

## EUROSPINE 2021 scientific programme oral presentations

Thursday, 7 October 2021, 16:15–17:15

**Best of Session: Presentation of the highest rates abstracts**

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### **LOCAL RETROPHARYNGEAL SPACE ANESTHETIC FOR DYSPHAGIA REDUCTION AFTER ANTERIOR CERVICAL DISCECTOMY AND FUSION SURGERY: A SINGLE-CENTER, PROSPECTIVE, RANDOMIZED, DOUBLE-BLINDED, PLACEBO-CONTROLLED CLINICAL TRIAL**

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#### Introduction

We hypothesized that a local anesthetic, bupivacaine hydrochloride, may facilitate the sympathetic blockade of the intraoperative stimulation and therefore reduce postoperative inflammation and swelling of the esophago-pharyngeal area.

#### Objective

The main objective of this study was to analyze the ability of local anesthetic instillation into the retropharyngeal space to reduce dysphagia symptoms and occurrence rates in patients undergoing anterior cervical discectomy and fusion (ACDF) procedures.

#### Methods

A single-center, prospective, randomized, double-blinded, and placebo-controlled clinical study was performed. We enrolled patients undergoing one- or two-level ACDF procedures for cervical degenerative disc disease with disc herniation, radiculopathy and/or myelopathy symptoms. The patients were randomly assigned (1:1 ratio) to receive either 0.5% bupivacaine hydrochloride or 0.9% NaCl solution.

#### Results

In total, 120 patients were randomized and 111 completed the study. Forty-three (74%) and 41 (77%) of patients reported dysphagia symptoms at the time of discharge in the investigational and control groups, respectively. There were no statistically significant differences in duration of dysphagia symptoms, Swallowing-Quality of Life (SWAL-QOL) survey or pain scores between the investigational or control patient groups at any of the follow-up time points. Controlling for independent variables, only younger age significantly predicted dysphagia symptoms at discharge, 2-week, and 3-month follow-ups ( $p < 0.03$ ;  $R > -0.038$ ;  $OR = 0.96$ , 95% CI 0.93 - 0.99). Female gender was associated with lower SWAL-QOL scores at discharge ( $p = 0.046$ ;  $R = 0.87$ ;  $OR = 2.38$ , 95% CI 1.02-5.56). A total of 8 (13.8%) and 6 (11.3%) patients in the investigational and control groups, respectively, were referred to a specialist or underwent speech therapy for their dysphagia symptoms. There were no adverse reactions to the study drug observed.

#### Conclusions

Local retropharyngeal space anesthetic instillation did not reduce dysphagia symptoms or occurrence rates in patients undergoing anterior discectomy and fusion surgeries.

#### Disclosures:

author 1: none; author 2: none; author 3: consultant=Medtronic, SI-Bone, Zimmer Biomet, Integrity Spine, royalties=Medtronic, SI-Bone; author 4: consultant=Functional Neuromodulation ; author 5: none

## **DEVELOPMENT OF A CROSSWALK FOR THE BIDIRECTIONAL MAPPING OF TWO COMMONLY USED CONDITION-SPECIFIC PATIENT-REPORTED OUTCOME MEASURES, THE OSWESTRY DISABILITY INDEX (ODI) AND THE CORE OUTCOME MEASURES INDEX (COMI)**

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### Introduction

Cross-walking is a method of mapping scores on different patient-reported outcome instruments that measure similar domains. It requires that changes in outcomes from two measures in the same individuals should be correlated and similarly responsive to change. The Oswestry Disability Index (ODI) and the Core Outcome Measures Index (COMI) are two commonly used self-rating outcome instruments in patients with spinal disorders. However, there is currently no formal cross-walk between the two that would otherwise allow the scores of one to be interpreted in terms of the other. This study aimed to create such a cross-walk.

### Methods

We performed a secondary analysis of data from conservative and operative patients with spinal disorders, from 2 observational studies and a registry (N = 3324 patients; 57±17y; 60.3% female), that had completed both an ODI and COMI at baseline and 1-year follow-up (FU). Correlations between the two instruments' baseline scores, FU scores and change-scores (baseline and 1y FU) were computed. The Cohen's kappa for agreement ( $\kappa$ ) was calculated with respect to achievement of the minimal clinically important change (MCIC) score on each instrument (ODI, 12.8 (Copay et al 2008) points; COMI, 2.2 points (Mannion et al 2006)) using the actual change-scores for each as well as those predicted from the change-scores on the alternative instrument. It was hypothesized that baseline, FU, and change-scores for the two instruments would be at least moderately correlated ( $r > 0.5$ ) and have moderately similar responsiveness ( $\kappa > 0.4$  for agreement in % reaching MCIC).

### Results

All pairs of measures were significantly positively correlated (baseline, 0.73; 1yr FU, 0.84; change-scores, 0.73). Overall, 53.9% patients achieved MCIC based on COMI change-scores and 52.4%, based on ODI change-scores; on an individual basis, there was 78% agreement between them, with  $\kappa = 0.56$ . The corresponding figures for achievement of MCIC based on individuals' change-scores predicted from their change-scores on the alternative instrument were 56.6% and 55.6%, respectively ( $\kappa = 0.56$ ).

### Conclusion

Many institutions exhibit a preference for the use of one outcome instrument over another, and have a history of data collection with their chosen instrument; the ability to share data via the developed crosswalk, to convert scores between the two scales, should open up more centres/registries for collaboration and facilitate the pooling of data in meta-analyses.

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**DECOMPRESSION WITH OR WITHOUT FUSION IN DEGENERATIVE LUMBAR  
SPONDYLOLISTHESIS - THE NORDSTEN-DS TRIAL**

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## **GAIN IN HRQL AFTER ASD SURGERY IS MAINTAINED BETWEEN 2 AND 5 YEARS' FOLLOW-UP. RESULTS FROM A PROSPECTIVE MULTICENTRE OBSERVATIONAL COHORT STUDY**

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### Introduction

Despite the increasing number of surgeries done for Adult Spinal Deformity (ASD), there is a lack of data with > 5 years of follow-up (5YFU). The aim of our study was to investigate the durability of ASD surgical outcomes and identify predictors of HRQL gain at 5YFU.

### Methods

We included all surgical patients enrolled in an international (5 sites) ASD database, operated before March 2015, and assessed 2YFU and 5YFU outcomes: adverse events (major complications, MC; unplanned reoperations, UR), HRQL (ODI, SRS22, SF36) and standing radiographic (coronal and sagittal) parameters. We compared values at 2YFU and 5YFU for spinal alignment, HRQL gain, % of patients reaching published MCID and PASS (patient acceptable symptom state, defined as ODI<18 or SRS22-subtotal>3.5) and adverse events, and identified predictors of the gain in HRQL at 5YFU using multivariable linear regression, controlling for confounding factors.

### Results

361 patients [77.8% women; mean (SD) age 52.1 (19.17) y], mean 8.9 fused levels, 16.6% 3CO, 36.3% pelvic fixation, 94.6% posterior only] met inclusion criteria. 316 (87.5%) completed 2YFU and 258 (71.5%), 5YFU. Lack of 5YFU data was related to site ( $p<0.05$ ) but not to baseline characteristics (demographic, radiographic) or 2YFU outcome (HRQL, MC, RI, radiographic). There was no change ( $p>0.05$ ) in coronal alignment, lumbar lordosis, LGap or SVA from six weeks postop to 5YFU. A significant increase in T2-T12 kyphosis (43.4° vs 50.6°,  $p=0.02$ ), PT (18.1° vs 21.7°,  $p=0.02$ ) and global tilt (18.6° vs 24.4°,  $p=0.03$ ) was observed between 6w and 5YFU. The incidence of MC (24.9% vs 10.5%,  $p<0.001$ ) and UR (18.8% vs 12.2%,  $p<0.0018$ ) was greater during the first 2YFU than between 2 and 5YFU. Mean HRQL scores, proportion of patients reaching MCID and PASS, and satisfaction with treatment were similar at 2YFU and 5YFU (Table). Worse baseline HRQL scores and sagittal balance (Global Tilt, LGap) were associated ( $p<0.05$ ) with a greater gain in 5YFU HRQL while postoperative MC and UR were associated with a lesser gain ( $p<0.05$ ).

### Conclusions

This study represents the largest prospective multicentre surgical cohort of ASD patients, with >5YFU, reported in the literature to date. This study provides strong evidence to suggest that surgery for ASD is associated with durable outcomes that do not deteriorate over time. The extent of the gain in HRQL at 5YFU depends on baseline HRQL and sagittal alignment, as well as the occurrence of major complications and unplanned reinterventions.

HRQOL				
	Baseline	2y	5y	p value 2y-5y
ODI	37.2 (19.6)	27.2 (21.3)	28.1 (21.1)	0.67
SRS22-Subtotal	2.8 (0.7)	3.5 (0.8)	3.4 (0.9)	0.76
SRS22-Satisfaction		4.1 (1.1)	4.0 (1.0)	0.23
SF36-PCS	36.4 (9.5)	42.2 (10.4)	41.8 (11.2)	0.67
SF36-MCS	42.9 (12.2)	46.8 (12.3)	47.6 (11.3)	0.29
Proportion of patients reaching MCIDs				
ODI	Preop-2Y		39.9%	p=0.56
	Preop-5Y		37.0%	
SRS22 Subtotal	Preop-2Y		61.9%	p=0.357
	Preop-5Y		57.5%	
SF36 PCS	Preop-2Y		48.9%	p=0.93
	Preop-5Y		49.8%	
Proportion of patients reaching PASS (Patient Acceptable Symptom State)				
ODI <18	At 2Y		41.2%	p=0.49
	At 5Y		37.9%	
SRS22 Subtotal >3.5	At 2Y		45.3%	p=0.61
	At 5Y		47.9%	
Major complications				
Before 2Y				
Neurologic			17 (8.2%)	
Mechanical			109 (52.1%)	
Infectious			29 (13.9%)	
Medical			54 (25.8%)	
TOTAL			209 (100%)	
Between 2-5y				
Neurologic			2 (2.8%)	
Mechanical			55 (78.6%)	
Infectious			4 (5.7%)	
Medical			9 (12.9%)	
TOTAL			70 (100%)	
Major complications				
Before 2Y		24.9% of the patients		p <0.001
Between 2-5Y		10.5% of the patients		
Reinterventions				
Before 2Y		18.8% of the patients		p = 0.018
Between 2-5Y		12.2% of the patients)		

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## IS VBT SAFE AND EFFECTIVE FOR $\geq 60^\circ$ MAIN THORACIC CURVES? A MATCHED COHORT ANALYSIS

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**Background:** Patient preference and surgeon curiosity create a tendency towards applying Vertebral Body Tethering (VBT) for bigger curves. However, the efficacy, let alone safety, of this procedure is not assessed for such magnitudes.

**Purpose:** To compare results of VBT for large curves to VBT for smaller curves and Posterior Spinal Fusion (PSF) for similar curves.

**Methods:** Prospectively collected fusion data and retrospectively collected non-fusion data were evaluated. A multicenter database was queried for JIS and AIS patients having  $60^\circ$ - $80^\circ$  baseline (Main Thoracic) MT curves who had  $\geq 2$  years follow-up after VBT surgery. Patients were 1-to-1 matched with  $40^\circ$ - $60^\circ$  MT curve VBT patients using UIV and LIV locations, Sanders and Risser; and 1-to-1 matched with  $60^\circ$ - $80^\circ$  MT curve PSF patients using curve types, exact Cobb angles and Risser. Perioperative data, curve flexibility, pulmonary, mechanical (broken tether and proximal junctional failures) and growth-related complications (adding-on, overcorrection and crankshafting), and reoperations were compared. Radiographic success was defined as having  $\leq 35^\circ$  MT curve at final follow-up.

**Results:** 108 patients (93F, 15M) were included in VBT40-60, VBT60-80 and PSF60-80 groups (n=36 for each). On average, the cohort displayed significant growth potential (mean age  $12.4 \pm 1.6$ y, median Sanders 3, median Risser 0 and 63.5% TRC open). Curve flexibility was similar among groups. Additional interventions: for VBT40-60 were 3% thoracoplasty; for VBT60-80 were 6% annulotomy and thoracoplasty; for PSF60-80 were 19% anterior release, 27.8% thoracoplasty and 52.7% posterior column osteotomies. PSF surgeries lasted longer and resulted in higher estimated surgical blood loss. Pulmonary and growth-related complications were similar among groups. Mechanical complication and reoperation rates were more frequent after VBT, but were similar between VBT groups. Radiographic success rates were 36%, 67% and 94% for the VBT60-80, VBT40-60 and PSF60-80 groups, respectively. Fusion was avoided in 86% of VBT40-60 and 92% of VBT60-80 patients (Figure).

**Conclusion:** Radiographic success rate ( $\leq 35^\circ$  MT curve at last follow-up) of VBT for  $60^\circ$ - $80^\circ$  MT curves (36%) was lower compared to both VBT for  $40^\circ$ - $60^\circ$  (67%) and PSF for  $60^\circ$ - $80^\circ$  (94%). For  $60^\circ$ - $80^\circ$  preoperative main thoracic curves, VBT resulted in higher mechanical complication and reoperation rates compared to PSF. However, 92% of the patients avoided fusion at a mean of 3 years after surgery, a goal for those who prefer VBT. Pulmonary and growth-related complications were similar, while mechanical complications were higher in VBT. Future work is required to understand if and when  $60^\circ$ - $80^\circ$  curves should undergo VBT.

<b>Demographics</b>	VBT40-60	VBT60-80	PSF60-80	<i>p</i>
Age at surgery, years, Mean ± SD	12.8 ± 1.8	12.0 ± 1.7	12.4 ± 1.2	0.086
Height, cm, Mean ± SD	155.6 ± 9.9	151.3 ± 8.9	151 ± 9.1	0.074
Risser Stage, Median (Range)	0 (0-4)	0 (0-3)	0 (0-3)	0.919
Open Tri-radiate Cartilage, n (%)	22 (62.9%)	22 (64.7%)	22 (62.9%)	0.983
Sanders Stage, Median (Range)	3 (2-6)	3 (2-5)	n/a	0.822

<b>Radiographic Results</b>	VBT40-60	<i>p</i>	VBT60-80	<i>p</i>	PSF60-80
Preop MT Cobb, Degree, Mean ± SD	47.1 ± 4.6	<0.001*	64.3 ± 4.7	0.693	65.2 ± 5.2
First Erect MT Cobb, Degree, Mean ± SD	28.1 ± 6.5	<0.001*	35.2 ± 8.4	<0.001*	18.6 ± 4.9
Last F-up MT Cobb, Degree, Mean ± SD	30.2 ± 10.6	0.002*	38.4 ± 10.8	<0.001*	23 ± 8.8

<b>Radiographic Success</b>	VBT40-60	<i>p</i>	VBT60-80	<i>p</i>	PSF60-80
≤35° MT at last follow-up, n (%)	24 (66.7%)	0.009*	13 (36.1%)	<0.001*	34 (94.4%)

<b>Complications</b>	VBT40-60	<i>p</i>	VBT60-80	<i>p</i>	PSF60-80
Pulmonary, n (%)	2 (5.6%)	0.500	3 (8.3%)	0.693	2 (5.6%)
Mechanical, n (%)	11 (30.6%)	0.276	7 (19.4%)	0.002*	1 (2.8%)
Growth-related, n (%)	3 (8.3%)	0.231	5 (13.9%)	0.199	1 (2.8%)

<b>Reoperations</b>	VBT40-60	<i>p</i>	VBT60-80	<i>p</i>	PSF60-80
Revised patients, n (%)	6 (16.7%)	0.384	9 (25%)	0.006*	1 (2.8%)
Tether Release or Removal, n (%)	1 (2.8%)	0.357	4 (11.1%)		
Re-tethering, n (%)	1 (2.8%)	0.614	3 (8.3%)		
Conversion to Fusion, n (%)	5 (13.9%)	0.710	3 (8.3%)		

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## **ARTIFICIAL INTELLIGENCE CAN ACCURATELY AND RELIABLY DETECT TRAUMATIC THORACOLUMBAR FRACTURES ON SAGITTAL RADIOGRAPHS**

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**Introduction.** Traumatic thoracolumbar fractures are frequently encountered in Emergency Rooms and their correct identification is mandatory for appropriate treatment. Conversely, their detection is challenging on planar radiographs, resulting in significant rates of missed diagnoses (30%), and thus second-level diagnostic imaging (CT and MRI) is usually required. However, CT and MRI are time and resource consuming, and not always readily available. Thus, the ability of reliably detecting fractures in simple radiographic projections would have a significant impact on healthcare. Recently, Artificial Intelligence methods based on deep artificial neural networks have been applied in medical imaging and image processing with excellent results. Our hypothesis is that deep learning methods can be used to reliably and accurately detect thoracolumbar fractures in sagittal radiographs of the spine.

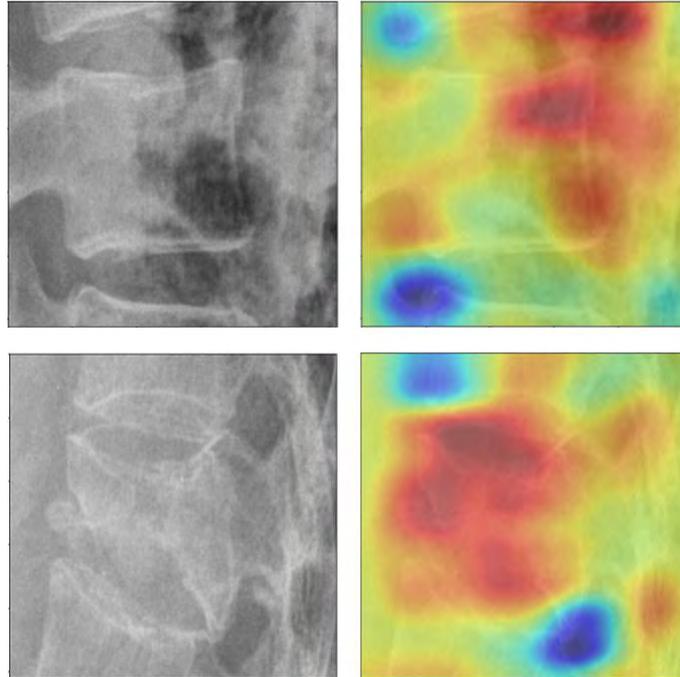
**Study design.** Retrospective data analysis.

**Methods.** We collected sagittal radiographs, CT and MRI scans of the thoracolumbar spine of 362 patients exhibiting traumatic vertebral fractures. Three expert spine surgeons labelled the dataset by drawing a Region of Interest (ROI) around each fractured and non-fractured vertebra on the sagittal X-rays, indicating the corresponding class (fracture/no-fracture), and using CT and MRI to confirm the presence of the fracture. From this dataset, 279 X-ray images of fractured vertebrae and 288 showing no fracture were annotated. The dataset was then used to train, validate and test two deep learning classifiers based on the ResNet and VGG architectures. Heatmaps indicating which parts of the images led the model to classify the vertebra as 'fracture' or 'no fracture' were calculated and then evaluated by the same three expert surgeons.

**Results.** Among the 52 images constituting the test set, accuracies of 88% and 84% were obtained with ResNet and VGG, respectively. Sensitivity was 89% with both architectures but ResNet had a significantly higher specificity of 88% compared to 79% of the VGG. Forty of the 52 heatmaps (77%) were judged to correctly indicate the fracture location. (See Figure).

**Conclusions.** The machine learning-based classifier proved to be able to detect thoracolumbar fractures on planar radiographs in a highly accurate and reliable manner. The use of deep learning could therefore enhance the detection of fractures on simple radiographic projections, providing benefits to settings in which tomographic images are not readily available such as emergency condition or developing countries and assisting the clinician in identifying patients in need of second-level imaging. Moreover, through the analysis of heatmaps, it was qualitatively verified that the model is in fact identifying the correct location of the fracture within the vertebral body.

**Figure caption.** Heatmaps for two representative fracture cases. The heatmaps correctly identified the zone where a fracture was actually present (red).



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