LENGTH OF STAY, READMISSION AND MORTALITY AFTER PRIMARY SURGERY FOR PEDIATRIC SPINAL DEFORMITIES: A 10-YEAR NATIONWIDE COHORT STUDY

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Introduction
Extended LOS (extLOS) and unplanned readmissions are a considerable challenge for the patient, costly for society and possibly preventable. Therefore, it is important to identify potential risk factors for extLOS and readmission.

Purpose
A description of postoperative morbidity and identification of risk factors for extLOS and readmission after primary pediatric deformity surgery in a nationwide cohort.

Methods
All patients ≤ 21 years of age undergoing spine deformity surgery in Denmark in 2006-2015 were identified by procedure and diagnosis code in the Danish National Patient Registry (DNPR). From DNPR, data on LOS, readmissions within 90 days and mortality were retrieved. Patients were categorized in six groups according to etiology. Medical records were reviewed for reason for extLOS (LOS >75th percentile according to etiology) and discharge summaries were scrutinized for reason for readmission within 90 days of surgery.

Results
For the 1322 patients, the median LOS was 8 days (IQR: 7-9). Patients were categorized according to etiology; idiopathic scoliosis (n=700), congenital scoliosis (n=113), neuromuscular scoliosis (n=287), syndromic scoliosis (n=60), spondylolisthesis (n=100), and Scheuermann kyphosis (n=62). A total of 274 (21%) patients had extLOS. The most common reason for extLOS was pain/mobilization difficulties in the idiopathic (59%), congenital (32%), spondylolisthesis (35%) and Scheuermann kyphosis (91%) groups. Pulmonary complications were the primary reason for extLOS in the syndromic (23%) and neuromuscular groups (23%). The 90-day readmission rate was 5.6%; 66% of readmissions were ‘medically’ related, mainly infections unrelated to surgical site (20%); 34% of readmission were ‘surgically’ related and 14% of patients required revision surgery. Neuromuscular scoliosis, spondylolisthesis and Scheuermann kyphosis were independent risk factors for readmission (OR = 7.0, 95% CI 3.7-13.3, OR = 2.9, 95% CI 1.1-7.8 and 5.7, 95% CI 2.0-15.8). The 90-day mortality rate was 0.4%.

Conclusion
In this nationwide cohort, pain and mobilization were the overall most common reason for extLOS. The 90-day readmission rate was 5.6% and the most common reason was infection unrelated to the surgical site. Readmission after pediatric spine surgery was related to the etiology. Increased focus should be directed towards patients operated for neuromuscular scoliosis and Scheuermann kyphosis.

Disclosures:
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INTRODUCTION
Aim of the study was to evaluate the incidence of proximal junctional kyphosis (PJK) in a cohort of patients affected by adolescent idiopathic scoliosis (AIS) surgically treated by means of an instrumented fusion with "all screws" or "hybrid" technique. The incidence of surgical revision need was also reported.

MATERIALS AND METHODS
From October 2011 to January 2018, 146 patients (33M -113F), underwent posterior instrumented fusion. Inclusion criteria were AIS diagnosis, age 10-18 years, posterior approach only. Exclusion criteria were previous spinal surgery, congenital deformities, and selective fusion of lumbar or thoraco-lumbar spine. Patients were divided in 2 groups based on surgical technique: Group 1: 101 patients all-screws technique; Group 2: 45 patients treated with hybrid technique; pedicle screws and hooks in the proximal thoracic spine. Pre-operative, early post-operative and last follow-up full-length long cassette X-Rays were performed. Coronal Cobb angle of main and secondary curve, thoracic kyphosis (TK), proximal junctional angle (PJA) were recorded. PJK was defined as an increase of the PJA ≥10° comparing the pre-operative and post-operative X-Rays, according to the International Spine Study Group. The proximal junctional failure (PJF) was considered as the symptomatic form of PJK, requiring surgical revision.

RESULTS
Mean age was 14.5 years (10-18) and mean follow-up 3.7 years (2-9). Post-operative, Cobb angle of the main curve decreased from 62.7° to 24.9° in group 1 (60.3% of correction) and from 59.9° to 30.3° in group 2 (correction of 49.4%). TK in group 1 increased from 26.4° to 28.8° at the early post-operative, up to 31.2° at the last follow-up. TK remained stable in group 2 (22.4° pre-operatively, 22.2° early post-operatively, 24.8° at the last follow-up). The PJA in group 1 increased from pre-operative 8.6° to 9.9° and 12.7° at the post-operative and last follow-up, respectively. In group 2 the PJA decreased from pre-operative to early post-operative (from 7.3° to 5.7°) and increased at last follow-up (6.8°). Proximal Junctional disease was detected in 7 patients in group 1 (6.9%), in no patient in group 2. 5 patients developed PJK and 2 patients developed a PJF that required surgical revision.

CONCLUSIONS
Considering the data reported in the present study, the all-screws technique results in a better correction of the curve in coronal plane compared to hybrid technique. There were no significant differences in sagittal plane correction. However, the all-screws technique showed a greater incidence of proximal junctional disease; in most cases with mild clinical impact and few need for surgical revision.

Disclosures:
RESTORATION OF THORACIC KYPHOSIS AND HIGHER T1 SLOPE ANGLE IMPACTS CERVICAL ALIGNMENT AFTER POSTERIOR SPINAL FUSION IN HYPOKYPOTIC ADOLESCENT IDIOPATHIC SCOLIOSIS: A RETROSPECTIVE STUDY WITH MINIMUM FIVE-YEARS FOLLOW-UP

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Introduction: The aim of this study was to investigate the impact of thoracic kyphosis (TK) restoration on cervical alignment measurements and to find out which global sagittal parameters influence the cervical alignment in hypokyphotic patients who had treated with posterior spinal fusion and had a minimum of 5 years f/up.

Methods: 54 AIS patients (50f,4m) with thoracic hypokyphosis (<20°) with posterior spinal fusion with mean f/up was 10.3 (5-21) years. Preop and last f/up x-rays measures were: C2 slope, C0-C2, C2-7(CK), C2-T3, T1 slope angles, C2-C7SVA, TK, LL, SS, PI and PT. Two groups were compared with respect to their cervical and global alignment parameters group A with CK ≤ 0 and group B with CK > 0. Patients with and without Ponte osteotomies were compared based on TK and CK improvements. HRQoL score was assessed by SRS-22r. Mann-Whitney U test was used for statistical analyses.

Results: Group A had 22 patients with preop TK of 15° which improved to 34° at last f/up; the mean preop CK was 16.9° before surgery and -3° at f/up. Group B included 32 patients that had improved TK from 13.2° preop to 24.8° at f/up and CK 10.8° preop to 9.2° at f/up. The TK and T1 slope were higher in group A (p<0.05), but 2 groups had similar global and pelvic parameters (p>0.05). ROC analyses showed that a min. TK of 29.5° and T1 slope of 10,5° at last f/up was highly correlated with cervical lordosis restoration. 12 patients who had Ponte osteotomies had more restoration of TK than those without osteotomies (36° vs 31°), but there was no statistical difference in terms of TK and CK restoration. SRS22 scores were similar in both groups.

Conclusion: T1 slope >11° and TK > 30° provides kyphotic cervical alignment to lordotic. A low T1 slope is significantly associated with a higher risk of cervical kyphosis (p<0.05). Upper cervical spine parameters, global sagittal and pelvic parameters did not contribute for compensation of cervical alignment as T1 slope and TK restoration in 5 years f/up.

Disclosures:
Background/Introduction
Anterior vertebral body growth modulation (AVBGM) aims to treat skeletally immature patients with progressive idiopathic scoliosis (IS). Early results are promising, but tether failure is a concern.

Purpose of the study
We aim to evaluate post-op evolution in patients who have experienced tether failures compared with patients without other major complications. Our hypothesis was that patients with post-operative tether failure have similar outcomes compared with patients with no complications.

Materials and methods
A retrospective review of a prospectively maintained database of IS patients operated with AVBGM from 2013 to 2020 was performed. All patients having at least two year clinical follow-up were included. Patients with tether breakages and those without failures were analyzed. SRS-30 scores and radiological parameters were evaluated and compared using Wilcoxon Rank-sum test.

Results:
66 patients were identified: 21 patients with tether failures and 34 patients without complications were analyzed. Patients with complications other than tether breakage or having revision surgery were excluded (11). Average age for index surgery was 11.9 for both groups. Average time to tether breakage is 31.5 months and mean last follow-up was 42.8 months for breakage group. Pre-op SRS QoL were significantly different for function, satisfaction and total scores. The effect sizes were small to moderate for all SRS QoL components when comparing both groups at last follow-up. SRS scores for function decreased post-operatively for patients with failures compared to MCID and MDMD. Pre-op Cobb angle were similar between both groups (48 vs 50). Final Cobb angle were statistically significantly higher in the tether breakage group (29.6 vs 17.9). 2 of the 21 patients were awaiting fusion due to curve progression.

Conclusion:
Although QoL outcome scores for function were similar between groups, lower scores were reported for the tether failure group. Patients without failures may have greater satisfaction post-operatively. Progression of curves was noted in patients with tether failures and must be closely monitored.
INTRODUCTION: Vertebral body tethering as a growth modulating, motion preserving surgical option is gaining popularity to correct scoliosis in skeletally immature patients. Posterior Vertebral Tethering (PVT) might induce a growth arrest on posterior portion of vertebral growth plates by compression, while inducing growth on anterior portion of growth plates by distraction, resulting in correction of the kyphotic deformity. We aimed to show the safety and efficacy of PVT as a fusionless, growth friendly approach used for the first time in the literature in 4 skeletally immature patients with Scheuermann’s kyphosis (SK) by describing the surgical technique.

METHODS: Patients with a diagnosis of SK had a mean age of 13.75 years (range 13-15) with mean thoracic Cobb angles of 80.5° (range 79-83). An excruciating pain with failed conservative treatment of at least a year was noted. It was discussed with the patients and their families, that this was an off-label use of the device and may yield to additional future surgeries.

RESULTS: Wiltze approach was utilized and by using Zimmer Dynesys system. Pedicle screws of a diameter of 6.5mm were placed on either side at levels of T4-T6-T8-T10-T12. Tethering cord was then applied to screws. After sufficient tethering and achievement of correction, set screws were placed and secured on the tether at each level. A mean correction of 43.7° (range 42° -46° ) of kyphosis was detected immediately after surgery (mean pre-operative: 80.5° , Post-operative: 36.8° ). At the latest follow-up (1st post-
operative year), mean sagittal Cobb angle was measured as 33.75° (range 33°-35°).

DISCUSSION AND CONCLUSION: PVT was noted to induce a growth arrest on the posterior portion of vertebral growth plates by compression, while inducing growth on the anterior portion of the growth plates by distraction, resulting in the correction of the kyphotic deformity; and hereby leading to improvement of vertebral wedging associated with the pathogenesis of SK and kyphosis itself over time, resulting in a correct sagittal alignment without any disruption of coronal balance. For the first time in the literature, it was concluded, that PVT was able to correct the kyphotic deformity; and lead to improvement of vertebral wedging associated with the pathogenesis of SK and kyphosis itself over time.

Disclosures:

ACCURACY OF ROD CONTOURING TO DESIRED ANGLES WITH AND WITHOUT A TEMPLATE: IMPLICATIONS FOR ACHIEVING DESIRED SPINAL ALIGNMENT AND OUTCOMES

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BACKGROUND: When performing multilevel thoracolumbar instrumented fusion, achieving appropriate spinal alignment can have major implications on clinical outcomes and risk of adjacent segment disease, including proximal junctional kyphosis (PJK). Despite greater recognition of optimal alignment goals and preoperative planning, the techniques to help translate these objectives into practice in the operating room, including contouring of rods to
desired angles, remain limited.

PURPOSE: To assess whether rods contoured to specific angles with a French rod bender using a template guide will be more accurate than rods contoured without a template.

STUDY DESIGN/SETTING: Surgeons were asked to contour 125mm length 5.5mm diameter titanium alloy lumbar rods with a French rod bender to 40°, 60°, and 80° with and without a template. The resultant rod contour angles were evaluated for accuracy.

OUTCOME MEASURES: Rod contour angles compared between bending with and without a template

METHODS: 10 experienced spinal deformity surgeons were asked to contour 5.5mm diameter (125mm length) titanium alloy rods with a French rod bender to 40°, 60°, and 80°, with (T) and without (NT) a template (2 rods per angle, 120 rods total). A sagittal photo was taken of each contoured rod and imported into angle measurement software. The rod arc length (s) was measured, a best fit circle was overlaid to find the arc radius (r), then the arc angle (theta) was calculated (s = r *theta).

RESULTS: The rods contoured with a French rod bender to a template were more accurate than rods contoured without a template (See Figure). The 40° rod contour average angle for rods contoured with a template was 41.5 ± 2.5° and without a template was 60.2 ± 13.9° (p<0.001). The 60° rod contour average angle for rods contoured with a template was 59.1 ± 2.3° and without a template was 78.9 ± 12.8° (p<0.001). The 80° rod contour average angle for rods contoured with a template was 78.7 ± 2.7° and without a template was 97.5 ± 18.6° (p<0.001). There was a tendency to overbend when contouring without a template with the greatest overbend in the 40° contour angle. The average difference for the 40°, 60°, and 80° contour angle from the goal angle when contouring without a template was 20.2 ± 13.9°, 18.9 ± 12.8°, and 17.5 ± 18.6°, respectively.

CONCLUSIONS: There is a tendency for surgeons to overbend rods when contouring to a desired angle. This can have major implications for clinical outcomes and risk of adjacent segment disease, including PJK. Use of a template markedly improved accuracy of rod contouring, suggesting a potential technique to help achieve desired alignment based on pre-operative planning.

Disclosures:
ANALYSIS OF 85 ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENTS CORRECTED WITH PATIENT SPECIFIC RODS WITH A MINIMUM OF 1 YEAR FOLLOW-UP

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BACKGROUND:
Restoring a degree of kyphosis consistent with good sagittal alignment of the spine is a key concern when performing surgery to correct adolescent idiopathic scoliosis (AIS). The objective of this study was to assess the outcomes of posterior fusion for AIS using patient-specific rods that were pre-contoured based on pelvic incidence. The primary evaluation criterion was thoracic kyphosis at last follow-up.

PURPOSE:
The use of pre-bent patient-specific rods has a favorable effect on thoracic kyphosis at last follow-up.

METHODS:
A total of 85 patients with AIS, including 35 with hypokyphosis, managed with patient-specific rods were included in a prospective study. The rod contouring angles were based on predefined pelvic incidence criteria. T4-T12 kyphosis was assessed before surgery and at last follow-up, after 9-39 months (mean: 19 months). Student test was applied to compare means.

RESULTS:
At last follow-up, the mean increase in kyphosis was 12.3° (p< 0.0001, Student) and there is no significant difference between the planned and postoperative kyphosis (p=0.593, Student). Mean differences between kyphosis at preoperative visit and last follow-up were 19° in the subgroup with preoperative hypokyphosis (<20°) and 9.6° in the subgroup with primary normal kyphosis (p< 0.0001, Student). Mean difference between target kyphosis and postoperative kyphosis was 6° in the subgroup with preoperative hypokyphosis (hypercorrection, p=0.011). However, 91% of patients with preoperative hypokyphosis have a postoperative kyphosis between 20 and 40°. Clinically, patients improved their SRS score from 3.6 to 4.7 (p< 0.0001).
CONCLUSION:
With patient-specific rods, kyphosis at last follow-up was closed to the target value and clinical status was improved. Correction in hypokyphotic patients suggest over-contouring the rods for these patients.

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CORRECTION OF ADOLESCENT IDIOPATHIC SCOLIOSIS BY VERTEBRAL COPLANAR ALIGNMENT MANEUVERS. A 3-YEAR MULTICENTER EXPERIENCE
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Background/Introduction
Bilateral Vertebral Coplanar Alignment (BVCA) is a new concept in the surgical management of scoliosis. BVCA obtains three-dimensional multisegmental correction by performing both spine alignment and rod implantation in one single step.

Purpose of the study
The purpose of this work is to present the results of a multicenter study treating AIS patients by BVCA, and to give an overview of the fundamental principles of this innovative method for correction of idiopathic scoliosis. Restoration of thoracic kyphosis was particularly addressed.

Material and Methods
Review of a prospective multi-center study including 87 AIS patients (73 females and 14 males) who underwent surgical correction of the deformity using all-pedicle-screw constructs. The mean age of the patients was 15.4 ± 3.2. The study includes Lenke I, II, III and V curves. The BVCA reduction maneuvers were use in all cases. Briefly, BVCA includes the correction of the deformity while descending an implantable rod within slotted tubes attached to the convex side screws. Through this maneuver, all the pedicles on the convex side are aligned as a result of a frame formed by the slotted tubes and the rod, allowing a more harmonious derotation. Once completed the reduction maneuver, a similar procedure was performed on the concave side. This system permits a restoration of a physiologic kyphosis by spreading the distal ends of the tubes at the thoracic spine using different sized spacers. The correction was assessed at the immediate postoperative and 3-year follow-up on full-spine standing radiographs.

Results
Mean preoperative Cobb of the main thoracic curves was 56.5º ± 15.4º and was corrected to 18.9º ± 13.5º (70.1%). The average surgical time was 245 ± 65 min. The preoperative average apical vertebral rotation of 16.1º ± 6.6º and was corrected to 8.6º ± 6.0º (46.8%). Preoperative average thoracic kyphosis (T5-T12) improved after surgery from 21.1º ± 18.2º to 26.5º ± 9.9º. Patients with (-) sagittal modifier gained 18.7º Cobb on average; those with (+) modifier decreased 11.3, and patients with N sagittal modifier remained almost unchanged (3.5º).
After surgery there were no hypokyphotic patients, 93.4% were normokyphotic, and only 6.6% remained hyperkyphotic.

Conclusions
BVCA is an entirely new approach for surgical correction of idiopathic scoliosis, which allows a three-dimensional correction in a standardized fashion. Clinical results using BVCA have proven its ability to obtain good correction of the coronal curve, real apical derotation, and a relevant restoration of thoracic kyphosis.

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