# EUROSPINE 2021 scientific programme
# Quick Fire presentations

Wednesday, 6 October 2021, 16:00–17:25

**Spinal degenerative disease & Craniocervical junction**

**QF1**

## MICRORNAS ASSOCIATED WITH TLR-2-INDUCED INFLAMMATION IN INTERVERTEBRAL DISC PATHOPHYSIOLOGY

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Background

Intervertebral disc (IVD) degeneration is a multifactorial pathological process involving the degradation of the extracellular matrix, inflammation, and cell loss due to apoptosis and senescence. Increased levels of inflammation are often accompanied by innervation, leading to the development of low back pain, which is the leading cause of disability worldwide. Toll-like receptors (TLRs) are known regulators of inflammation, amongst which TLR-2 has been shown to be specifically relevant in IVD degeneration. As strong post-transcriptional regulators, microRNAs (miRNAs) and their dysregulation has been connected to multiple pathologies, including degenerative diseases such as osteoarthritis and IVD degeneration.

Purpose of the study

However, the role of miRNAs in TLR signaling in the IVD is still poorly understood and was hence investigated in this study.

Materials and Methods

We activated the TLR 2 signaling pathway in human Nucleus pulposus (NP) and Annulus fibrosus (AF) cells (n=5) with a TLR-2/6 specific agonist (PAM2CSK4, 100 ng/mL for 6 hours), followed by (1) mRNA isolation and qPCR analysis of proinflammatory cytokines, and (2) miRNA isolation and next-generation sequencing. TLR-2 knockdown (siRNA) cells were used as a control. Statistical analysis was conducted by performing a two-tailed Student's t-test using GraphPad Prism version 9.0.2 for Windows (GraphPad Software, La Jolla California USA).

Results

TLR-2 activation resulted in the induction of an inflammatory cell response, with a significant increase of IL-6 (525 ± 180 fold change, $p < 0.05$) and IL-8 (7513 ± 1907 fold change, $p < 0.05$). TLR-2 activation was furthermore associated with changes in the miRNA profile of NP and AF cells. Specifically, we identified 10 differentially expressed miRNAs in response to TLR-2 activation, amongst which the most relevant are miR-355-3p (1.45 log2 FC, $p < 0.05$), miR-125b-1-3p (0.55 log2 FC, $p < 0.05$), and miR-181a-3p (-1.05 log2 FC, $p < 0.05$). These miRNAs are known to be associated with osteoarthritis (miR-355-3p), inflammation and IVD degeneration (mir-125-1-3p and miR-181a-3p), but the link to TLR signaling has not been previously reported. Experiments to validate the identified miRNAs by qPCR and to elucidate their functional role are undergoing.

Conclusion

The identification of these miRNAs provides an opportunity to further investigate miRNAs in the

context of TLR activation and inflammation and to enhance our understanding of underlying molecular mechanisms behind disc degeneration, inflammation, and TLR dysregulation.

Disclosures:
author 1: grants/research support=This research was funded by the Swiss National Science Foundation, grant number 310030_185240.;
author 2: none; author 3: grants/research support=SNF, consultant=Schoen Clinic,employee=RIT

QF2

# CERVICAL TOTAL DISC REPLACEMENT CAN RESTORE INTACT RANGE OF MOTION AND 3-D KINEMATICS

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## Introduction

In contrast to cervical discectomy and fusion, total disc replacement (TDR) aims at preserving the motion at the treated vertebral level. Spinal motion is commonly evaluated with the range of motion (ROM). However, more qualitative information about cervical kinematics before and after TDR is still lacking.
Therefore, the aim of this in vitro study was to investigate the influence of cervical TDR on ROM and three-dimensional helical axes.

## Methods

Six fresh frozen human cervical functional spinal units (FSUs) (C4-5, mean age 32 years, range 19-47 years) were biomechanically characterized in the intact state and after TDR. The tested implant is neither completely unconstrained nor constrained but rather a 'soft-constrained' artificial cervical disc. That means, it allows unconstrained motion around the neutral zone but also features a progressive increase of resistance. Additionally, to be able to test the prosthesis under in vivo conditions regarding temperature and abundant ambient water, hot water steam was used to create a warm and humid test environment with 37 °C.
Pure moment loading without preload has been shown to produce realistic cervical kinematics even in monosegmental specimens [1]. Thus, each FSU was quasistatically loaded with pure moments up to 2.5 Nm in flexion/extension (FE), right/left lateral bending (LB) and right/left axial rotation (AR) in a universal spine tester for 3.5 cycles at 1 °/s. Motion tracking was performed for each vertebral body individually. For each third cycle of motion the ROM was evaluated and an established method was used to determine the three-dimensional helical axes and to project them into planar X-rays [1].
Statistical analysis was performed using a Friedman-test and post hoc correction with Dunn-Bonferroni-tests ($p < 0.05$).

## Results

Normalizing the ROM after TDR of each specimen to its intact condition with steam revealed a 3 % ROM increase in FE and AR and a 16 % decrease in LB after TDR. No statistical differences between the intact ROM and ROM after TDR were observed.
The position as well as the orientation of the helical axes after TDR was in good agreement with the results of the intact specimens in all three motion directions (Fig. 1).

## Discussion

The results of this in vitro study indicate that the ROM of the intact cervical spine can be restored with cervical TDR. Additional to the widely used parameter ROM, also the three-dimensional motion pattern was investigated. The kinematics after cervical TDR are in good agreement with the kinematics of the intact specimens under in vitro conditions. This intact kinematics also closely match in vivo data.
From these results it can be concluded that this tested soft-constrained artificial cervical disc may replicate the quantity as well as the quality of motion of the intact cervical spine under in vitro conditions.

References
1. Jonas et al, Spine J, 18(3):515-524, 2018.
2. Anderst et al, J Biomech, 48(7):1286-1293, 2015.

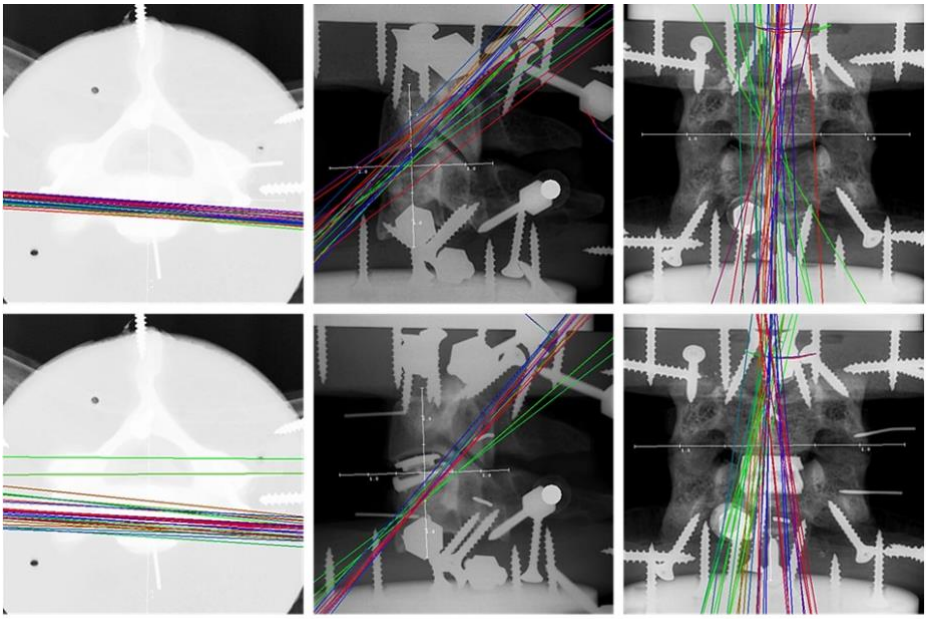

Figure 1: Helical axes in FE (left), LB (middle) and AR (right) of one intact specimen (top) and the same specimen after TDR (bottom).

Disclosures:
author 1: grants/research support=NGMedical GmbH, Nonnweiler, Germany; author 2: none; author 3: none; author 4: grants/research support=NGMedical, Zygofix, SpineWelding

QF3

# 10 YEAR RADIOLOGICAL FOLLOW-UP EVALUATING ROLE OF SYNTHETIC OSTEOCONDUCTIVE BONE SUBSTITUTE TO AUGMENT OCCIPITO-CERVICAL INSTRUMENTATION IN CHILDREN

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Background

Children undergoing occipito-cervical fixation (OCF), particularly the very young and those with bone dysplasia, autologous bone graft (iliac crest or rib) maybe immature or of poor quality. Furthermore, bone graft donor site morbidity including pain and local wound related complications occurs in up to 73 percent of cases. Bone substitutes offer an alternative means of augmenting fixation but their use in a large cohort of children has not been reported.

Objectives

To evaluate the efficacy of bone substitutes in children undergoing instrumented OCF. The primary outcome measure was radiological evidence of stability at last follow up.

Study Design & Methods

A single institute retrospective case review was performed of children undergoing instrumented occipito-cervical fixation with or without decompression. Age at surgery, underlying diagnosis and indication for fixation was recorded. Occipito-cervical instability due to trauma and children over the age of 16 years at the time of surgery were excluded. Last available radiographs were assessed for evidence of stability and bone formation.

Results

118 children (mean age 8.23 years) operated between 1993 and 2017 satisfied the inclusion criteria. Underlying diagnoses comprised of Downs syndrome (n=21), Morquio syndrome (n=11), Achondroplasia (n=20) among others. Mean follow up was 11.6 years (range 1-24y). 6 out of 118 patients died during follow up for reasons unrelated to the surgical procedure. Occipital plate, rod and screw constructs were used in all. Extent of fixation was O-C2 (n=99), O-C3 (n=08), O-C4 (n=11). Bone substitutes were used in all patients at the time of fixation. Overall complication rate was 10 percent with a revision rate of 2.5 percent and fusion rate of 100 percent.

Conclusions

Osteoconductive bone substitutes can be safely use to augment OCF procedures in the paediatric population. Rates of successful fusion and wound related complications are comparable to contemporary series using autologous bone graft.

Keywords: Bone Substitute, Occipito-Cervical, Fusion, Children

Disclosures:
author 1: none; author 2: none; author 3: no indication; author 4: no indication

QF4

# IS THE TECHNIQUE MEASURING THE C2-MANDIBLE ANGLE FOR PHYSIOLOGIC ALIGNMENT EFFECTIVE IN PATIENTS WITH CRANIOCERVICAL DISSOCIATIONS UNDERGOING OCCIPITAL-CERVICAL FUSIONS?

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The C2-Mandible Angle (C2-M) is a described radiographic tool that reliably estimates neutral craniocervical alignment in patients without any pathology and has been shown to be reproducible and equivalent to the occipitocervical angle (OCCa). The authors have utilized this technique to try to make the posterior mandible- anterior C2 body angle (PM/AB) parallel ($0^o$) intra-operatively, yet this has not been scientifically evaluated.
Purpose: To assess the reliability and accuracy of the C2-M in reproducing neutral Craniocervical alignment in patients with Craniocervical Dissociations (CCD) who underwent surgical fixation.
Methods: Retrospective radiographic assessment of 68 consecutive adult patients with a diagnosis of CCD who underwent surgical treatment at a level 1 trauma center between 2003 and 2018 with intra-op and/or post-op neutral radiographs. All patients were identified from a prospectively collected trauma database. Inclusion criteria: intraoperative lateral cervical fluoroscopic xray and/or a postoperative lateral cervical xray in the upright position. One spine orthopaedic spine surgeon and a spine fellow independently obtained measurements of the C2-M angle in a blinded manner. Demographics and outcomes were collected from EMR.
Results: 68 consecutive patients (44 male, mean age 34.8 years) underwent Occipital-Cervical instrumented fusion with a minimum of occiput to C2 instrumentation for management of CCD. 67 had saved intra-op fluoroscopy films and 61 had saved post-operative, upright, lateral radiographs for evaluation. The mean AB/PM was $-1.0^o$ (SD of $8.4^o$) based on intra-operative fluoroscopy. Assessing post-op radiographs, the mean AB/PM was $-1.7^o$ (SD of $7.8^o$). Comparing change in angulation between intra-operative to post-operative imaging, the mean difference was $3.2^o$ (SD $2.2^o$). 5.8% of the patients were outside the range of $-17^o$ to $10.7^o$ which were the minimum and maximum values of „normal“ as previously defined. Assessing intra-op measurements, 39% of the patients were within +/-$5^o$; 63% within +/- $7.5^o$; and 78% within +/- $10^o$. Assessing post-op lateral films, 35% of the patients were within +/- $5^o$; 68% within +/- $7.5^o$; and 84% within +/- $10^o$. Using the mean value of $-4.2^o$ as previously described in „normal“ individuals without fusion, 40% were within +/- $5^o$; 60% within +/- $7.5^o$; and 75% within+/- $10^o$. Using the $-4.2^o$ on the 61 post-op lateral films, 49% were within +/- $5^o$; 64% within +/- $7.5^o$; and 80% within +/-$10^o$.
Conclusion: The C2-M (PM/AB) angle is an adequate and reliable means of estimating neutral CC alignment in patients with CCD undergoing surgical fixation. A mean of $3.2^o$ differences was measured between intra-operative and post-operative radiographs.

| **C2M angle** | **+/- $5^o$** n (%) | **+/- $7.5^o$** n (%) | **+/- $10^o$** n (%) |
|---|---|---|---|
| **Intra-op $0^o$ (n = 67)** | 26 (38.8) | 42 (62.6) | 52 (77.6) |
| **Post-op $0^o$ (n = 61)** | 21 (34.4) | 41 (67.2) | 51 (83.6) |
| **Intra-op $-4.2^o$ (n = 67)** | 27 (40.2) | 40 (59.7) | 50 (74.6) |
| **Post-op – $4.2^o$ (n = 61)** | 30 (49.1) | 39 (63.9) | 49 (80.3) |

**Table 1.** Summarizes the findings for intra-operative and post-operative films in the measurement of C2M angle using $0^o$ and $-4.2^o$ baseline values within +/- $5^o$, +/- $7.5^o$, and +/- $10^o$.

Disclosures:
author 1: other financial report=Globus; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none

QF5

# ACDF WITH ULTRA-LOW DOSE BMP-2 VERSUS POSTERIOR APPROACH IN MULTILEVEL FUSIONS TO THE CERVICO-THORACIC JUNCTION

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Introduction: The cervicothoracic junction (CTJ) is a critical surgical landmark, acting as a mechanical transition point between the cervical and thoracic spine. Multilevel surgery in this region is subject to a number of potential sequelae, including adjacent segment disease (ASD), pseudarthrosis, and sagittal malalignment. Surgical approach and length of construct can impact the rate of complications, revisions and clinical outcomes; however, there is a paucity of reports comparing the anterior approach with posterior cervical fusion (PCF) and inclusion of the CTJ. Therefore, the purpose of this study was to compare the clinical and radiographic outcomes in multilevel cervical fusion with respect to the approach and inclusion of the CTJ.

Methods: Between 2005 and 2013, 155 patients with at least 5 years of follow-up underwent multilevel fusion to the CTJ. Patients were divided into three groups: 1) ACDF to C7, 2) PCF to C7, and 3) PCF to T1/T2. Patients with complete records were included in outcome analysis, and patients with complete preoperative, early (<1 mo postop), and late (>2 yr) films were included in radiographic analysis. Standard binomial and categorical comparative analyses were performed.

Results: 155 patients were included in the final outcome analysis. Overall reoperation rates were 1) 14.5%, 2) 8.3%, 3) 10.0% (p=0.588), respectively. The rate of pseudarthrosis was 7.2% in Group 1, 2.8% in Group 2 and 6% in Group 3 (p=0.869). ASD was seen in 2.9% of patients in Group 1, 2.8% of patients in Group 2 and 2% of patients in Group 3 (p=0.951). Group 1 had 4 revisions due to neuroforaminal stenosis, 2 revisions due to persistent radicular pain, 2 hardware removal operations due to dysphagia, 1 revision due to pseudarthrosis and 1 revision due to ASD. Group 2 had 3 revisions total, one due to ASD, another due to pseudarthrosis and one due to hardware failure. Group 3 had 4 total revisions. Three due to pseudarthrosis, 1 due to ASD and one due to persistent radicular pain. Radiographic analysis showed a statistically significant difference (p=<0.001) in both mean early and late restoration of lordosis between the ACDF group (-7.0° and -8.0°) and the PCF groups (C7: +8.3° and +6.6°; T1/T2: +6.6° and +5.5°).

Conclusion: Clinically relevant complication rates leading to reoperation for long cervical fusions were less than anticipated in all groups. Anterior procedures underwent a higher rate of revision but had better restoration of lordosis and pain scores at 5 years. Stopping at or crossing the CTJ did not result in better overall clinical outcomes.

Disclosures:
author 1: no indication; author 2: none; author 3: none; author 4: none; author 5: no indication; author 6: consultant=Stryker Spine; author 7: consultant=Stryker Spine; author 8: grants/research support=NuVasive

QF6

# THE EFFECT OF DISCECTOMY ON FORAMINAL HEIGHT IN CERVICAL SURGERY

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Anterior cervical discectomy with fusion is the golden standard in the surgical treatment of cervical disc herniation. The additional implantation of an intervertebral device is expected to prevent recurrent nerve root compression following foraminal prolapse. Previous research showed that anterior cervical discectomy (ACD) resulted in comparable clinical outcome in comparison to anterior cervical discectomy and fusion (ACDF) or anterior cervical discectomy and arthroplasty (ACDA). The present study aimed to investigate foraminal height (FH) in patients with cervical disc herniation at baseline and one-year after surgery, comparing ACD, ACDF and ACDA patients subdivided in two groups based on baseline disc height.

We used data from two Dutch double-blind randomised controlled trials (NECK trial, n=112 and PROCON trial, n=132) which included patients aged 18-65 with one-level cervical disc herniation and one of the following treatments: ACD, ACDF and ACDA. Patients were subdivided in two groups based on baseline disc height. The cut-off for significant difference in disc height was determined through calculation of disc height at baseline measured on X-ray images. FH was measured on 3T MRI images at baseline and at one-year follow-up, using Sectra Medical.

The mean FH at index level of all patients at baseline was 9.9 ± 2.1 mm at the symptomatic side and 10.3 ± 1.8 mm (p=0.045) at the asymptomatic side. FH was equal in ACDF, ACDA and ACD groups at baseline (p=0.716).
The cut-off value for disc height was 5.2 mm. The mean FH at baseline in the group with low disc height (<5.2 mm) was lower (9.3 ± 2.2 mm) than the mean FH in the group with high disc height (>5.2 mm, 10.4±1.9 mm)(p=0.001).
At one-year follow-up, FH in the ACD group decreases, whereas FH in ACDF and ACDA groups increases. This decrease in ACD patients was not statistically significant (p=0.567) and independent of baseline disc height. At one-year follow-up there was no significant difference in FH between disc height groups (p=0.283). However, FH increases at one-year follow-up in ACDF patients with baseline disc height <5.2 mm (p=0.011).

Foraminal height is dependent on intervertebral disc height at baseline. After surgery, foraminal height increases especially in patients with low disc height at baseline, undergoing anterior cervical discectomy with additional implantation of an intervertebral cage (ACDF). This group is expected to benefit most from neurosurgical intervention.
Foraminal height decreases in patients undergoing ACD. This decrease is small and independent of baseline disc height. This small decrease does not lead to a difference in clinical outcome and its clinical relevance is thus debatable. Single level ACD without implanting an intervertebral device may therefore be a reasonable alternative to ACDF or ACDA. Future research should enclose the minimal difference in foraminal height required for clinical significance.

Disclosures:
author 1: none; author 2: none; author 3: no indication; author 4: grants/research support=Covidien sponsors a trial on legpumps in neurosurgical surgery. Ynske Meyes Fund and SAG fund sponsor a trial on epidural injections in sciatica. CSRS Europe sponsors the follow up of a trial on cervical disc prostheses. EANS sponsors a trial on disc inflammation. These are all investigator initiated trials. The payment is not made to my own account but to our research department. Board of CSRS Europe and Netherlands Neurosurgical Society (NVvN), Advisory Board for Rijndam Rehabilitation centre, faculty for EANS, CSRS, Eurospine and webinar for AO spine. Lecture for Nuvasive for Women in Spine.

QF7

# A MULTICENTRE PROSPECTIVE RANDOMIZED CONTROLLED TRIAL COMPARING EFFICACY AND SAFETY OF PRODISC-C TO ANTERIOR CERVICAL DISCECTOMY AND FUSION FOR TREATMENT OF SYMPTOMATIC CERVICAL DISC DISEASE

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Objectives:
The aim was to compare safety and efficacy of ProDisc-C, a cervical total disc replacement(TDR) device to anterior cervical discectomy and fusion(ACDF) in treating single-level symptomatic cervical disc disease(SCDD) in Asians. We hypothesized ProDisc-C to be non-inferior to ACDF with lower incidence of adjacent segment disease(ASD).

Methods:
This multicentre, prospective, randomized controlled trial was initiated in January-2008, after obtaining ethical approval at nine centres (China/Hong Kong/Korea/Singapore/Taiwan). Patients with single-level SCDD involving C3-C7-vertebral segments were enrolled and randomized in 2:1 ratio into: group A treated with ProDisc-C and group B with ACDF. A protocol modification(January-2010) allowed patients with cervical myelopathy also to be included. Assessments were conducted at baseline, 6-weeks, 3/6/12/18/24-months post-surgery and annually thereafter out to 84-months. Primary endpoint was overall success, the composite of:(1)improvement in neck disability index(NDI) by ≥20%;(2)maintained/improved neurologic parameters;(3)no implant removal/revision/re-operation at index-level;(4)no adverse/severe/life-threatening events. Secondary endpoints included:(1)incidence of ASD at 24-months;(2)individual endpoints of primary outcome;(3)outcomes of short-form survey(SF-36), visual analogue scale(VAS) score(neck/arm-pain intensity/frequency; patient' satisfaction);(4) radiological parameters [range of motion(ROM)].

Results:
Of 120 enrolled/treated patients (80 ProDisc-C, 40 ACDF), 76 with ProDisc-C and 37 with ACDF were treated as per protocol(PP). Overall success [PP, last observation carried forward(LOCF)] was 79% in group-A and 83.8% in group-B at 24-months(p=0.10). ProDisc-C demonstrated non-inferiority to ACDF at 18-months (81.6% versus 83.8%,p=0.0398) with borderline non-inferiority at 3-months (76.3% versus 78.4%,p=0.054). In intent-to-treat-LOCF analysis, overall success at 24-months was 78.2% with ProDisc-C and 81.6% with ACDF(p=0.06). ProDisc-C demonstrated non-inferiority to ACDF at both 3-months (75.6% versus 76.3%,p=0.0396) and 18-months (80.8% versus 81.6%,p=0.0284). Secondary outcomes improved after 24-months for both groups with no significant differences between groups for percentage change from baseline. Occurrence of ASD was higher in ACDF versus ProDisc-C, with no statistical significance. The ROM was sustained with ProDisc-C at 24-months. Whilst, loss of ROM was noted in group-B.

Conclusions:
Cervical TDR with ProDisc-C is feasible, safe, and effective for treatment of SCDD in Asians. ProDisc-C was non-inferior to ACDF at 3 and 18 months after index-surgery with no clear non-inferiority at 24-months. Patients treated with ProDisc-C demonstrated significant improvement in terms of NDI, neurologic success, VAS-pain scores, and SF-36, along with preservation of ROM at 24-months post-surgery. Incidence of ASD was comparable between the two groups at 24-months.

Disclosures:
author 1: grants/research support=Depuy Synthes; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none; author 7: grants/research support=AO synthesis

QF8

# ADJACENT SEGMENT DISEASE AFTER ANTERIOR CERVICAL DECOMPRESSION SURGERY FOR CERVICAL DEGENERATIVE DISC DISEASE: A SINGLE CENTER RETROSPECTIVE COHORT STUDY WITH LONG-TERM FOLLOW-UP

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Objectives: One of the most common surgical treatment options for patients with radiculopathy and/or myelopathy as a consequence of single- or multilevel cervical degenerative disc disease (CDDD) is anterior cervical discectomy with fusion (ACDF) or without (ACD). Both techniques show good short-term clinical results. Within 10 years subsequent to surgery, approximately 25% of patients develop adjacent segment disease (ASDis) and about two-thirds of these patients require additional surgery. The primary objective of this study was to determine the incidence of additional surgery due to ASDis after anterior cervical decompression surgery for radiculopathy and/or myelopathy as a consequence of CDDD. Secondary objectives were to asses risk factors for the development of ASDis and to determine long-term clinical outcomes.

Methods: This is a single-center, retrospective cohort study with long-term follow up. Chart review was performed to identify eligible patients. Patients were included if they underwent anterior decompression surgery for CDDD between January 2012 and December 2019. Patients were contacted between July and September 2020 to retrieve long-term follow-up data. Only adult patients with radiculopathy and/or myelopathy due to degenerative causes were included.

Results: A total of 673 patients were included, of which 530 (78.8%) patients were successfully contacted for long-term follow-up results. The average follow-up period was 4.4 years. Most patients underwent ACDF (95.4%). A total of 61 (9.1%) patients developed ASDis, of whom 44 (6.5%) required additional surgery. Half of these additional surgeries took place within 2.5 years. This represents an incidence of 23 per 1000 person years. A significantly higher risk on ASDis was seen in those that underwent ACD when compared to ACDF as initial surgery. Baseline degeneration at the index level and at the adjacent levels, measured with Kellgren Scores, was not significantly different between patients with and without ASDis. This argues against natural degeneration being the only significant factor in the development of ASDis.

Conclusion: A large cohort of 673 CDDD patients treated with anterior cervical decompression surgery is presented, in which 9.1% (N=61) of patients developed ASDis and 6.5% (N=44) required additional surgery due to ASDis with a mean follow-up time of 4.4 years.

Disclosures:
author 1: none; author 2: none; author 3: none; author 4: none; author 5: none; author 6: none

QF9

# SIMILAR EFFECTIVENESS OF LAMINECTOMY WITH FUSION AND LAMINECTOMY ALONE IN DEGENERATIVE CERVICAL MYELOPATHY

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Background

Optimal type of posterior surgery for degenerative cervical myelopathy remains to be identified. Our aim was to delineate the effectiveness of laminectomy with and without fusion in the cervical spine.

Methods
Prospectively collected data in the Swedish Spine registry was searched.
Individuals with degenerative cervical myelopathy treated with laminectomy with instrumented fusion (n=66) were age matched with individuals treated with laminectomy alone (n=132). Outcome measures such as the European Myelopathy Scale (EMS), the Neck Disability Index (NDI), the Numeric Rating Scale (NRS) for neck pain and the EQ-5D index were available at baseline, and at the 1 and 2 year follow-up. Analyses were performed with T-tests, Chi2 or Fisher tests. Effect sizes were determined with Cohen's D.

Results
In the whole cohort of 198 patients, myelopathy grading according to the European Myelopathy Scale (EMS) was as follows: severe in 9 individuals, moderate in 69 individuals, mild in 102 individuals, normal in 18 individuals, and with no difference in distribution between the treatment groups ($p=0.23$).

Baseline variables, including the patient reported outcome variables, did not differ between the groups with the exception of a longer laminectomy in the fusion group (spanning 4.2 vs 3.4 vertebraes; $p<0.001$). Both groups improved their EMS, NDI, NRS and EQ-5D from baseline to 1 year ($p<0.011$), but not between 1 and 2 years ($p>0.09$). Effect sizes for within group changes between baseline and 2 years were small to medium, ranging between -0.26 to -0.57. EMS, NDI, NRS and EQ-5D did not differ significantly ($p>0.08$) between the treatment groups at 2 years. There were no between group differences in effect size.

The number of laminectomies was not associated with any of the baseline variables (all $p>0.34$). During the first half of the time period a higher proportion of laminectomies with fusion was performed (47 out of 99 surgeries; 48%) compared to the second half (19 out of 99 surgeries; 19%), $p<0.001$, but preoperative patient characteristics and patient reported outcome did not change (all $p>0.09$).

Conclusion
Our data from a cohort of mostly mild and moderate degenerative cervical myelopathy suggests equal effectiveness of laminectomy with instrumented fusion and laminectomy alone. Additional effectiveness of decompression may not be expected beyond the first year.

Disclosures:
author 1: none; author 2: none; author 3: none

QF10

# THE ROLE OF SPECT/CT IN ANALYSING THE RADIOGRAPHIC PREVALENCE OF ASYMPTOMATIC DEGENERATIVE SPONDYLOSIS IN A CONSECUTIVE COHORT OF PATIENTS PRESENTING WITH CANCER

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Introduction

Degenerative spondylosis (DS) represents a challenging condition to diagnose and treat. The onset is often insidious but radiographic evidence does not necessarily equivocate to pain generators. The clinical picture could be further complicated by predisposing spine-related factors and underlying medical conditions accumulated over time.

There are multiple modalities to investigate DS including X-ray, MRI and CT, but symptoms may not be equivocal to DS to support the clinical findings. The investigation of metastases commonly utilises SPECT/CT for identification of areas of increased osteoblastic activity to denote disease. It is also utilised as a second line investigation of potential pain generators in the spine.

The aim of the study was to analyse the prevalence of asymptomatic DS in a consecutive hospital cohort of oncology patients who had SPECT/CT for investigation of metastases.

Methods

Oncology patients underwent SPECT/CT were analysed between 2015-2019.
Exclusion criteria: back pain, inflammatory disorders, metastases, trauma, infection. Radiology reports were examined for DS and anatomical distribution of tracer uptake.

Results

A total of 1182 patients had a Whole-Body SPECT CT used for the spinal analysis. After exclusions (age >80 [n=260], non-cancer [n=318], back pain [n=72]), 522 reports with cancer were utilised. Mean age was 65 (4-80). Age and distribution of DS are given in the table.

Conclusion

The prevalence of radiological asymptomatic DS is prevalent in large proportions of patients without back pain, and its incidence increases with age.

Approximately 60% of 60 year old and 70% of 70 years old patients have asymptomatic DS in the lumbosarcal region.

We conclude that SPECT/CT will detect radiographic degenerative spondylosis in an asymptomatic hospital cohort and this prevalence increase with age. Therefore, this modality of imaging must be utilised with caution when investigating potential pain generators.

**Proportion of patients with DS by age.**

| | | Age Group | | | | | |
|---|---|---|---|---|---|---|---|
| | | ≤30 (n=0) | 31-40 (n=11) | 41-50 (n=39) | 51-60 (n=87) | 61-70 (n=178) | 71-80 (n=207) |
| Location of DS (%) | Cervical | | | 10% | 29% | 30% | 33% |
| | Thoracic | | 27% | 33% | 61% | 65% | 64% |
| | Lumbo-sacral | | 9% | 28% | 62% | 77% | 76% |
| | Sacro-iliac joint | | 9% | 10% | 15% | 16% | 4% |
| | Whole spine | | | 5% | 20% | 25% | 27% |

Disclosures:
author 1: none; author 2: none; author 3: none; author 4: consultant=,none; author 5: none; author 6: none; author 7: consultant=Stryker,Globus, ZImmer; author 8: none; author 9: consultant=Zimmer Biomet

QF11

# COMPARISON OF TITANIUM-INTERLAYER MEDIATED HYDROXYAPATITE COATED AND UNCOATED POLYETHERETHERKETONE CAGES IN TRANSFORAMINAL LUMBAR INTERBODY FUSION SURGERY

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Background: The biological variance of polyetheretherketone (PEEK) coated with titanium (Ti) and hydroxyapatite (HA) are still not clear. This study aims to compare the in vivo response of the Ti-interlayer mediated HA coated and uncoated PEEK cages after transforaminal lumbar interbody fusion surgery (TLIF) in patients with single-level lumbar degenerative disease.
Methods: A prospective and non-randomized study was conducted to compare the clinical and radiological outcomes of the Ti-interlayer mediated HA coated (PEEK/Ti/HA group) and uncoated PEEK cages (PEEK group). Postoperative follow-up time of all patients was more than 2 years. Radiological assessments included disc height (DH), regional lordosis (RL), and fusion rate. Clinical parameters included Visual Analogue Scale (VAS) and Japanese Orthopedic Association (JOA) scores.
Results: Sixty-four patients (PEEK/Ti/HA group: PEEK group = 32: 32) were enrolled. The RL and DH were comparable between the two groups before and after surgery and both of them were restored postoperatively. The PEEK/Ti/HA group had a significantly higher fusion rate than the PEEK group at 3-month post-operation (93.7 % vs. 75.0 %). However, the fusion rate of the both groups was the same at the last follow-up (100%). There were no significant between-group differences with respect to the VAS and JOA scores.
Conclusions: Compared with uncoated PEEK cage, Ti and HA coating provided a higher fusion rate in patients with single-level TLIF surgery at 3-month post-operation. At the last follow-up, patients with the two cages could achieve solid osseous fusion. There was no significant difference in terms of RL, DH, and clinical outcomes (JOA and VAS score) between the PEEK/Ti/HA group and PEEK group preoperatively, at 3-month and last follow-up.

Disclosures:
author 1: none; author 2: none; author 3: none; author 4: none

QF12

# EARLY FAILURE OF DYNAMIC TOPPING-OFF CONSTRUCTS IN LUMBAR DEGENERATIVE DISEASE

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Introduction. Dynamic topping-off systems have been developed to provide semi-rigid stability. They are designed to allow guided segmental motion cranially to the fused segments and thus to reduce the development of adjacent segment pathologies (ASP). However, the benefits of dynamic topping-off systems to prevent ASP are discussed controversially in the literature. The aim of this study was 1) to determine the rate of failure related to the dynamically stabilized segment requiring revision surgery, and 2) to identify risk factors correlating with failure of dynamic lumbar implants.
Methods. We retrospectively analyzed 43 patients (67 ± 9.7 [44 - 86] years; 58% male) suffering from degenerative lumbar disease who received a posterior long segment (≥ 3 segments) stabilization of the lumbar spine (L1 - S1/ilium) with an additional dynamic topping-off (Hybrid Performance System) between 2014 - 2017. Mean follow-up time was 1.2 ± 0.7 [0.5 - 3] years. All patients were followed-up clinically and radiographically. In case of construct failure requiring revisions sugery, the mode of failure and the interval between the index and revision surgery was identified. Logistic regression was performed to assess risk factors for failure (age, gender, osteoporosis, pelvic incidence (PI), lumbar lordosis (LL), spinopelvic mismatch (PI minus LL).
Results. Of all included 43 patients, five patients (12%) required revision surgery related to failure of the dynamically stabilized segment. The mean time to failure was 1.1 ± 0.4 [0.5 - 2] years. The modes of failure included adjacent segment disease (3 patients), screw-loosening (1 patient), and adjacent fracture (1 patient). None of the listed factors increased the risk for failure.
Conclusion. This study reveals a 12% failure rate related to the dynamically stabilized segment at short-term follow-up. Based on these findings, the benefits of constructs with a dynamic topping-off in terms of preventing ASP can be questioned. However, future studies including
larger patient numbers, a control group, and longer follow-up periods are required to confirm or rule out these findings.

Disclosures:
author 1: none; author 2: none; author 3: no indication; ; author 4: none; author 5: no indication

QF13

# ISTHMIC SPONDYLOLISTHESIS IS ASSOCIATED WITH LESS REVISIONS FOR ADJACENT SEGMENT DISEASE AFTER LUMBAR SPINE FUSION THAN DEGENERATIVE SPINAL CONDITIONS - A 10-YEAR FOLLOW-UP STUDY

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Background
Adjacent segment disease (ASD) is a major reason for late reoperations after lumbar spine fusion (LSF) surgery. Several risk factors are linked to the progression of ASD, but the understanding of the underlying mechanisms is imperfect. If isthmic spondylolisthesis is infrequently complicated with ASD, contrary to degenerative spinal disorders, it would emphasize the role of the ongoing degenerative process in spine in the development of ASD.

Methods
This is a prospective follow-up (average 9.7 years) of 365 consecutive patients that underwent elective LSF surgery at a single university clinic. Primary indications for surgery were classified into 1) isthmic spondylolisthesis, 2) degenerative disorders (spinal stenosis with or without spondylolisthesis), and 3) other reasons (deformities, postoperative conditions after decompression surgery, posttraumatic conditions). All spinal reoperations were collected from hospital records. Rates of revisions for ASD were determined using Kaplan-Meier methods.

Results
Altogether, 65 (17.8%) patients were reoperated for ASD. In patients with isthmic spondylolisthesis (n=64), the incidence of revisions for ASD was 4.8% (95% CI: 14.0 to 22.1%). In patients with degenerative spinal disorders (n=222) it was 20.5% (95% CI: 15.6 to 26.7%) and in the third group (n=79) it was 20.6% (12.9 to 31.9%). After adjusting the groups by age, sex, fusion length, and the level of the lower end of fusion, when comparing with isthmic spondylolisthesis group, the other groups had significantly higher hazard ratios (HR) for the revision for ASD [the degenerative group: HR (95% CI) 3.92 (1.10 to 13.96), p=0.035], [the third group: HR (95% CI) of 4.27 (1.11 to 15.54), p=0.036].

Conclusions
With isthmic spondylolisthesis, the incidence of revisions for ASD is less than a 4th of that with degenerative spinal disorders. Efforts to prevent the acceleration of the degenerative process at the adjacent level of fusion are the most important with degenerative spinal disorders.

Disclosures:
author 1: grants/research support=This study was funded by the Competitive State Financing of the Expert Responsibility Area of Tampere University Hospital.; author 2: no indication; author 3: none; author 4: none

QF14

# POSTOPERATIVE ADVERSE EVENTS SECONDARY TO IATROGENIC VASCULAR INJURY DURING ANTERIOR LUMBAR SPINAL SURGERY

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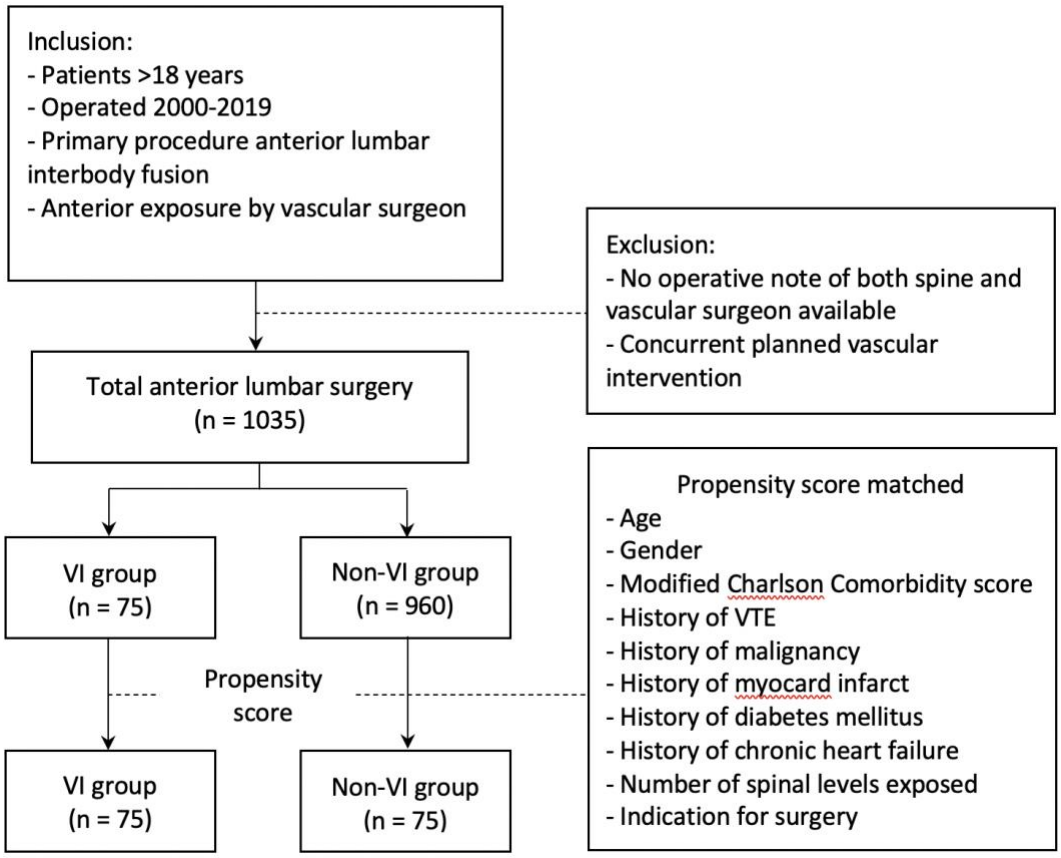
BACKGROUND: Anterior lumbar spine surgery (ALSS) requires mobilization of the great vessels, resulting in a high risk of iatrogenic vascular injury (VI). It remains unclear whether VI is associated with increased risk of postoperative complications and other related adverse outcomes.
PURPOSE: The purpose of this study was to (1) assess the incidence of postoperative complications attributable to VI during ALSS, and (2) outcomes secondary to VI such as procedural blood loss, transfusion of blood products, length of stay (LOS), and in hospital mortality.
STUDY DESIGN: Retrospective propensity-score matched, case-control study at 2 academic and 3 community medical centers,
PATIENT SAMPLE: Patients 18 years of age or older, undergoing ALSS between January 1st, 2000 and July 31st, 2019 were included in this analysis.
OUTCOME MEASURES: The primary outcome was the incidence of postoperative complications attributable to VI, such as venous thromboembolism, compartment syndrome, transfusion reaction, limb ischemia, and reoperations. The secondary outcomes included estimated operative blood loss (milliliter), transfused blood products, LOS (days), and in-hospital mortality.
METHODS: In total, 1,035 patients were identified, of which 75 (7.2%) had a VI. For comparative analyses, the 75 VI patients were paired with 75 comparable non-VI patients by propensity-score matching. The adequacy of the matching was assessed by testing the standardized mean differences (SMD) between VI and non-VI group (>0.25 SMD).
RESULTS: Two patients (2.7%) had VI-related postoperative complications in the studied period, which consisted of two deep venous thromboembolisms (DVTs) occurring on day 3 and 7 postoperatively. Both DVTs were located in the distal left common iliac vein (CIV). The VI these patients suffered were to the distal inferior vena cava and the left CIV, respectively. Both patients did not develop additional complications in consequence of their DVTs, however, did require systemic anticoagulation and placement of an inferior vena cava filter. There was no statistical difference with the non-VI group where no instances (0%) of postoperative complications were reported (p=.157). No differences were found in LOS or in hospital mortality between the two groups (p=.157 and p=.999, respectively). Intraoperative blood loss and blood transfusion were both found to be higher in the VI group in comparison to the non-VI group (650 mL, interquartile range [IQR] 300−1400 vs. 150 mL, IQR 50−425, p≤.001; 0 units, IQR 0−3 vs. 0 units, IQR 0−1, p=.012, respectively).
CONCLUSION: This study found a low number of serious postoperative complications related to VI in ALSS. In addition, these complications were not significantly different between the VI and matched non-VI ALSS cohort. Although not significant, the found DVT incidence of 2.7% after VI in ALSS warrants vigilance and preventive measures during the postoperative course of these patients.




Disclosures:
author 1: none; author 2: none; author 3: none; author 4: stock/shareholder=SentryX

QF15

# THE CLINICAL SIGNIFICANCE AND INTER-OBSERVER RELIABILITY OF THE MODIC CHANGES GRADING SCORE

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Study design: A register-based study including an intra- and inter-reliability assessment of the Modic change(s) (MC) grading score

Objective: To evaluate the clinical significance and inter-observer reliability of the MC grading score in patients with low back pain and MC.

Summary of background data: MC is present in up to 50% of all chronic low back pain patients. MRI finding of MC is associated with low back pain and disability. However, previous studies have shown heterogeneous results regarding the association and the clinical relevance of MC. A grading score for MC has been previously proposed, but the association between the extent of MC involvement in the vertebral body, or MC grade and patient-reported outcomes (PRO) has not been investigated.

Method: MRI-scans from patients who had a discectomy registered in the Danish national spine register, DaneSpine, were reviewed. Based on the MRI findings the patients were divided into two groups: +MC and -MC. The MRI of patients +MC were graded using the MC grading score from A-C where grade A in the midsagittal vertebral plane affects less than 25% of the vertebral height grade B between 25% and 50% and grade C more than 50%. All MRIs were reviewed by two physicians to evaluate the intra- and inter-reliability of the MC grading score. The association between MC grade and disability as measured by ODI and EQ-5D were analyzed by t-test.

Results: In total 300 patients were included, of these 150 had MC- 73 patients with MC-1 and 77 patients with MC-2. Of the +MC group, 34% had Grade A changes, 45% Grade B, and 21% Grade C. A scatter-plot showed that some patients with Grade B had worse PROs than some patients with grade C. Thus, patients were stratified into Grade A vs Grade B-C. A statistically significant higher percentage of patients with MC-1 had grade B-C changes compared to patients with MC-2 ($p<0.001$). Grade B-C changes were significantly associated with a worse preoperative ODI-score, 44 vs. 52 ($p=0.02$) and EQ-5D 0.46 vs. 0.26 ($p=0.05$) compared to Grade A. The intra- and inter-reliability of the MC grading score demonstrated substantial reliability, Intra Kappa=0.73, and Inter Kappa=0.64.

Conclusion: The current study found a significant difference in the vertical extent of MC between MC-1 and MC-2. An increased vertical extent of the intervertebral MC was significantly associated with worse preoperative PROs. The reliability for the grading score was substantial for both intra- and interobserver reliability in a clinically relevant population. We suggest that further studies on degenerative spine changes include a description of the vertebral extent of MC as an MC grading score.

Disclosures:
author 1: none; author 2: none; author 3: consultant=National Spine Health Foundation,employee=Norton Healthcare, University of Southern Denmark

QF16

# ANTEROLATERAL VERSUS POSTERIOR MINIMALLY INVASIVE INTERBODY FUSION FOR PATIENTS WITH SPONDYLOLISTHESIS: 12 MONTHS FOLLOW-UP

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Background/ introduction:
The rationale for choosing an anterolateral or posterior minimally invasive (MI) lumbar interbody fusion (LIF) approach, varies from surgeon to surgeon. It is not well documented whether the choice of MI LIF approach in degenerative spondylolisthesis (DS) patients has an impact on the mid-term patient reported outcomes (PROM)and fusion rate results.
Purpose of the study:
Patients with DS receiving an anterolateral or posterior MI LIF improved by an equal amount at 3-month post-surgery on measures of disability and quality of life. This study reports on the fusion rates and PROMs for both approaches at 1-year post-surgery.
Materials and Methods:
Patients with DS (n=231) indicated for one- or two-level MI LIF were consecutively enrolled in a multi-center prospective clinical study (NCT02617563) across Europe, Latin America, and Asia. Each surgeon determined if their patient(s) would receive either an anterolateral or posterior approach. Fusion status at 1-year (± 6-months) was assessed by the surgeon or radiologist using CT or radiography. The criterion for fusion when assessed by CT-scan was bony bridging. When assessed using radiography the criteria were bony bridging, no motion (<4°) in flexion/extension views and integrity of instrumentation. PROMS assessed at baseline and 1-year post-surgery included: disability (ODI), back and leg pain (VAS) and quality of life (EQ-5D). Paired sample t-tests and ANCOVA were used to test for improvements from baseline and group differences.
Results
One-year post-surgery, patients demonstrated statistically significant and clinically important improvements from baseline on ODI, VAS, and EQ-5D scores. Patients who received posterior compared to anterolateral MI LIF demonstrated greater improvement on disability (p=.028) and quality of life (p <.001). For back and leg pain, and fusion rate there was no difference in outcomes between groups. The level of improvement on all PROMS remained stable from 3-months to 1-year follow-up.
Up to 18 months post-surgery, 6 MI-LIF procedure-related (3 anterolateral; 3 posterior) and 6 device related serious adverse events (4 anterolateral; 2 posterior) were recorded.

Conclusion
DS patients treated with either an anterolateral or posterior approach for MI LIF demonstrated substantial improvement in quality of life, alleviation of disability, back and leg pain, good rates of fusion and a good safety profile 1-year post-surgery. The statistically significant differences between groups in ODI ad EQ-5D scores might be explained by patients in the posterior group deriving greater benefit from direct lumbar stenosis decompression compared to that achieved from anterior indirect decompression. It remains to be seen if this trend continues to develop at future, annual, follow-up timepoints.

Disclosures:
author 1: grants/research support=Stryker, Clariance, Medtronic, Philips, consultant=Stryker, Clariance, Philips; author 2: consultant=Medtronic; author 3: none; author 4: grants/research support=medtronic ; author 5: consultant=; author 6: grants/research support=Medtronic; author 7: consultant=Medtronic; author 8: grants/research support=Medtronic; Zimmer, Geistlich, Baxter, consultant=medtronic, Zimmer, Paradigm spine, Eos Imaging, Medacta, OHST, royalties=Medacta, OHST, Medtronic; author 9: consultant=Depuy Synthes, Globus Medical, Stryker, Spine Art; author 10: consultant=medicrea-medtronic-stryker,other financial report=medicrea; author 11: none; author 12: grants/research support=Medtronic ; author 13: none; author 14: grants/research support=Medtronic, consultant=Medtronic; author 15: grants/research support=Medtronic