TWO-YEAR OUTCOMES OF PATIENTS TREATED WITH BVN ABLATION FOR THE RELIEF OF CHRONIC LOW BACK PAIN: RESULTS OF THE SMART TRIAL

Bernhard Meyer, Peter vajkoczy, Rick Sasso, Sotirios Michalitsis, Al Rhyne, Jeff Fishground, Jorg Franke
Department of orthopedics, Klinikum Magdeburg Germany

Introduction

Thirty percent of Americans have low back pain (LBP) at any given time, leading to approximately 50 million physician visits in the U.S. annually. For patients with chronic low back pain (CLBP), the etiology can be difficult to diagnose and then treat using either current non-surgical therapies, with inherent patient adherence challenges, or surgical interventions, with associated long recovery times. Antonacci et al., following anatomic study, proposed that a portion of pain previously ascribed to the disc actually emanates from the vertebral body endplate nociceptors which communicate to the CNS through the basivertebral nerve (BVN).1 We report on the two-year outcome data of the treatment arm patients in the SMART trial, which studied RF BVN ablation to treat CLBP.

Methods

A total of 128 patients, from the per-protocol treatment arm of the SMART trial, a double-blind sham-controlled randomized trial, were followed for up to 24 months. ODI and VAS instruments were used to collect patient reported outcomes at baseline, 2 wks., 6 wks., 3 mo., 6 mo., 12 mo., and 24 mo.

Results

ODI and VAS data were available on 106 and 104 patients at 24 months respectively. The mean baseline ODI in the treatment arm was 42.4, decreasing to 22.6 at 12 months and 18.8 at 24 months. The mean baseline VAS in the treatment arm was 6.73, decreasing to 3.96 at 12 months and 3.13 at 24 months. Using a paired t-test comparing the 12 and 24-month VAS observations, the mean score at 24 months was significantly improved compared to 12 months (3.80 vs. 3.13, p=0.004).

Discussion

The SMART trial demonstrates that BVN ablation is statistically and clinically superior to the sham intervention, and that the degree of ODI improvement is approximately one disability category.2
Longitudinal follow-up of these patients demonstrates that ablation of the BVN for the relief of CLBP is a durable procedure with continuing improvement in patient reported ODI and VAS scores at up to two years.


Disclosures:
NON-FUSION THORACOSCOPY ANTERIOR VERTEBRAL BODY TETHERING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS: PRELIMINARY RESULTS OF A SINGLE EUROPEAN CENTER

Ahmet Alanay, Barbaros O Cebeci, Kadir Abul, Suna Lahut, Gökhan Ergene, Sahin Senay, Caglar Yilgor

Department of Orthopedics and Traumatology, Acibadem Mehmet Ali Aydinlar University, Istanbul, Turkey; Comprehensive Spine Center, Acibadem Maslak Hospital, Istanbul, Turkey; Thoracic surgery, Acibadem Maslak Hospital, Istanbul, Turkey; Acibadem Mehmet Ali Aydinlar University School of Medicine, Turkey

Summary
A single European center experience on first 19 thoracoscopic anterior vertebral body tethering (VBT) cases for adolescent idiopathic scoliosis since 2014 suggests that surgical correction is followed by correction attained during follow-up in rapid growing cases (i.e., Sanders ≤4). Spontaneous correction in the non-operated compensatory lumbar levels were also recorded. Application of VBT in steady growing cases (i.e., Sanders 5-7) was also demonstrated to be safe maintaining curve correction after minimum 1 year follow-up.

Hypothesis
Significant major and compensatory curve correction can be achieved with Anterior vertebral body tethering (VBT).

Design
Retrospective analysis of a prospectively collected data of a single surgeon experience.

Introduction
Anterior VBT has been reported to be safe and effective in 2 published clinical series of a single center. This technique has been used in our center since April 2014 for rapid growing adolescent (Sanders ≤4) patients. With experience, in Jan 2016, the indications were extended to include steady growing (Sanders 5-7) pts. The aim was to report our experience after ≥1 year follow-up.

Methods
All patients were operated via thoracoscopy. Radiographic measurements were done in pre- and post-operative first-erect, 6-weeks, 3-6-9-12-18-24- and 36-months f/up. Surgical and total f/up correction percentages were calculated. Patients were analyzed as a whole cohort and as two groups; Rapid and Steady Growing. A descriptive analysis was done.

Results
19 Lenke 1 pts were included. Mean age: 12.5±1(11-14) yrs. Mean f/up: 17.6±7.3(12-41) months. UIV was T5 or T6, and LIV was T11-T12 or L1. Rapid Growing mean height gain: 8.1 (5-17)cm. Pre-op mean MT Cobb was 45.4° (35°-59°). Average initial and total correction rates: 53% and 75% (Fig 1a). Mean compensatory TL/L Cobb was 29.9° (12°-42°). Average initial and total spontaneous correction rates: 44% and 64%. Average hump reduction: 12.9° to 5.6°. 2 atelectasis resolved with physical therapy. LIV screw loosened in a patient who grew 17cm. A tether was released due to overcorrection and there are 2 more candidates. Steady Growing mean height gain: 2.6 (1-4)cm. Pre-op mean MT Cobb was 44.2° (40°-48°) Average initial and total correction rates: 53% and 57% (Fig 1b). Mean compensatory TL/L Cobb was 30.2° (22°-40°). Average initial and total spontaneous correction rates: 52% and 62%. Average hump reduction: 11° to 6°. No complications were recorded.

Conclusion
VBT is a promising minimal invasive non-fusion technique enabling spontaneous correction while
allowing for growth. It may also safely be performed in steady growing patients. However, longer term follow-up is needed.

Disclosures:
author 1: grants/research support: DEPuy; author 2: none; author 3: none; author 4: none; author 5: none; author 6: not indicated; author 7: none
ANTERIOR VERTEBRAL BODY TETHERING FOR THE TREATMENT OF IDIOPATHIC SCOLIOSIS: FEASIBILITY, OUTCOMES, AND COMPLICATIONS

Firoz Miyanji, Luigi Nasto, Fahimeh Karimi, Eva Habib, Andrea Simmonds
Dept of Orthopaedic Surgery, Vancouver, Canada

Introduction: Spinal fusion remains the gold standard for progressive IS, however concerns about the long-term effect of spinal fusion have led to the development of growth-modulation techniques. More recently anterior vertebral body tethering (AVBT) has sparked interest as a possible alternative in the management of progressive idiopathic scoliosis (IS). To date limited available data exists regarding the efficacy and complication rate with AVBT. The aim of our study was to evaluate the clinical, radiographic and perioperative outcomes and complication rates to determine the efficacy of AVBT in skeletally immature patients with IS.

Methods: A retrospective review of all consecutive patients treated with AVBT between 2012 and 2016 was conducted after IRB approval. Demographic data was collected from chart review. Pre-operative and most recent follow-up radiographic parameters were measured by an independent reviewer. Perioperative outcome variables and complication data was obtained from chart review. Clinical success was set a priori as major coronal Cobb ≤30° at most recent f/u.

Results: 32 patients with 34 procedures were analyzed. Mean age at surgery was 13.6±1.4 years with majority female (93.8%). Mean Risser grade was 0.77±0.79 with a mean follow up of 17.8±10.9 months. Mean major pre-op Cobb of 50.6°±8.6° improved to mean 18.3°±9.5° at most recent follow up (% correction: 64.3%, p<0.001). Significant spontaneous curve correction was also observed in the un-instrumented curves on average by 48.7±24.2% (p<0.001). Thoracic axial rotation significantly improved on average from 15.0°±4.2° to 8.0°±4.1°(p<0.001) as measured by scoliometer. Average number of instrumented levels was 6.8±0.9 with a mean OR time of 348.4±84min. Average EBL was 252.8±83.4cc with no patient requiring allogeneic blood. Length of hospital stay was mean 5.3±1.0 days with 84.3% of patients returning to full activity at 3 months. Clinical success was noted in 96.6% of patients at most recent follow up. We noted a 23.5% complication rate however there were no re-admission to hospital or re-operations in this cohort.

Conclusions: AVBT is an effective technique in obtaining clinical success in skeletally immature patients with IS. It not only prevents curve progression but also attains curve correction in this setting. No major complication requiring re-operation or re-admission to hospital was noted in this cohort suggesting an acceptable safety profile of this technique. Early results appear promising, however longer-term follow-up is needed to determine the true clinical benefits of AVBT.
### Patient Demographics (N=32)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age at Surgery (yrs)</td>
<td>13.6 ± 1.4</td>
</tr>
<tr>
<td>Mean Gender</td>
<td>F= 93.8%, M= 6.3%</td>
</tr>
<tr>
<td>Mean BMI</td>
<td>19.3 ± 2.8</td>
</tr>
<tr>
<td>Mean Risser Grade</td>
<td>0.77 ± 0.79</td>
</tr>
<tr>
<td>Structural Main Thoracic Curve (N, %)</td>
<td>31 (91.2)</td>
</tr>
<tr>
<td>Structural Lumbar Curve (N, %)</td>
<td>3 (8.8)</td>
</tr>
</tbody>
</table>

### Radiographic Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-op</th>
<th>First Erect</th>
<th>Most Recent Follow-up</th>
<th>% Correction</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Major Cobb (°)</td>
<td>50.6 ± 8.6</td>
<td>21.1 ± 8.8</td>
<td>18.3 ± 9.5</td>
<td>64.3 ± 18.0</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Mean Un-instrumented Minor Cobb (°) #1</td>
<td>34.3 ± 10.5</td>
<td>19.9 ± 10.4</td>
<td>18.0 ± 10.9</td>
<td>48.7 ± 24.2</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Mean Un-instrumented Minor Cobb (°) #2</td>
<td>25.1 ± 8.3</td>
<td>17.1 ± 7.0</td>
<td>16.2 ± 7.1</td>
<td>35.7 ± 27.8</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Mean T2-T12 Kyphosis (°)</td>
<td>26.3 ± 13.5</td>
<td></td>
<td>26.9 ± 11.0</td>
<td>0.671</td>
<td>0.709</td>
</tr>
</tbody>
</table>

### Outcome Variables (N=34)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Complication Type (N=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Follow-up (mths)</td>
<td>Pulmonary 4</td>
</tr>
<tr>
<td>Mean OR Time (min)</td>
<td>Surgical Site Infection 1</td>
</tr>
<tr>
<td>Mean Blood Loss (mL)</td>
<td>Neurological 1</td>
</tr>
<tr>
<td>Mean Cell Saver (mL)</td>
<td>Pain 2</td>
</tr>
<tr>
<td>Mean Number of Levels Instrumented</td>
<td>6.8 ± 0.9</td>
</tr>
<tr>
<td>Mean Length of Stay (days)</td>
<td>5.3 ± 1.0</td>
</tr>
<tr>
<td>Clinical Success (Major Cobb curve ≤ 30°) (%)</td>
<td>94.1</td>
</tr>
</tbody>
</table>

Disclosures:  
author 1: grants/research support: Setting Scoliosis Straight Foundation; author 2: none; author 3: none; author 4: none; author 5: none
 DOES THE USE OF ROBOTIC GUIDANCE AND NAVIGATION REDUCE THE INCIDENCE OF PEDICLE SCREW REVISIONS?

Victor E. Staartjes, Anita M. Klukowska, Marc L. Schröder
Department of Neurosurgery, Bergman Clinics, Amsterdam, The Netherlands

Background
Spinal instrumentation is performed at an increasing rate, and accounts for a considerable portion of health care charges. Various computer-based guidance systems have been devised to reduce costly pedicle screw-related complications, yet their clinical effectiveness has never been comparatively assessed in a meta-analysis.

Methods
Systematic searches in MEDLINE, Embase, Scopus, and the Cochrane Library were performed to identify controlled trials comparing either robot-guided, navigated or freehand spinal instrumentation for any indication. Studies specifically reporting the proportion of patients that experienced pedicle screw revision events were included. Estimates were pooled using random-effects meta-analyses. Sensitivity analyses that included zero-event trials and that assessed per-screw incidences were carried out.

Results
Among 37 studies (7095 patients), intraoperative revisions were not reduced in robot-guided (OR: 3.6, 95% CI: 0.7 - 19.4, p = 0.14) and navigated (OR: 1.5, 95% CI: 0.3 - 7.2, p = 0.64) procedures in comparison to freehand. While postoperative revisions were reduced in robot-guided (OR: 0.3, 95% CI: 0.1 - 0.9, p = 0.04) and navigated (OR: 0.3, 95% CI: 0.2 - 0.5, p < 0.001) procedures, statistical significance was lost in sensitivity analyses for robotic guidance, but not for navigation. Neither robotic guidance (OR: 2.3, 95% CI: 0.5 - 10.7, p = 0.28) nor navigation (OR: 0.7, 95% CI: 0.2 - 3.2, p = 0.68) lead to a reduction in total revision events.

Conclusions
Presently, there is insufficient evidence to suggest that either robotic guidance or navigation is superior to freehand instrumentation in terms of pedicle screw revision events. It is essential to further investigate if there are any clinical benefits that warrant the high acquisition and maintenance costs inherent to these systems.

Disclosures:
MINIMALLY INVASIVE CANTILEVER CORRECTION TECHNIQUE FOR ADULT SPINAL DEFORMITY USING REDUCTION PERCUTANEOUS PEDICLE SCREW SYSTEM -TECHNICAL NOTES-

Sei Terayama, Yasuo Ohori, Azusa Sudo
Dept. of Orthopedic, Tokyo, Japan

Introduction.
Recently, spinal minimally invasive surgery (MIS) using a percutaneous pedicle screw system (PPS) has been performed widely for degenerative lumbar disease with short segment fusion. Otherwise, it has been considered that the PPS system is not useful for spinal deformity because it might be impossible to gain an adequate correction angle. Our techniques for patients with ASD by cantilever technique include lateral interbody fusion (LIF), reduction PPS for the dual purpose of performing less invasive surgery and obtaining a balanced spine. The objective of this study is to evaluate long-segment fusion with MIS deformity techniques.

Methods.
We performed a retrospective study of ASD patients treated in hospital from 2015 to 2017. We evaluated the following radiographic spinal parameters in pre-, post-operative and final follow-up standing whole-spine X-rays: the Cobb angle (CA), pelvic incidence (PI) and lumbar lordosis (LL).

Surgical methods.
First, we performed LIF and/or LIF corpectomy for severe vertebral body collapse. Next, changing to the prone position, we performed L5/S1 transforaminal lumbar interbody fusion, sacral alar iliac screw insertion, lumbar PPS, 3 or more thoracic conventional pedicle screws and sublaminar taping with the central approach. The reduction PPS system can attach a rigid extender sleeve which provides up to 30mm of reduction. A 5.5-mm diameter titanium rod was inserted from the caudal to the cranial direction. Correction techniques involved 2 steps: the dual rod insertion with cantilever, and the adaptation to the rods by multiple extender sleeve reduction without any posterior osteotomy.

Results.
There were 25 patients (3 males, 22 females; mean age, 76 years). All 25 cases had no general complications. The mean operative time was 134 minutes for lateral surgery (3.8 levels) and 300 minutes for posterior surgery (10.0 levels). The mean amount of intra-operative estimated blood loss was 382 g.

The following were found on radiological evaluation: CA, 24 degrees pre-operation vs. 8 degrees last follow-up; LL increased from 9 to 46 degrees; PI-LL decreased from 45 to 6 degrees. The minimum follow-up period was 12 months.

Discussion.
We have to evaluate how invasive procedure elderly patients can tolerate and how much angle we need to correct. This might be resolved by using MIS deformity techniques that include LIF, PPS and some correction techniques.

The thoracic open method has some merits, as sublaminar taping may prevent proximal junctional failure for an osteoporotic spine; strong correction can be realized with a cantilever technique. In addition, the bone grafting and cranial extension could be performed easily. A limitation of this study is the short follow-up period.

Conclusion.
We retrospectively reviewed MIS deformity techniques and 25 cases of ASD. We conclude that we
might be able to perform less invasive surgery and also obtain a balanced spine.

Disclosures:
author 1: none; author 2: none; author 3: none
DEVELOPMENT OF PREOPERATIVE COMPUTER MODELS WHICH ACCURATELY PREDICT ANSWERS TO ALL INDIVIDUAL QUESTIONS ON SRS-22 AT 2 YEAR FOLLOW UP: A STEP TOWARDS INDIVIDUALIZED MEDICINE

Vall d’Hebron Institute of Research (VHIR), Barcelona, Spain

Introduction
Health related quality of life (HRQoL) instruments are essential in a value-driven healthcare economy. Informed decision making requires patient comprehension of expected outcomes of surgery. HRQoL measures may be difficult for patients to interpret and appreciate. The purpose of this study was to create a predictive model for individual SRS-22 questions at 1 and 2 years after adult spinal deformity (ASD) surgery.

Methods
Two prospective observational cohorts were retrospectively queried for ASD patients with SRS-22 data at baseline, 1 year and 2 years after surgery. 150 Covariates were used in the training models and included demographic data, surgical data, and perioperative complication data. Outcomes as answers of the SRS22r were dichotomized as “good” (4, 5) or “bad” (1-3). 6 different prediction algorithms were trained with 3-time horizons: baseline to 1 year, baseline to 2 years, and 1 year to 2 years. External validation was accomplished via an 80/20 data split for training and testing each model, respectively. Goodness of fit was measured using the area under receiver operating characteristic curves (AUROC) in the test set. Variable importance were calculated.

Results
561 Patients met inclusion criteria. The AUROC of most models were approximately 75-80% indicating successful fits. Items regarding back pain in the last 6 months (q1), level of activity (q5), domestic activity (q12) and feeling attractive with the current back condition (q19) of the SRS22 questionnaire were most accurately predicted. The models were less sensitive to questions regarding financial difficulties (q15), depression (q16) and days of sick leave or ceasing domestic activity in the last 3 months (q17).

Conclusion
Preop models to predict answers to each of the SRS-22 questions at 2-year followup were created with 75-80% accuracy. Items related to pain, function, and self-image were most accurately predicted. The ability to predict individual question responses may be useful in preoperative
counseling of patients in the age of individualized medicine.

Table 1: Patient baseline probabilities and simulation at 2 year follow up

<table>
<thead>
<tr>
<th>Baseline Answer</th>
<th>Chance of &quot;Good&quot; at 2 Years</th>
<th>Chance of &quot;Bad&quot; at 2 Years</th>
<th>Chance of &quot;Good&quot; Wait 5 Years, Same Surgery</th>
<th>Chance of &quot;Good&quot; Wait 10 Years and 1 Revision Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>2</td>
<td>47.80%</td>
<td>52.20%</td>
<td>47.80%</td>
</tr>
<tr>
<td>Q2</td>
<td>2</td>
<td>82.20%</td>
<td>17.80%</td>
<td>82.20%</td>
</tr>
<tr>
<td>Q3</td>
<td>4</td>
<td>51.90%</td>
<td>48.10%</td>
<td>51.90%</td>
</tr>
<tr>
<td>Q4</td>
<td>1</td>
<td>86.80%</td>
<td>13.20%</td>
<td>85.20%</td>
</tr>
<tr>
<td>Q5</td>
<td>3</td>
<td>75.00%</td>
<td>25.00%</td>
<td>74.00%</td>
</tr>
<tr>
<td>Q6</td>
<td>3</td>
<td>50.00%</td>
<td>50.00%</td>
<td>50.00%</td>
</tr>
<tr>
<td>Q7</td>
<td>3</td>
<td>61.10%</td>
<td>38.90%</td>
<td>61.10%</td>
</tr>
<tr>
<td>Q8</td>
<td>2</td>
<td>73.20%</td>
<td>26.80%</td>
<td>73.20%</td>
</tr>
<tr>
<td>Q9</td>
<td>2</td>
<td>43.10%</td>
<td>56.90%</td>
<td>43.10%</td>
</tr>
<tr>
<td>Q10</td>
<td>2</td>
<td>24.20%</td>
<td>75.80%</td>
<td>24.20%</td>
</tr>
<tr>
<td>Q11</td>
<td>2</td>
<td>79.60%</td>
<td>20.40%</td>
<td>79.40%</td>
</tr>
<tr>
<td>Q12</td>
<td>2</td>
<td>27.70%</td>
<td>72.30%</td>
<td>27.70%</td>
</tr>
<tr>
<td>Q13</td>
<td>4</td>
<td>66.70%</td>
<td>33.30%</td>
<td>66.70%</td>
</tr>
<tr>
<td>Q14</td>
<td>4</td>
<td>23.20%</td>
<td>76.80%</td>
<td>23.00%</td>
</tr>
<tr>
<td>Q15</td>
<td>4</td>
<td>65.70%</td>
<td>34.30%</td>
<td>65.70%</td>
</tr>
<tr>
<td>Q16</td>
<td>3</td>
<td>58.30%</td>
<td>41.70%</td>
<td>58.30%</td>
</tr>
<tr>
<td>Q17</td>
<td>2</td>
<td>26.20%</td>
<td>73.80%</td>
<td>26.20%</td>
</tr>
<tr>
<td>Q18</td>
<td>2</td>
<td>17.80%</td>
<td>82.20%</td>
<td>17.80%</td>
</tr>
<tr>
<td>Q19</td>
<td>2</td>
<td>43.20%</td>
<td>56.80%</td>
<td>43.20%</td>
</tr>
<tr>
<td>Q20</td>
<td>3</td>
<td>22.40%</td>
<td>77.60%</td>
<td>21.60%</td>
</tr>
<tr>
<td>Q21</td>
<td>3</td>
<td>29.00%</td>
<td>71.00%</td>
<td>28.30%</td>
</tr>
<tr>
<td>Q22</td>
<td>3</td>
<td>38.00%</td>
<td>62.00%</td>
<td>28.40%</td>
</tr>
</tbody>
</table>

Patient: Female with no prior spine surgery, with anemia, employed, steady gait, 60 years old, 162cm height, 59 kg weight, 137.22 sagittal balance, 58.4° of major curve Cobb angle, 21.9° pelvic tilt, 42 ODI score baseline and more than 10 years with spine problems. Surgery: pelvic fixation, IFF, 8 fused vertebrae, posterior instrumentation, 0 SPOs, 5 levels between UV and LIV.

Disclosures:
APPLICATION OF GELATIN SPONGE IMPREGNATED WITH A MIXTURE OF 3 DRUGS TO INTRAOPERATIVE NERVE ROOT BLOCK TO PROMOTE EARLY POSTOPERATIVE RECOVERY OF LUMBAR DISC HERNIATION

Jin Peng Du, Yong Fan, Ding Jun Hao
Dept of spine surgery, Xi'an, China

Objective: To observe the effect of application of gelatin sponge impregnated a mixture of 3 drugs (GSIAM) to intraoperative nerve root block to promote early postoperative recovery of lumbar disc herniation (LDH).

Method: A total of 265 patients with single-level LDH were retrospectively analyzed from January 2013 to October 2017. Patients were divided into intervention group and control group according to whether intraoperative GSIAM. All patients underwent unilateral MIS-TLIF surgery. Clinical data such as postoperative bedbound period, postoperative hospital stays, preoperative and postoperative VAS score of low back pain and leg pain, JOA score, postoperative satisfaction questionnaire results, and therapeutic effect were collected.

Results: 136 cases were included in the intervention group, 129 cases were included in the control group. The intervention group had significantly shorter bedbound period and postoperative hospital stay than the control group (P <0.05). The postoperative day 1-10 VAS scores of low back pain and leg pain in the intervention group were significantly lower than those in the control group (P <0.05). The incidence of root pain caused by early postoperative edema reaction of lumbar intervertebral disc herniation in the intervention group was 30.9%, which was significantly lower than that in the control group (57.4%, P <0.05). The JOA score at postoperative day 6 and satisfaction at 72 hours after operation were significantly higher in the intervention group than those in the control group (P <0.05). The clinical effect of the intervention group at postoperative day 6 was significantly better than that of the control group (P <0.05).

Conclusions
Intraoperative application of GSIAM to intraoperative nerve root block can significantly promote the early postoperative recovery of LDH, and has great short-term clinical efficacy.

Disclosures:
author 1: none; author 2: none; author 3: none
ANULAR CLOSURE REDUCES RECURRENT HERNIATION AND REOPERATION IN A HIGH-RISK POPULATION FOLLOWING LUMBAR DISCECTOMY: 3-YEAR DATA FROM A MULTI-CENTER, PROSPECTIVE, RANDOMIZED TRIAL

Claudius Thomé, Peter Vajkoczy, Geoffrey Lesage, Volkmar Heidecke
Department of Neurosurgery, Innsbruck Medical University, Innsbruck, Austria

Introduction
Recurrent disc herniation and reoperation following lumbar discectomy are associated with worse clinical outcomes and greater socioeconomic burden [1, 2]. Multiple studies have reported that patients with large anular defects (≥ 6 mm wide) are at significantly greater risk for recurrent herniation and reoperation following lumbar discectomy, with rates as high as 27% [3, 4]. This study hypothesized that occluding the anular defect with a mechanical barrier at the time of primary discectomy would reduce the incidence of recurrent herniation and reoperation in high-risk patients with large anular defects. This analysis reports outcomes through 3 years follow-up from a randomized, prospective, multi-center trial of an anular closure device (ACD).

Methods
Primary discectomy patients at 21 sites were randomized intra-operatively 1:1 to be treated either with discectomy alone (Control, 278 patients) or discectomy supplemented with the ACD (272 patients). Inclusion criteria consisted of 6 weeks conservative care, minimum Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) for leg pain scores (40/100), a minimum of 5 mm posterior disc height and an intra-operatively measured anular defect width of 6-10 mm. Baseline and follow-up measurements included patient reported outcomes, neurological exams, adverse events, and imaging. A Kaplan-Meyer survival analysis was utilized to evaluate freedom from recurrent herniation and reoperation. ACD was compared with Control using the log-rank test and p-values less than 0.05 were considered significant.

Results
At the time of this analysis, 93% of patients in the ACD (253/272) and Control (258/278) groups were at least 3 years post-op. Symptomatic reherniation at the index level was confirmed intra-operatively during reoperation or with MRI and neurological symptoms. The incidence of patients with at least one symptomatic recurrent herniation within 3 years in the ACD and Control groups was 13.7% and 26.7%, respectively (p = 0.0001). At least one reoperation, for any reason including device complications, was required in 10.6% and 18.1% of unique patients in the ACD and Control groups, respectively (p=0.01).

Conclusion
These data demonstrate the utility of this ACD for significantly reducing the rates of symptomatic recurrent herniations and reoperations among high-risk lumbar discectomy patients through 3 years of follow-up.

References

Disclosures:
author 1: grants/research support: BrainLab, DepuySynthes, Intrinsic Therapeutics, Pfizer, Signus Medical, TETEC AG; consultant: DepuySynthes, Intrinsic Therapeutics, Signus Medical; author 2: none; author 3: none; author 4: not indicated
ANATOMICAL FEASIBILITY OF EXTRADURAL TRANSFERRING S2 AND S3 VENTRAL ROOTS TO S1 VENTRAL ROOT FOR RESTORING NEUROGENIC BLADDER IN SPINAL CORD INJURY

Kaixiang Yang, Xiaojian Cao

1) Department of Orthopaedics, The First Affiliated Hospital of Nanjing Medical University, Nanjing, China and Department of Orthopaedics, The Second Affiliated Hospital of Nanjing Medical University, Nanjing, China; 2) Department of Orthopaedics, The First Affiliated Hospital of Nanjing Medical University, Nanjing, China

Title
Anatomical feasibility of extradural transferring S2 and S3 ventral roots to S1 ventral root for restoring neurogenic bladder in spinal cord injury.

Background
Numbers of researches of neurastomosis methods have been used for treating the bladder dysfunction in spinal cord injury. However, some limitations retard the development of those studies including the enormous trauma in the operation, the great cost retard its development, the high risks of postoperative cerebrospinal fluid leakage, long time for the nerve growth and difficulty for identifying the intradural ventral and dorsal roots.

Purpose of the study
To reduce the above limitations, we started the anatomical study to try to replace the intradural anastomosis with the extradural anastomosis. The goal of this study is to provide an anatomical basis for transferring the S2 and S3 VRs to S1 VR without opening the spinal dural mater to restore the neurogenic bladder.

Materials and Methods
6 formalin-fixed cadavers were dissected (4 males, 2 females). The feasibility of exposing the S1, S2 and S3 extradural nerve roots by a limited laminectomy, isolating the ventral root and dorsal roots from each extradural nerve root and transferring the S2, S3 ventral roots to the S1 ventral root were assessed.

Results
A limited laminectomy was performed to expose the S1 to S3 extradural nerve roots. At the location of the dorsal root ganglion, the connective tissues between the ventral roots and dorsal roots were loose and were easy to be separated (Figure 1A). The ventral roots of S1 to S3 were isolated from the extradural nerve root outlet to the juncture of the ventral and dorsal roots (Figure 1B). After the ventral roots of S1-S3 segments were separated from the corresponding dorsal roots, the distal end of the S1 ventral root was transferred to the proximal end of the S2 and S3 ventral roots, and the S1 dorsal root was intact. Then, after the above steps, the S2, S3 dorsal roots were severed (Figure 1C). The diagram of our surgical anastomosis was showed in Figure 1D.

Conclusion
To reduce some limitations of the current treatments for the spinal cord injury-Induce neurogenic bladders, a modified surgical method is considered to be vital. Our study provides anatomic criteria for the extradural nerve root transfer technique for treating the patients with neurogenic bladders in spinal cord injury. This technique has great potential and good prospect of being applied in clinical.
Disclosures:
author 1: none; author 2: not indicated
MRI CHANGE AFTER PERCUTANEOUS ENDOSCOPIC LUMBAR FORAMINOPLASTY FOR LUMBAR FORAMINAL STENOSIS

Jongchul Chung, Changbong Kong, Woosung Sun, Byongwook Hwang, Hyungdong Kim
Department of Neurosurgery, Busan, Korea

PURPOSE Currently, clinical outcomes of percutaneous endoscopic lumbar foraminoplasty (PELF) performed for lumbar foraminal stenosis (LFS) have been reported in the literature. However, none has reported the radiographic change of MRI after surgery. This report presents the clinical outcome as well as radiographic changes of MRI after PELF for elderly patients with unilateral radiculopathy.

MATERIALS & METHODS
Between January 2015 and December 2016, twenty-four patients with unilateral radiculopathy and diagnosed with LFS over 65-year-old were identified. Patient demographic data, operative information including operative time, and complications were collected. Visual analog pain scale (VAS), Oswestry Disability Index (ODI), radiographic data were evaluated. We used sagittal MR images to measure the diameter and cross-sectional area (CSA) of intervertebral foramen, and corresponding nerve root. The maximum width and height of intervertebral foramen and nerve root were measured on sagittal MR image at the zone the nerve root exit. As the preoperative data consisting of VAS scores, each measurement of the neuronal and foraminal structure were normally distributed, paired t-test was performed to analyze the outcome.

RESULTS
The study group consisted of 5 men and 19 women with an average age at surgery of 74.6 years (range 65-82) and a mean follow-up of 9.2 months (range 6-18). The mean operation time was 73.2 minutes (range 30-140). Preoperative radiating pain improved immediately in 23 of 24 patients (96%). The VAS score significantly improved from 7.89± 1.8 to 2.57± 2.5 (67.4%) and the ODI also significantly improved from 33.15±9.2 to 10.24±6.7 (69.1%) at last follow up.

1. Change in width and shape of intervertebral foramen before and after surgery: On average foraminal width increased about 1.67 mm (21.4%) from 6.55 ± 2.1 mm to 8.23 ± 4.7 mm, and foraminal height increased about 5.00 mm (36.9%) from 8.56 ± 5.5 mm to 13.56 ± 7.6 mm and the CSA increased about 55.27 mm ² (60.6%) (P <0.005) from 34.40 ± 25.1 mm to 89.67 ± 65.7 mm.

2. Changes in the size and shape of the nerve section before and after surgery: After foraminoplasty, all deformed cross-section of nerve changed to round or ellipsoidal shape. On average, the maximum width of CSA of the nerve increased 0.2 mm (5.23%) from 3.62 ± 1.9 mm to 3.82 ± 1.8 mm, and maximum width of CSA of the nerve increased from 0.4 mm (7.4%) from 4.18 ± 2.5 mm to 4.51 ± 2.6 mm, the CSA increased 3.55 mm ² (23.2%) from 11.75 ± 8.9 mm to 15.30 ± 10.7 mm but, it was not statistically significant (p>1.0)

CONCLUSION
We performed PELF in limited case series of elderly patients. The radiographic changes of MRI of this study demonstrated considerable decompression, and the patients also showed clinically
relevant improvement. This highlights that the PELF resulted in sufficient mobilization and decompression of neuronal component in LFS.

Radiographic measurement on sagittal MR

![Preoperative and postoperative changes of VAS score and radiographic measurements](image)

<table>
<thead>
<tr>
<th>Table. Preoperative and postoperative changes of VAS score and radiographic measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>VAS leg</td>
</tr>
<tr>
<td>Intervertebral foramen on sagittal plane</td>
</tr>
<tr>
<td>Max. width (mm)</td>
</tr>
<tr>
<td>Max. height (mm)</td>
</tr>
<tr>
<td>CSA (mm²)</td>
</tr>
<tr>
<td>Nerve root on sagittal plane</td>
</tr>
<tr>
<td>Max. width (mm)</td>
</tr>
<tr>
<td>Max. height (mm)</td>
</tr>
<tr>
<td>CSA (mm²)</td>
</tr>
</tbody>
</table>

Disclosures:
author 1: none; ; author 2: none; ; author 3: none; author 4: none; ; author 5: none
ASSESSMENT OF PSOAS MUSCLE DAMAGE AND CLINICAL OUTCOMES IN THE EARLY POSTOPERATIVE PERIOD AFTER LATERAL LUMBAR INTERBODY FUSION

Shimei Tanida, Shunsuke Fujibayashi, Bungo Otsuki, Shuichi Matsuda
Department of Orthopaedic Surgery, Graduate School of Medicine, Kyoto University

Study Design.
A retrospective multicenter study.

Objective.
To assess psoas muscle (PM) damage after lateral interbody fusion (LIF).

Summary of background data.
Although PM damage is a complication resulting from the surgical approach of LIF, there are no detailed studies about PM damage.

Methods.
We reviewed 26 patients who underwent oblique LIF (Group O) at one institution and 17 patients who underwent extreme LIF (Group X) at another institution. The number of fused levels was limited to one or two. To assess PM damage, we used magnetic resonance imaging to measure the average cross-sectional area (CSA) of PM and the hematoma within PM (PH) on the approach and contralateral side before and after the operation. The Japanese Orthopedic Association (JOA) score was also assessed preoperatively and 3 months postoperatively.

Results.
Five patients in Group X and three in Group O exhibited complications with complication associated with PM damage or sensory nerve injury (PM weakness and thigh/groin pain). The CSA of PH was significantly larger in Group X than in Group O on both the contralateral-side and approach-side (both p <0.01). The CSA of PM on both sides did not significantly change after the operation in Group O, whereas that of Group X was significantly larger postoperatively than preoperatively on both the contralateral-side and approach-side (both p = 0.03). In this study group, the recovery rate of the JOA score correlated negatively with the CSA of PH (r=-0.45, p=0.011) (Figure).

Conclusion. In this study, the area of damage of PM was larger in Group X than in Group O. This damage might have caused the difference in the early clinical recovery rate between the two
procedures. These findings suggest that the PM should be treated gently during the LIF procedure.

Disclosures:
author 1: none; author 2: none; author 3: none; author 4: none
A NOVEL SURGICAL APPROACH FOR TRANSPLANTATION OF OLFACTORY ENSHEATHING CELLS FOLLOWING A TRANSECTION TYPE SPINAL CORD INJURY IN MICE
Ronak Reshamwala, Todd Shelper, Megha Shah, James St John
Griffith University, Queensland, Australia.

Cell based therapies for treatment of spinal cord injuries (SCI) have shown some efficacy. Olfactory ensheathing cells (OECs) in particular have been investigated with increasing focus owing to their inherent regenerative activity in the olfactory nerve. However, survival and integration of transplanted OECs has been poor following a SCI in animal studies. We have employed a novel technique for transplanting olfactory ensheathing cells following a transection type SCI in C57BL/6 mice. The transection is performed following a laminectomy at T10 vertebral level. Transplanted OECs are harvested from the olfactory mucosa of P7 s100B-DsRed transgenic mice. The glial cells in these mice express DsRed protein that can be visualized as fluorescence. 200,000 cells are prepared and transplanted 7 days following a SCI. Fibrin glue is used to anastomose the cut ends of the spinal cord. The animals are then sacrificed at different time points following the treatment and their spines are harvested. The spines are sectioned and stained for immunofluorescence assays. Upon imaging the spinal cord sections, we found DsRed positive cells at and near the site of transplantation. These cells also appear to localize more in the injury site and to be associated with structural repair of the cord. Since only the transplanted cells express DsRed, it can be stated with certainty that our method of transplanting OECs into an injured spinal cord results in longer survival and better integration.

Disclosures:
author 1: grants/research support: Griffith University International Postgraduate Research Scholarship, Griffith University Postgraduate Research Scholarship, Perry Cross Spinal Research Foundation; author 2: none; author 3: none; author 4: grants/research support: Motor Accident Insurance Commission of Queensland
MINIMALLY INVASIVE LATERAL LUMBAR INTERBODY FUSION AND POSTERIOR INSTRUMENTATION FOR CLINICAL ADJACENT SEGMENT PATHOLOGY: A RETROSPECTIVE MATCHED COHORT STUDY WITH ONLY POSTERIOR INSTRUMENTATION

Hyung-Ki Min, Kee-Yong Ha, Young-Hoon Kim, Sang-II Kim, Hyung-Youl Park, In-Soo Oh, Jun-Yeong Seo, Dong-Gune Chang

Department of Orthopedic Surgery, Seoul St. Mary’s Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea

Introduction
Minimally invasive techniques have been increasingly applied for spinal surgery. To the best of our knowledge, no report has been published that compare LLIF (lateral lumbar interbody fusion) and PI (posterior instrumentation) to conventional PI for adjacent segment pathology (ASP). The purpose of this study is to evaluate the clinical and radiological efficacies of minimally invasive LLIF in clinical ASP.

Methods
Forty patients that underwent LLIF with PI (combined group) were matched in a 1-to-1 format to 40 patients that only underwent PI by age, sex, body mass index, bone mineral density, and number of fusion levels. The radiological outcomes including indirect decompression and clinical outcomes such as the Oswestry Disability Index (ODI) and visual analog scale (VAS) were assessed. The postoperative major complications and reoperations were also compared.

Results
In the LLIF group, laminectomy levels (0.6 vs. 1.3, \(p=0.0001\)) and estimated blood loss (887.2 vs. 1250.0mL, \(p=0.0001\)) were significantly lower compared to only PI group. Correction of segmental Cobb angle (CA) and segmental lordosis were also significantly higher postoperatively (-2.8° vs. -0.9°, \(p=0.012\) for segmental CA; 7.4° vs. 2.5°, \(p=0.009\) for segmental lordosis) and last follow-up (-2.4° vs. -0.5°, \(p=0.026\) for segmental CA; 4.8° vs. 0.8°, \(p=0.016\) for segmental lordosis) in the combined group. Moreover, significant improvements in the postoperative 3-month back VAS (4.1 vs. 5.6, \(p=0.011\)) and ODI (48.9 vs. 59.6, \(p=0.007\)) were observed in the LLIF group. Regarding the indirect decompression of the LLIF, a significant increase of canal area (83.4 vs. 113.8mm²) and foraminal height (17.8 vs. 20.9mm) on postoperative MRI was noted. Postoperative complications and reoperations were not significantly different between the two groups.

Conclusion
Minimally invasive LLIF for ASD has advantages of indirect decompression, and greater improvements of segmental coronal and sagittal correction leading to better clinical outcomes compared to only posterior surgery.
Disclosures:
MISS TLIF VS XLIF IN THE L4L5 LEVEL: COMPLICATIONS AND OUTCOMES
Juan Del Castillo-Calcañeo, Khai Lam
Department of Neurosurgery, Pemex, Mexico City, Mexico; London Bridge Hospital, London, UK

Introduction:
The L4/L5 level has been controversial in the past years, especially when using the Lateral Lumbar Interbody Fusion (LLIF) approach due to potential damage of the lumbar plexus.

Material and Methods:
This is a non-randomised comparative study of patients who underwent Minimally Invasive Transforaminal Interbody Fusion (MIS-TLIF) of the L4L5 level versus patients who underwent LLIF. The patients were followed up using the Oswestry Disability Index (ODI), SF-36 Questionaire and VAS for pain assessment at 3, 6 and 12 months as well as complications incidence between both techniques. All surgeries were performed by a single surgeon.

Results:
A total of 81 single level L4/5 fusion patients were obtained, 36 operated using MIS-TLIF and 45 using LLIF, mean age in both groups was 56 years. All patient statistically improved at every time point but there was no statistically significant difference between both groups, with ODI reduction (28.8 TLIF vs 27.8 XLIF), VAS reduction (LBP 3.7; LP 3.9 vs LBP 3.9; LP 3.8) and SF-36 (PCS 8.1; MCS 10.5 vs PCS 7.9; MCS 10.2). In terms of complications in the XLIF group, 1 patient presented with L4 radicular pain after surgery which was attributed to the surgical access, in the TLIF group 1 subject presented with a dural tear, in terms of patients requiring revision surgery we also found 1 in the MIS-TLIF group and 2 in the XLIF group, the MIS-TLIF patient required revision for pseudoarthrosis which resolved with an anterior fusion, the 2 patients which required revision in the XLIF group required additional decompression and their symptoms resolved.

Conclusion:
This non-randomised comparative study shows that in experienced hands the rate of complications from the LLIF approach is minimal as compared with MIS-TLIF. And that there are no differences in terms of clinical disability and pain variations in our 12 month follow-up when approaching the L4/5 level from either approach.

Disclosures:
author 1: none; author 2: none
MIDDLE TERM RESULTS OF MINIMALLY INVASIVE UNILATERAL PEDICLE SCREW FIXATION COMBINED WITH TRANSFORAMINAL INTERBODY FUSION FOR THE TREATMENT OF ONE LEVEL DEGENERATIVE DISC DISEASE IN THE LUMBAR SPINE

Giuseppe Morassi, Lykourgos Kollintzas, Sherief Elsayed, Iosif Tarazi
Brighton and Sussex University Hospitals

Purpose: The aim of this study was to evaluate the efficacy, safety, clinical results and fusion rate of a minimal invasive unilateral pedicle screw fixation combined with a trasforaminal interbody fusion for the treatment of symptomatic one level degenerative disc disease of the lumbar spine causing radicular leg and back pain.

Methods Retrospective study.
Sample The data of 50 patients (24 Male and 26 Female) that underwent one level minimally invasive unilateral pedicle screw fixation with transforaminal interbody fusion from August 2012 to August 2016 by the senior author were retrospectively evaluated. The mean age of the patients was 56,42 (34-84 years). The side that the pedicle screws were placed was the ipsilateral side of the leg pain and that was also the side where decompression was performed. Fusion was performed at the L3/4 level in 2 cases, L4/5 in 26 cases and at the L5/S1 level in 22 cases. All the patients had MRI scans of the lumbar spine and standing x rays AP and LAT views of the lumbar spine preoperatively. The approach was right sided in 29 cases and left sided in 21 cases. The primary outcomes were patient related outcome scores Visual Analog Score (VAS) for leg and back pain and Oswestry Disability Index (ODI) at regular Follow Ups at 3, 6, 12 and 24 months. Also the fusion rate was evaluated on plane x rays and CT scans. The mean follow up was 26,6 months (ranging from 24-62 months).

Results Out of the 50 cases there has been one case of migration of the interbody cage which was removed and pedicle screws were placed on the contralateral side and one case of deep wound infection which was treated with removal of the pedicle screws and antibiotic with preservation of the interbody cage. No dural tear or neurological complication was noted. VAS score for Leg pain and Back pain has improved at 3 months postop and remained better compared to preop at 6, 12 and 24 months follow up in the majority of the cases. Mean Preop VAS for leg 7,8 (SD 1,8) Postop at 1 year 3,1 (SD 1,4) p<0,05. Preop ODI 64(SD 12) Postop ODI at 1 year 42 (SD 7).
The fusion rate was estimated using the Lenke classification on CT scans of the lumbar spine at 1 year and 2 years.
At 1 year the fusion rate was 78,8 % and at 2 years 84,6%.

Conclusion The minimal invasive unilateral pedicle screw fixation with transforaminal interbody fusion for the treatment of one level symptomatic degenerative disc disease is an efficient and safe method compared to the bilateral pedicle screw fixation which has the advantage of preserving the midline musculo-ligamentous structures and the contralateral facet joint.