IDE trial between May 2002 and October 2004 was analyzed. Patients had symptomatic cervical disc disease and failed conservative care. They were followed at regular intervals for at least 10 years. Overall success was defined as $\geq$ 15-point improvement in NDI scores, maintenance or improvement in neurologic status, no serious adverse events related to the implant or implant/surgical procedure, and no subsequent surgery or intervention classified as "failure".

At 10-year follow-up, 128 arthroplasty and 104 fusion patients were available for evaluation. Overall success rate was higher in the arthroplasty group (81.3% vs. 66.3%, $P = 0.005$). The rate of second surgeries at adjacent levels was lower for the arthroplasty group (9.7% vs. 15.8%, $P = 0.146$). NDI scores improved significantly in the arthroplasty group (Δ38.3 vs. Δ31.1, $P = 0.01$). Visual Analog Scale for neck and arm pain was slightly improved in the arthroplasty group but it was not statistically significant.

On the basis of these data the authors conclude that cervical disc arthroplasty can preserve and maintain motion in the long term compared with anterior cervical discectomy and fusion. There was a trend towards fewer adjacent segment surgeries for the BRYAN disc but it did not reach statistical significance. There was a significant improvement in neck disability index scores which might suggest better long term success.

William F. Lavelle, K. Daniel Riew, Allan D. Levi and Jeffrey E. Florman, SPINE Volume 44, Number 9, pp. 601–608.

2. Supervised physical therapy vs. home exercise for patients with lumbar spinal stenosis: a randomized controlled trial

Exercise has been reported to improve short-term outcomes for patients with lumbar spinal stenosis in terms of disability and back and leg pain. However, no studies have compared supervised exercise with unsupervised exercise or quantified physical activity using a pedometer to confirm compliance with a home exercise program. Minetama et al. performed a single-center, open-label, randomized controlled trial to compare the effectiveness of supervised physical therapy with unsupervised exercise for patients with lumbar spinal stenosis.

Patients with lumbar spinal stenosis were randomized to a physical therapy group, who performed supervised physical therapy twice per week for 6 weeks, or a home exercise group. Physical therapy sessions included manual therapy, individually tailored stretching and strengthening exercises, cycling, and body weight-supported treadmill walking. The primary outcome was improvement in symptom severity scores on the Zurich Claudication Questionnaire at 6 weeks.

Forty-three patients were randomly allocated to the physical therapy group and 43 patients to the home exercise group. Compared with the home exercise group, the physical therapy group had greater percentage of responders achieving minimal clinically important difference in the Zurich Claudication Questionnaire symptom severity, physical function and walking distance on the self-paced walking test as well as leg pain on the numerical rating scale, and number of daily steps, all of which were statistically significant.

On the basis of these data the authors conclude that supervised physical therapy for patients with lumbar spinal stenosis resulted in significant short-term improvement in symptom severity, physical function, walking distance, pain, and physical activity compared with unsupervised exercise. The study did not assess the lasting effects of physical therapy, the avoidance of surgery, or relative costs per improvement of quality adjusted life years.

https://doi.org/10.1016/j.semss.2019.100748

Masakazu Minetama, Mamoru Kawakami, Masatoshi Teraguchi, Ryohei Kagotani, Yoshimasa Mera, Tadashi Sumiya, Masafumi Nakagawa, Yoshio Yamamoto, Sachika Matsuo, Yumi Koike, Nana Sakon, Tomohiro Nakatani, Tomoko Kitano, Yukihiro Nakagawa, The Spine Journal 19 (2019), 1310–1318.

3. Increasing reoperation rates and inferior outcome with prolonged symptom duration in lumbar disc herniation surgery – a prospective cohort study

Lumbar disc herniation is associated with great morbidity and significant socioeconomic impact in many parts of the world. Studies have shown that most disc herniations can be treated effectively with nonoperative management. Currently, there is little consensus regarding the timing of surgery for patients suffering from radicular pain due to lumbar disc herniation. Støttrup et al. performed this study to evaluate if prolonged symptom duration is correlated with less favorable outcome following lumbar disc herniation surgery.

Patients with a first-episode lumbar disc herniation were included in the study and data were prospectively collected in a national spine registry. Subjects were divided into three groups based on their preoperative self-reported duration of leg pain: <3 months, 3 to 12 months, and >12 months. Associations between patient-reported outcomes, perioperative complications and duration of symptoms were evaluated.

There were 2144 patients included in the study, with complete 1-year follow-up on 1694 patients (79%) and a reoperation rate of 8.4%. Incidence of surgical complications, specifically dural tears, was higher with increasing duration of leg pain; however this did not reach statistical significance ($p = 0.039$). Prolonged preoperative symptoms adversely influenced all patient related outcomes (EQ-5D, ODI, VAS) 1 year after surgery ($p = 0.001$). In addition, reoperation rates increased with longer duration of preoperative symptoms.

On the basis of these data the authors conclude that delayed surgical intervention results in inferior outcomes and increased reoperation rates. Patients who had surgery within the first 3 months of leg pain achieved significantly better outcome 1 year after surgery when compared to other groups. A potential limitation of the present study is the retrospective analysis of data from the database and lack of full 1 year follow-up on all patients. In addition, the previous cut-off time point has been assumed to be 6 months and this study grouped patients between 3 and 12 months into a single group, whereas a 6 month cut-off might have been helpful. Perhaps a similar study with larger numbers might allow for this distinction in the future.

Christian C. Støttrup, Andreas K. Andresen, Leah Carreon, Mikkel Ø. Anderson, The Spine Journal 19 (2019), 1463–1469.

4. Multimodal nutritional management in primary lumbar spine surgery

Poor nutritional status is common in the perioperative period in primary lumbar spine surgery, and may impede recovery after surgery. Xu et al. performed a prospective randomized controlled trial to evaluate the clinical effect and safety of a new multimodal nutritional management protocol for patients receiving primary lumbar spine surgery.

A total of 187 patients were included in this prospective randomized controlled trial. They were randomly assigned to the multimodal nutritional management group or the control group. Albumin infusion, postoperative albumin level, electrolyte disorders, postoperative electrolyte levels, transfusion rate, postoperative hemoglobin level, length of stay, and complications were compared between the groups.

Compared with the control group, the rate and total amount of albumin infusion were lower in the multimodal nutritional management group and the postoperative level of albumin in the multimodal nutritional management group was higher on the first postoperative day and the third postoperative day. The incidence of hypokalemia, hyponatremia, and hypocalcemia were lower in the multimodal nutritional management group. The postoperative levels of sodium, potassium, and calcium were higher than the control group. The transfusion rate was similar between the two groups and while the hemoglobin level was similar on the first postoperative day it was higher in the multimodal nutritional management group on the third postoperative day. Length of stay in the nutrition management group was shorter than in the control group. The incidence of wound drainage was also lower in the multimodal nutritional management group. No statistical differences were observed regarding surgical complications between the two groups.

On the basis if these data the authors conclude that the multimodal nutritional management protocol effectively reduced albumin infusion, the incidence of electrolyte disorders, and wound drainage, while increasing postoperative levels of albumin, sodium, potassium, and calcium. In addition, the protocol reduced the length of stay without increasing the rate of postoperative wound complications. It would seem from this study that administration of nutrition powder at bedtime the day before surgery, protein powder 6 h before the induction of anesthesia and carbohydrate powder 2 h before the induction of anesthesia along with a few other maneuvers were effective as a multimodal nutritional protocol.

Bin Xu, Wei-xing Xu, Yang-jun Lao, Wei-guo Ding, Di Lu, and Hong-feng Sheng, SPINE Volume 44, Number 14, pp. 967–974.

5. The neck trial: effectiveness of anterior cervical discectomy with or without interbody fusion and arthroplasty in the treatment of cervical disc herniation; a double-blinded randomized controlled trial

Motion preserving anterior cervical disc arthroplasty in patients with cervical radiculopathy was introduced to prevent adjacent segment disc degeneration compared with discectomy and fusion. Prior reports suggest that anterior cervical discectomy and fusion is not more effective than anterior cervical discectomy alone for the treatment of radiculopathy. Vleggeert-Lankamp et al. performed a double-

blinded randomized controlled trial to evaluate whether patients with cervical radiculopathy due to a herniated disc benefited more from undergoing anterior cervical disc arthroplasty, anterior cervical discectomy and fusion, or anterior cervical discectomy without fusion.

One hundred-nine patients with one level herniated disc were randomized to one of the three treatment groups. Clinical and radiological outcome were measured by Neck Disability Index, Visual Analog Scale for neck pain, Visual Analog Scale for arm pain, SF-36, EQ-5D, and other parameters.

The Neck Disability Index declined from 41 to 47 points at baseline to 19 in the anterior cervical discectomy alone group, 19 in the anterior cervical discectomy and fusion group, and 20 in the anterior cervical disc arthroplasty group following surgery. The other parameters were comparable in all groups and no statistical differences were demonstrated between the treatment groups.

On the basis of these data the authors conclude that the hypothesis that anterior cervical disc arthroplasty would lead to superior clinical outcome in comparison to anterior cervical discectomy and fusion or anterior cervical discectomy alone could not be confirmed during a 2-year follow-up period. Single-level anterior cervical discectomy without implanting an intervertebral device may be a reasonable alternative. There have been many earlier studies that demonstrated that discectomy alone without an interbody fusion device does not have the long term durability of an anterior cervical discectomy and fusion. It is unclear whether there is a difference in adjacent segment degeneration between those two procedures. In any case this study did not demonstrate an advantage of disc arthroplasty.

Carmen L.A. Vleggeert-Lankamp, Tessa M.H. Janssen, Erik van Zwet, Caroline M.W. Goedmakers, Lisette Bosscher, Wilco Peul, Mark P. Arts, The Spine Journal 19 (2019), 965–975.

6. Intraosseous basivertebral nerve ablation for the treatment of chronic low back pain: 2-year results from a prospective randomized double-blind sham-controlled mutlicenter study

Low back pain is one of the most expensive occupational disorders in the United States and a leading cause of disability worldwide. Few therapies have level-one evidence supporting their effectiveness for the treatment of chronic low back pain. Fischgrund et al. performed a prospective randomized double-blind sham-controlled multicenter study to determine the outcomes of radiofrequency ablation of the basivertebral nerve for the treatment of chronic low back pain.

A total of 147 patients were treated with radiofrequency ablation of the basivertebral nerve in a randomized controlled trial designed to demonstrate safety and efficacy as part of a Food and Drug Administration-Investigational Device Exemption trial. Evaluations, including patient self-assessments, physical and neurological examinations, and safety assessments, were performed at 2 and 6 weeks, and 3, 6, 12, 18, and 24 months postoperatively. Participants randomized to the sham control arm were allowed to cross to the radiofrequency ablation group after 12 months. Due to a high rate of crossover, radiofrequency ablation treated participants acted as their own control in a comparison to baseline for the 24 month outcomes.

Clinical improvements in the Oswestry Disability Index, Visual Analog Scale, and the Medical Outcomes Trust Short-Form Health Survey Physical Component Summary were statistically significant compared to baseline at all follow-up time points through 2 years. The mean percent improvements in ODI and VAS compared to baseline at 2 years were 53.7% and 52.9%, respectively. Responder rates were also maintained through 2 years with patients showing clinically meaningful improvements for both.

On the basis of these data patients treated with radiofrequency ablation of the basivertebral nerve for chronic low back pain exhibited sustained clinical benefits in ODI and VAS and maintained high responder rates at 2 years following treatment. These data would suggest that basivertebral nerve ablation in properly selected patients could be a durable minimally invasive treatment for the relief of chronic low back pain.

Jeffrey S. Fischgrund, Alfred Rhyne, Jörg Franke, Rick Sasso, Scott Kitchel, Hyun Bae, Christopher Yeung, Eeric Truumees, Michael Schaufele, Philip Yuan, Peter Vajkoczy, Michael Depalma, David G. Anderson, Lee Thibodeau, Bernhard Meyer, International Journal of Spine Surgery, Vol. 13, No. 2, 2019, pp. 110–119.

7. Extended-release gabapentin for failed back surgery syndrome: results from a randomized double-blind cross-over study

Persistent pain after lumbar surgery remains one of the indications for chronic analgesia administration. However, no analgesics have proven efficacious for this situation. Although trials have evaluated gabapentinoids for chronic low back pain, none of these trials focused solely on failed back surgery syndrome.

The authors performed a double-blind cross-over trial to evaluate the efficacy of gabapentin (1800 mg per day) for failed back surgery syndrome. Eligible patients had an average daily pain score of at least 4 of 10, a neuropathic pain component (indicated by the PainDetect), and reported at least half of their pain radiating in the lower extremity. Participants were randomized to 2, 7-week study periods separated by a 10-day washout. The primary outcome measure was a 0–10 Numeric Rating Scale of average pain and secondary measures included the McGill Pain Questionnaire and Patient Global Impression of Change. The treatment effect was analyzed using a mixed effect analysis of covariance with fixed effects for treatment.

The outcome of the model was the mean 7-day Numeric Rating Scale score for the last 7 days of each treatment. Thirty-two participants were randomized and included in the primary analysis and 25 completed both study periods. No difference was detected between treatments on any outcome measure including the primary.

On the basis of these data the authors conclude that extended-release gabapentin was not any more successful than other methods of treatment. Given the escalating rate of complex lumbar surgery and the projected increased

likelihood that there will be patients with continuing symptoms, future research to develop novel therapies for this situation is needed.

Jennifer S. Gewandter, Maria E. Frazer, Xueya Cai, Valerie F. Chiodo, Shirley A. Rast, Michelle Dugan, Hudson A. Carter, Redi Rahmani, Jonathan J. Stone, John D. Markman, Pain Journal, May 2019, Volume 160, Number 5.

8. In brief – bladder scans and postvoid residual volume measurement improve diagnostic accuracy of Cauda Equina syndrome

Cauda Equina Syndrome is an ill-defined condition with a spectrum of presenting symptoms. The authors performed a prospective, observational cohort study to determine the role of pre- and postvoid bladder scans in predicting Cauda Equina Syndrome. Patients with suspected Cauda Equina Syndrome were admitted over a 6-month period and prospectively assessed by physical examination including digital rectal examination, pin prick perianal sensation and bladder ultrasound scanning. The results were compared with the subsequent magnetic resonance imaging scans and those patients who had emergent surgery. Ninety-two patients were included in the study and MRI validated Cauda Equina compression was present in only 18%. The sensitivity of the anal tone to predict Cauda Equina Syndrome was 52.9%. Perianal numbness had a sensitivity of 82.3% and a negative predictive value of 92%. For the non-operative group without Cauda Equina Syndrome mean postvoid residual was 199 ml. On the basis of receiver operating curves, the optimal bladder volume cut-off for predicting Cauda Equina Syndrome was $\geq$ 200 ml. A postvoid residual of $<$ 200 ml give a Cauda Equina Syndrome probability of only 3.6%. If it was over 200 ml then the probability was 43%. More importantly a postvoid residual of $<$ 200 ml had a negative predictive value of 97%. On the basis of these data the authors conclude that bladder scanning was a useful adjunct in the diagnosis of Cauda Equina Syndrome.

Muralidharan Venkatesan, Luigi Nasto, Magnum Tsegaye and Michael Grevitt, SPINE Volume 44, Number 18, pp. 1303–1308.

9. Cages in ACDF are associated with a higher nonunion rate than allograft

Existing literature consists of primarily single-center studies with inconsistent findings with regard to the rate nonunion in patients treated with structural allograft versus intervertebral cages as part of an anterior cervical discectomy and fusion procedure. The authors performed a retrospective analysis of 6130 patients in the PearlDiver database having surgery from 2007 to 2016. 4063 patients were included in the allograft group, while 2067 were included in the interbody cage group. Overall nonunion rates were significantly higher in the cage group (5.3%) than in the allograft group (2.0%), which was statistically significant ($P < 0.01$). When controlling for confounders increased rates of nonunion were consistently observed in the intervertebral cage group achieving statistical significance in 25 of the 26 analyses. On the basis of these data the authors conclude that an increased rate of nonunion is associated with intervertebral body cages in the cervical spine and may suggest superiority of allograft.

Sean Pirkle, Samuel Kaskovich, David J. Cook, Alisha Ho, Lewis L. Shi and Michael J. Lee, MD, SPINE Volume 44, Number 6, pp. 384–388.

10. Prevention of nerve root thermal injury caused by bipolar cauterization near the nerve roots

In spine surgery, bipolar cauterization of epidural venous plexus near nerve roots is a common procedure to control bleeding. Although a potential risk of neurologic thermal damage exists, the strategies for prevention have not been elucidated. The authors performed a controlled, interventional animal study looking at temperature measurements in histology after bipolar cauterization near the posterior branch of lumbar spinal nerve roots in a rabbit model. The authors found that when bipolar cauterization near the nerve roots was performed in a perpendicular rather than parallel fashion the increase in temperature of the nerve roots and likelihood of causing thermal root injury was substantially lower. As a result of these data the authors conclude that surgeons set bipolar forceps perpendicular to nerve roots or use saline irrigation for prevention of nerve root injury.

Shoichiro Ohyama, Shinji Takahashi, Koji Tamai, Yusuke Hori, Yoshihiro Hirakawa, Masatoshi Hoshino, Akinobu Suzuki and Hiroaki Nakamura, MD, PhD, SPINE, Volume 44, Number 6, pp. E321–E328.

11. The impact of vancomycin and cefazolin as standard preoperative antibiotic prophylaxis on surgical site infections following instrumented spinal fusion

Cefazolin is the standard antibiotic of choice for preoperative antibiotic prophylaxis during spine surgery. Increasingly Methicillin-resistant Staphylococcus aureus (MRSA) infections have been recognized for surgical site infections. The authors performed a retrospective cohort study to assess whether administration of prophylactic vancomycin, in addition to cefazolin, decreased the need for revision surgeries for postoperative surgical site infection. Data was collected from all eligible patients from 2005 to 2009 and from 2011 to 2015 at a single institution. Logistic regression techniques were used to evaluate unadjusted results for the prophylactic antibiotic protocol on all revision surgeries as well as those for surgical site infections. Revision surgeries performed for a diagnosis of infection were reduced from a rate of 4% ($n = 57$) in the period 2005 to 2009 down to 2% ($n = 44$) during the period of 2011 to 2015. At the same time the incidence of revision surgeries for any cause was also reduced from 14% to 9%, respectively. In adjusted analysis the odds of a revision procedure for surgical site infection were reduced by 50% following introduction of the protocol combining prophylactic antibiotics. No significant difference in the organisms responsible for

surgical site infection was identified between the two study periods. On the basis of these data the authors conclude that this natural experiment has shown some utility for a preoperative prophylactic antibiotic regimen of vancomycin plus cefazolin which could lead to meaningful reductions in revision procedures performed for surgical site infection.

Wylie Y. Lopez, Sean M. Rider, Kenneth Nwosu, Erick R. Kazarian, Justin A. Blucher, Erin M. Schoenfeld, Andrew K. Simpson, James D. Kang and Andrew J. Schoenfeld, SPINE, Volume 44, Number 6, pp. E366–E371.

12. Preoperative opioids and 1-year patient-reported outcomes after spine surgery

Back pain is one of the most disabling conditions worldwide and over half of patients presenting for spine surgery report using opioids. The authors performed a Longitudinal Cohort Study to determine1-year patient-reported outcomes associated with preoperative chronic opioid therapy and high-preoperative opioid doses in patients undergoing elective spine surgery. A prospectively collected institutional spine registry was reviewed for spine surgery that occurred between 2010 and 2017. Of 2128 patients included in the study preoperative chronic opioid therapy was identified in 21% and was associated with significantly higher odds of not achieving meaningful improvements at 1-year in extremity pain, axial pain, function, and quality of life. On the basis of these data the authors conclude that patients treated with chronic opioids prior to spine surgery are significantly less likely to achieve meaningful improvements at 1-year in pain, function, and quality of life. They are also less likely to be satisfied at 1-year with higher odds of 90-day complications, regardless of dosage. What is not clear from this study is whether or not opioid cessation prior to spine surgery, and for what period of time, would normalize patient risk.

Jeffrey M. Hills, Jacquelyn S. Pennings, Kristin R. Archer, Joseph B. Wick, MD, Joshua Daryoush, Marjorie Butler, Ahilan Sivaganesan, Inamullah Khan, Richard Call and Clinton J. Devin, SPINE, Volume 44, Number 12, pp. 887–895.

13. Observed patterns of cervical radiculopathy: how often do they differ from a standard, “Netter diagram” distribution?

Traditionally, cervical radiculopathy is thought to present with symptoms and signs in a standard, textbook, reproducible dermatomal pattern. The purpose of this study was to examine cervical radiculopathy patterns in a surgical population and to determine how often patients present with these standard textbook versus nonstandard patterns of symptoms. The authors identified all patients with single level cervical radiculopathy that underwent surgery from March 2011 to March 2016 by six surgeons. The observed pattern of radiculopathy was compared to a standard textbook pattern of radiculopathy that strictly adheres to a dermatomal map. Overall, 239 cervical levels were identified. The observed pattern of pain and numbness followed the standard pattern in only 54%. When a nonstandard radicular pattern was present, it differed by 1.7 dermatomal levels from the standard pattern. Neck pain on the radiculopathy side was the most prevalent symptom and was found in 81% of patients and did not differ by cervical level. On the basis of these data the authors conclude that observed patterns of cervical radiculopathy only followed the standard textbook pattern in 54% of patients and did not differ by the cervical level involved. Surgeons should think broadly when identifying causes of levels because they may frequently not appear to textbook descriptions as in actual clinical practice and this could be a good indication for a diagnostic selective nerve root block in situations where the pattern is atypical.

Steven J. McAnany, John M. Rhee, Evan O. Baird, Weilong Shi, Jeffrey Konopka, Thomas M. Neustein, Rafael Arceo, The Spine Journal 19 (2019), 1137–1142.