EUROSPINE 2019 scientific programme quick fires

Friday, 18 September, 2019
14:00 – 15:20 **Growing Spine, Craniocervical Junction (all pathologies)**

QF91

CLINICAL, RADIOLOGICAL AND HRQOL OUTCOMES AFTER SELECTIVE THORACIC FUSION WITH MINIMUM 15 YEARS FOLLOW-UP

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Introduction:
The purpose of this study was to evaluate the minimum 15 year natural history of uninstrumented compensatory lumbar curves in patients who underwent posterior selective thoracic fusion, and measure the HRQoL scores beyond 15 years after surgery, while comparing them with an age, gender, and BMI matched population.
Methods:
Group A included 43 female AIS patients whom underwent selective thoracic fusion (STF) with mean age 33 (27-42) years, and a mean of follow-up of 18.7 (15-28) years, and mean BMI 22 (18-29). Preoperative, early postoperative, and follow-up x-rays were reviewed for the natural behavior of lumbar curves. Group B included randomly selected 43 female individuals with mean age 33 (27-41), and mean BMI 22 (17-33).The exclusion criteria for control group was knowledge of spinal deformity or spinal intervention. HRQoL scores (SRS-22, ODI, VAS) were compared between the two groups in latest f/up. The disc height, osteophyte formation, rotatory subluxation, and lateral spondylolisthesis were evaluated by using the latest x-rays between groups. Mann whitney-u test was used for the statistical assessment.
Results:
A posterior fusion was performed in all 43, with all pedicle screws used in 41 and all-hook constructs in 2 with fusion to T11 (4), T12 (25), or L1 (14). Main thoracic curve correction improved from pre-op to early post op and maintained at latest f/up (55,6°-16,1°-16,9°). Spontaneous lumbar curve correction was also maintained beyond 15 years (39,9°-16,6°-17,1°) Two pts (4,6%) with decompensation in early postop period improved and became compensated in latest f/up. No revisions or other spinal interventions were performed to Group A. Mean HRQoL scores, self image, and mental health scores were higher in group A than group B ($p<0.05$). SRS-22r pain, function, ODI and VAS scores, marital status, number of children were similar between the groups ($p>0,05$) . All disc heights except (T11-T12 and L5-S1) were significantly lower in group A ($p< 0,05$). There was no significant difference between the groups in terms of osteophyte formation, rotatory subluxation, and lateral spondylolisthesis in the latest x-rays.
Conclusion:
Despite disc height narrowing, uninstrumented lumbar curve in selective thoracic fusion maintains spontaneous curve correction and does not show any significant degenerative changes at an average 18 years. HRQoL scores suggested that the psychological and functional well-being were quite good in the long term in AIS patients who have undergone selective thoracic fusion when compared with an age - gender - BMI matched population.

Disclosures:
author 1: none; ; author 2: none; ; author 3: none; ; author 4: none; ; author 5: none; ; author 6: none; ; author 7: none; ; author 8: none; ; author 9: none; ; author 10: consultant: Medtronic

QF92

DO PATIENTS WITH ANTERIOR VERTEBRAL BODY GROWTH MODULATION HAVE A BETTER QUALITY OF LIFE THAN PATIENTS WITH A POSTERIOR SPINAL FUSION?

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Introduction
Anterior Vertebral Body Growth Modulation (AVBGM) aims to gradually correct scoliosis, using the patient's growth, while preserving spine motion.

Purpose of this study:
The objective was to compare patients with IS undergoing surgical correction with AVGBM for clinical and radiological outcome with a matched cohort of patients with PSF. Our hypothesis was that Patients with IS undergoing surgical correction with AVBGM have a better quality of life 2-year post-op compared to patients undergoing PSF.

Methods
We reviewed the clinical, perioperative and radiological prospectively collected data of the first 53 patients who received AVBGM at our institution. Each AVBGM patient was matched to a PSF patient based PreOp Cobb Angle, sex and Lenke class. Quality of life questionnaires (SRS-22 and SF-12) were collected. Preop and 2-year post-op data were compared and analyzed. Paired t-test of specific parameters and questionnaires scores were calculated on 49 patients with AVBGM that reached 2-year follow-up.

Results
Patients were paired with pre-op Cobb Angle (PSF 53.5°±8.2°, AVBGM 49.6°±8.7), Lenke type and sex. AVBGM cohort is younger (12.4±1.2 vs.13.9±2.4). Two-year post-op %correction showed similar rates for AVBGM vs. PSF (69% vs. 73.1%; p=0.342). Pre-op SRS-22 analysis (see table) demonstrated that AVBGM patients have less pain (p=0.03), a better self-image (p=0.005) and a better total score (p=0.019) compared to PSF patients. Pre-op SF-12 analysis demonstrated that AVBGM patients have better social functioning (p=0.023) compared to PSF patients. Post-op SRS-22 analysis demonstrated a trend that AVBGM patients score better in all domains (NS). Post-op SF-12 analysis demonstrated that AVBGM patients have better general health (p=0.025), social functioning (p=0.041) and role-emotional (p=0.05) compared to PSF patients. AVBGM and PSF patients reached the MCID for the self-image domain.

Conclusion
Although patients in the PSF group had slightly larger pre-operative curves, AVBGM patients show a better quality of life 2 years after the surgery while obtaining similar surgical correction rates. Their HRQoL are better before the surgery and this trend persists after surgery. When compared to a matched cohort of patients undergoing PSF, AVBGM patients demonstrated significant improvements in the general health, social functioning and role-emotional domains with similar surgical results.

Table. Descriptive Statistics on Individual Domain Scores

	Pre-Operative				Post-Operative			
	PSF	**AVBGM**			**PSF**	**AVBGM**		
SRS-30 Pain domain	3.8 ± 0.7	4.1 ± 0.6	p=0.03		4.3 ± 0.8	4.4 ± 0.5		
SRS-30 Mental Health	3.9 ± 0.6	4.1 ± 0.6			4.1 ± 0.8	4.3 ± 0.6		
SRS-30 Self-Image	3.2 ± 0.6	3.6 ± 0.7	p=0.005		4.1 ± 0.7	4.3 ± 0.6		
SRS-30 Activity	4.1 ± 0.5	4.2 ± 0.4			4.3 ± 0.4	4.4 ± 0.3		
SRS-30 Total Score	3.8 ± 0.5	4.0 ± 0.4	p=0.019		4.2 ± 0.6	4.4 ± 0.4		
SF-12 Physical functioning	74.0 ± 29.2	80.7 ± 23.2			82.9 ± 40.6	87.9 ± 26.0		
SF-12 Role-physical	75.3 ± 27.0	83.1 ± 22.6			84.3 ± 19.5	92.1 ± 11.0		
SF-12 Bodily Pain	60.9 ± 31.3	64.6 ± 24.1			79.3 ± 19.6	70.0 ± 24.1		
SF-12 General Health	78.3 ± 17.6	77.3 ± 24.0			75.7 ± 28.8	86.5 ± 14.4	p=0.025	
SF-12 Vitality	69.8 ± 21.2	72.9 ± 22.4			73.6 ± 21.8	80.0 ± 19.0		
SF-12 Social Functioning	78.7 ± 27.3	89.6 ± 18.5	p=0.023		81.6 ± 24.9	92.7 ± 13.1	p=0.041	
SF-12 Mental Health	66.2 ± 18.0	71.1 ± 18.8			68.9 ± 22.2	77.1 ± 18.6		
SF-12 Role-Emotional	82.6 ± 24.3	87.0 ± 20.1			85.0 ± 22.7	93.6 ± 11.9	p=0.05	

p paired T Test

Disclosures:
author 1: grants/research support: DePuy Synthes Spine, Medtronic, EOS-Imaging, Spinologics, K2M,consultant: DePuy Synthes Spine,stock/shareholder: Spinologics,royalties: EOS-Imaging; author 2: none; ; author 3: none; ; author 4: none; ; author 5: none

QF93

NON-FUSION ANTERIOR SCOLIOSIS CORRECTION (ASC): COMPARISON OF OUTCOMES IN SKELETALLY IMMATURE VS. SKELETALLY MATURE PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Introduction: Anterior vertebral body tethering (VBT) in skeletally immature AIS patients has been reported with success in approximately 60%. Non-fusion Anterior Scoliosis Correction (ASC) allows more curve correction and derotation at surgery even when patients are skeletally mature. The purpose of this review is to compare outcomes of a cohort of skeletally immature patients to cohorts of skeletally maturing and mature patients.
Methods: In this retrospective IRB-approved review, inclusion criteria included primary curves 40-70°, age ≤ 21 years, min. 2-year follow-up or failure before. 79 patients met the criteria, and 71 (90%) had 2-year radiographic follow-up for analysis. 59/71 (83%) were female. Of the 71 patients, 28 were immature (Risser 0-1, Sanders ≤ 4), 36 patients were maturing (Risser 2-4, Sanders 5-7), and 7 patients were mature (Risser > 4, Sanders ≥ 8). 34/71 patients (48%) had both thoracic and lumbar curves instrumented leaving 105 curves for analysis.
Results: Age of the patients at time of surgery was avg. 12.6 years for the immature, avg. 14.5 years for the maturing, and avg. 17.9 years for the mature patients. Average follow-up and clinical success (final curve ≤ 30°) were similar across all 3 groups (NS, p values > 0.10). In the immature group, expected (anticipated) revision occurred in 3/28 (11%) for overcorrection and in 1/28 (4%) for a large, stiff curve, and there was only 1/28 (4%) unanticipated revision for adding on (instrumented too short) with cord failure. There was 1/36 (3%) unanticipated revision in maturing group, and 1/7 (14%) pending revision in the mature group.
Conclusion: Early 2-year results of non-fusion ASC showed clinical success with residual curves ≤ 30° in 93% of immature patients, 81% of maturing, and 86% of mature patients. There was a 14% incidence of expected anticipated reoperations in the immature group. The unanticipated reoperation rate was 1 patient (4%) in the immature, 1 patient (3%) in the maturing, and 1 patient (14%) pending in the mature group.

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QF94

EFFECT OF CORRECTION OF THORACIC HYPOKYPHOSIS ON LUMBAR LORDOSIS AFTER SURGICAL TREATMENT OF THORACIC ADOLESCENT IDIOPATHIC SCOLIOSIS

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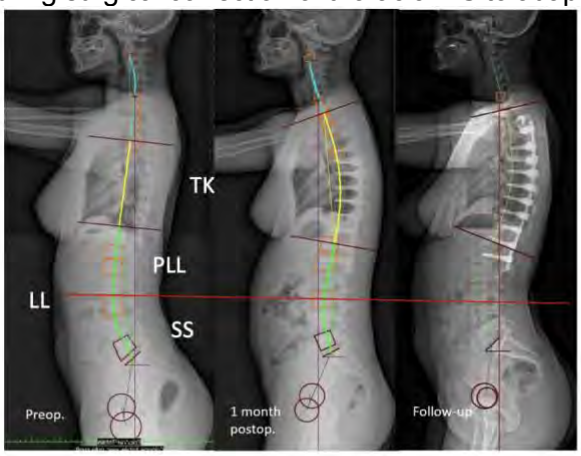
Summary of background data: Thoracic kyphosis (TK) is often low in adolescent idiopathic scoliosis (AIS) patients. In AIS, Thoracic hypokyphosis is correlated with low Proximal Lumbar Lordosis (PLL) and low Lumbar Lordosis (LL), while distal lumbar lordosis (DLL=Sacral Slope) is normal and correlated with pelvic incidence (PI).
Purpose: To analyze how post-operative changes of thoracic kyphosis influence lumbar lordosis, proximal lumbar lordosis and sacral slope in order to improve surgical planning of TK.
The hypothesis states correction of hypokyphosis increases lumbar lordosis (LL) through increase in PLL after surgical correction of TK.
Study design: Prospective monocentric study
Methods: 111 consecutive thoracic AIS, Lenke 1 or 2 who underwent posterior selective thoracic fusion with reduction by simultaneous translation on 2 rods and ≥2 years follow-up have been prospectively selected and analyzed. Instrumentations below L1 and anterior releases were excluded. Global TK, global LL and other spino-pelvic parameters were measured by dedicated software. Patients were divided into 2 groups according to preoperative TK: Normokyphosis ≥20 °, Hypokyphosis <20 °.
Statistical analyses: Mean values were compared through T test, correlations assessed through Pearson's coefficient and linear regressions.
Results: Global TK increased from 27° to 46° at the last follow-up ($p < 0.0001$) and LL from 58° to 65° ($p < 0.0001$). PLL increased by 8° (range 15°, 23°), and distal lumbar lordosis remained stable (42°).
LL increased after the first postoperative month. At 1 month, there was a significant increase in pelvic tilt and decrease in sacral slope ($p<0.05$), offsetting the LL increase, and indicating a temporary pelvic retroversion.
The average coronal correction of the main curve was 69% at mean follow-up of 64 months (range 24, 175).
The increase in PLL correlated with the gain in TK (coefficient=0.70): PLL increase = 0.76 + 0.34 * TK increase ($p < 0.001$), as the increase in LL (coefficient=0.65): LL increase = 0.6 + 0.4 * TK increase ($p < 0.001$).
In the Hypokyphosis group, mean TK increased from 7° preoperatively to 41° at the last follow-up, mean LL from 53° to 66° and mean PLL from 10 ° to 22 ° ($p < 0.05$); mean SS remained stable (43° to 44°, $p = 0.3$).
In the Normokyphosis group, mean TK increased from 36° to 48°, mean LL from 60° to 64°, mean PLL from 18 ° to 23° ($p < 0.05$); SS remained stable (42° to 41°, $p = 0.4$).
TK, LL and PLL increases were higher for the Hypo-Kyphosis group than for the Normo-Kyphosis group ($p < 0.001$).
Conclusions: Increase in TK led to increase in uninstrumented LL through increase in PLL with a linear correlation between TK and PLL. These results allow surgeons to calculate the TK required

during surgical correction of thoracic AIS to adapt LL to pelvic incidence.



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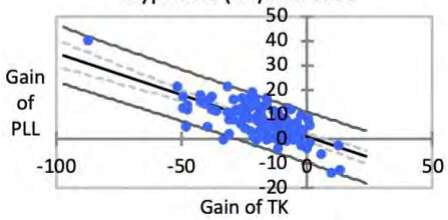
Proximal lumbar lordosis (PLL)= Lumbar Lordosis (LL)- Sacral Slope (SS)

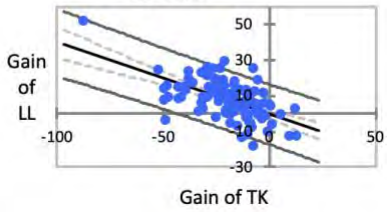
Linear regressions

PLL increase = 0.76 + 0.34 * Thoracic Kyphosis (TK) increase



p<0.001, Pearson's coefficient=0.70

LL increase = 0.6 + 0.4 * TK increase



p>0.001, Pearson's coefficient=0.65

Disclosures:
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PATHOLOGIC SAGITTAL ALIGNMENT IS ALREADY PRESENT IN EARLY STAGES OF ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS)

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Summary:
Lordotic deformation is together with rotation and lateral deviation an integral part of the complex three-dimensional deformity in AIS. Classification of 192 mild, 253 severe AIS and 156 controls according to the recently introduced Abelin-Genevois classification showed that even in mild AIS, the sum of rotated apical and junctional zones present in 55% of the curves as a pathological thoracic pattern in the midsagittal plane versus 6% in normal controls. In severe thoracic AIS, 63% had a pathological sagittal pattern.

Hypothesis:
The starting point of sagittal malalignment of the thoracic spine in AIS is much earlier on than at the point of severe spinal deformation.

Design:
Epidemiological, cross-sectional study

Introduction:
The complex three-dimensional spinal deformity in AIS consist of rotated, lordotic apical areas and neutral junctional zones and could lead to modifications of the presentation of the thoracic sagittal profile. The Abelin-Genevois classification system differentiates 4 specific patterns of sagittal alignment in AIS.

Methods:
Sagittal spinal morphology of the thoracic spine in mild (n=192, Cobb 10-20 degrees) and severe (n= 253, >45 degrees) AIS patients was studied in an international consortium. Sagittal patterns were compared to 156 non-scoliotic adolescents, stratified to before, at or after the adolescent growth spurt. Outcomes were epidemiology of Abelin-Genevois sagittal curve types and kyphosis characteristics (T4-T12 thoracic kyphosis, T10-L2 angle, C7 slope, location of the apex of kyphosis and of the inflection point).

Results:
In severe thoracic AIS, 63% had a pathological sagittal profile. Hypokyphosis (type 2a) was the most prevalent curve type, hypokyphosis+thoracolumbar kyphosis (type 2b) occurred more frequently in high-PI and primary lumbar curves, whereas cervicothoracic kyphosis (type 3) occurred more in double thoracic curves. Even in mild thoracic AIS, already 49% of the curves present as a thoracic hypokyphosis (type 2a), whereas 13% of mild (thoraco)lumbar curves have a pathological sagittal pattern. Only 6% of the normal adolescents had a pathological pattern.

Conclusion:
This study revealed that specific pathological sagittal patterns are often already present in AIS at the earliest stage of the disease, whereas those are rare in non-scoliotic adolescents, before, during and after the growth spurt.

Take home message:
Sagittal `malalignment' is an integral part of the development of AIS and also at an early stage,

treatment of AIS should address the sagittal pathological patterns of the disease.

Table 1: Distribution of pathological (type 2a, 2b and 3) sagittal alignment and normokyphosis (type 1) in AIS patients and non-scoliotic adolescents.

	n	Type 1 (normokyphosis)	Type 2a (hypokyphosis)	Type 2b (hypokyphosis + TL kyphosis)	Type 3 (cervicothoracic kyphosis)	P
						
Mild AIS, n (%)	**192**	**113 (59)**	**67 (35)**	**10 (5)**	**2 (1)**	
Thoracic	128	58 (45)	63 (49)	5 (4)	2 (2)	**<.001**
(Thoraco)lumbar	64	55 (86)	4 (6)	5 (8)	0 (0)	
Severe AIS	**253**	***112 (44)***	***95 (38)***	***20 (8)***	***26 (10)***	
Lenke 1	111	43 (39)	56 (50)	2 (2)	10 (9)	
Lenke 2	41	14 (34)	13 (32)	2 (5)	12 (29)	***<.001***
Lenke 3/4	42	24 (57)	12 (29)	5 (12)	1 (2)	
Lenke 5/6	59	31 (53)	14 (24)	11 (19)	3 (5)	
Non-scoliotic adolescents	**156**	**147 (94)**	**6 (4)**	**2 (1)**	**1 (1)**	
Before PHV	74	67 (91)	5 (7)	1 (1)	1 (1)	**0.47**
At PHV	37	36 (97)	1 (3)	0 (0)	0 (0)	
After PHV	45	44 (98)	0 (0)	1 (2)	0 (0)	

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QF96

PREEMPTIVE PREGABALIN DOES NOT REDUCE POSTOPERATIVE OPIOID CONSUMPTION OR PAIN IN CHILDREN AND ADOLESCENTS UNDERGOING POSTERIOR INSTRUMENTED SPINAL FUSION.
A DOUBLE-BLIND, PLACEBO-CONTROLLED, RANDOMIZED CLINICAL TRIAL.

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Background: Pregabalin as part of a multimodal pain management has been shown to reduce opioid consumption after spinal surgery in adults, but not in children and adolescents. We conducted a double-blind, placebo-controlled, randomized clinical trial on pediatric patients undergoing instrumented spinal fusion.

Purpose: To evaluate effects of pre-emptive pregabalin on postoperative opioid consumption.

Methods: Adolescents, aged 10 to 21 years, undergoing posterior spinal fusion with all pedicle screw instrumentation were randomized to receive preoperatively and five days after surgery either pregabalin 2mg/kg twice daily or placebo. Opioid consumption was measured using patient-controlled analgesia. Pain scores and opioid adverse effects were evaluated.

Results: Sixty-three patients out of 77 eligible were included and analyzed (51 AIS, 8 spondylolisthesis, and 4 Mb Scheuermann). Total oxycodone consumption per kilogram was similar in the study groups during the first 24 h (pregabalin 0.72 ± 0.25 vs. placebo 0.76 ± 0.28, p=0.540) and 48 hours postoperatively (pregabalin 1.49 ± 0.47 vs placebo 1.59 ± 0.54, p=0.487). The postoperative pain scores (1 hour to 48 hours) did not differ statistically between the study groups. No differences were found between the groups for any measured opioid-related adverse effects.

Conclusions: The use of perioperative pregabalin does not reduce the opioid consumption or affect the pain scores in adolescents after posterior spinal fusion surgery.

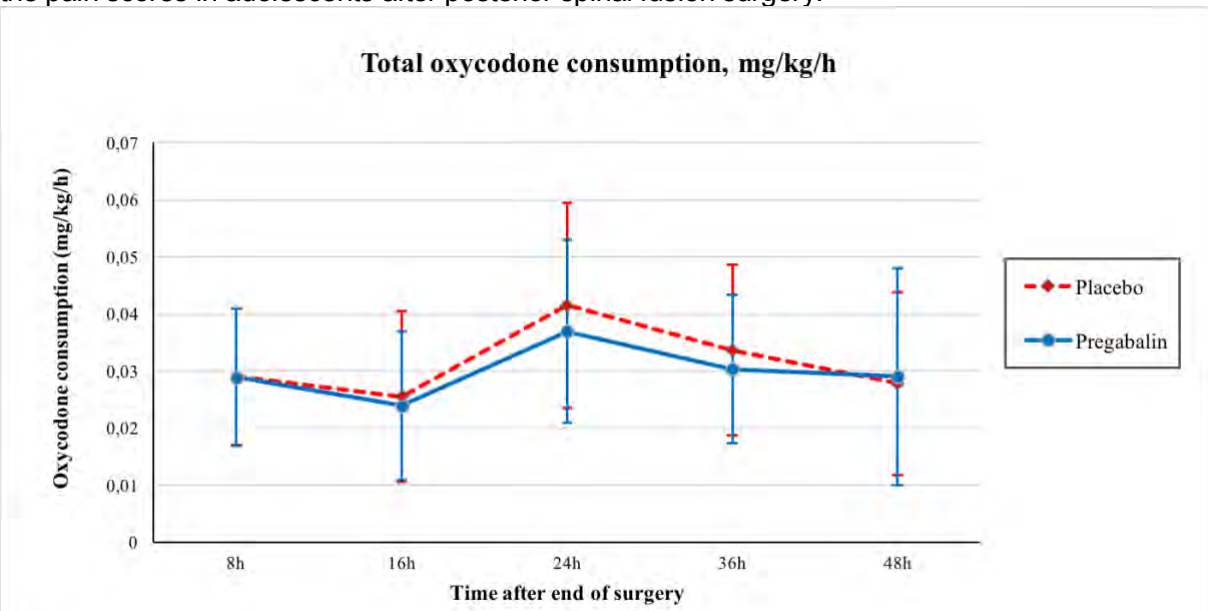

Figure 2. Oxycodone consumption per hour, data shown in mean and SD

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QF97

THE EFFECT OF DIFFERENT STRATEGIES AND CORRECTION MANEUVERS IN AIS SURGERY

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Introduction

Adolescent idiopathic scoliosis (AIS) is a complex 3-D deformity of the spine, characterized by rotation, coronal deviation and relative lordosis of the thoracic spine. It is generally believed that the 3-D correction of this spinal shape in AIS surgery is determined by the correction manoeuvre, but also that patient position, surgical releases, instrumentation strategy as well as rod contouring may be contributing factors to postoperative spinal alignment.

Hypothesis

The complete surgical cascade of different `schools for AIS surgery' (in the United States, France and the Netherlands) have a different effect on the 3-D morphology of the primary, main thoracic curve and could explain the differences in onset of PJK.

Design

Multinational experience-based retrospective cohort study

Methods

Three consecutive series of patients who underwent posterior scoliosis surgery for classical thoracic AIS curves (Lenke 1-4) were collected in 3 different major scoliosis clinics (n=193). Patients were treated according to the local surgical expertise. Pre- and postoperative main thoracic curve morphology were determined by coronal Cobb angle, thoracic sagittal alignment (T1-T12, T4-T12, inflection point, Abelin curve type), and PJK angle and C7 slope at follow-up.

Results

Pre-operative major curve magnitudes were not different between the cohorts. The French strategy (primarily using translation manoeuvres, higher UIV) resulted in 59% Cobb angle correction versus 75% in the USA (derotation manoeuvres, full implant density) versus 70% in the Netherlands (derotation, low implant density) (table 1, $P<0.001$). Despite similar postoperative T4-T12 kyphosis (22.4, 21.7 vs 20.6 degrees), the American strategy led to significantly more thoracolumbar lordosis whereas the Dutch strategy led to a higher inflection point. At latest follow-up, PJK angle was higher and C7 slope lower in the American and Dutch as compared to the French cohort ($P<0.001$).

Conclusion

Based on comparison of three different `scoliosis schools', it seems that derotational strategies lead to more coronal curve correction as compared to translation. Apical derotation, however, demands low thoracic lordosis creation and therefore higher risk for PJK. A translation manoeuvre, however, results in a sagittal harmonious spine, but significantly less coronal and axial correction.

Take home message

If you focus on correction in the one plane in AIS surgery, you may sacrifice in the other.

	French cohort (n=98)	*American cohort (n=44)*	*Dutch Cohort (n=51)*	*P*
Demographics				
Females, n (%)	93 (95)	33 (75)	41 (80)	.002*
Age at surgery	14.5±1.7	14.4±1.7	15.5±2.2	.005*
Follow-up in months	22±13	20±7	15±7	.002*
Preoperative parameters				
MT curve (degrees)	60±14	58±12	61±14	.501
MT apex, mode	T7	T6	T7	.019*
Abelin type 1 (normokyphosis)	36 (37%)	16 (36%)	29 (57%)	.08
Sagittal T1-T12 angle	25±14	24±14	29±6	.16
Sagittal T4-T12 angle	20±15	16±14	23±8	.036*
Sagittal T10-L2 angle	-1±9	-6±11	1±7	.002*
Inflection point	T12-L1	T12-L1	T12-L1	.19
Surgical details				
UIV, mode	T2	T3	T3	<.001*
LIV, mode	L2	L3	L3	.003*
Technique	Primarily translation	Primarily derotation	Primarily derotation	
	Low implant density	High implant density	Low implant density	
Postoperative parameters (first erect radiograph)				
MT Cobb angle	25±9	14±7	18±8	<.001*
Abelin type 1 (normokyphosis)	55 (56%)	23 (52%)	24 (47%)	.318
Sagittal T1-T12 angle	28±8	30±11	27±8	.19
Sagittal T4-T12 angle	22±7	22±6	21±8	.40
Sagittal T10-L2 angle	-4±5	-7±9	-5±8	.047
Inflection point	T12-L1	T12-L1	T11-T12	<.001
Follow-up parameters				
Proximal junctional angle	3±4	6±7	9±7	<.001
C7 slope	16±7	11±7	14±7	<.001

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REPRODUCIBILITY OF THE CLASSIFICATION OF EARLY-ONSET SCOLIOSIS (C-EOS)

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Background/Introduction

The Classification of Early-Onset Scoliosis (C-EOS) is a promising classification system for patients with Early-Onset Scoliosis (EOS). However, the measurement errors for Major Curve Angle (MCA), kyphosis and Annual Progression Rate (APR) have not previously been reported in a consecutive EOS-only cohort.

Purpose of the study

To test the reproducibility of the C-EOS and measurement errors of MCA, kyphosis and APR.

Methods

This study was performed according to Guidelines for Reporting Reliability and Agreement Studies (GRRAS). We included a single-center consecutive cohort of patients diagnosed with EOS seen in the outpatient clinic from January 1, to June 30, 2015. Patients had no history of prior deformity surgery. Four raters with different levels of experience in spine surgery participated. Seventy patients were identified; the first 6 entered a pilot study, 4 were excluded due to insufficient radiographs leaving 60 for the final study. Two anterior-posterior full spine radiographs taken minimum 6 months apart and one sagittal radiograph were measured twice by all raters in a blinded test-retest setup with minimum 2 weeks between the first and second rating. We calculated 95% limits of agreement (LOA) for MCA, kyphosis and APR using a linear mixed effects model. Inter- and intrarater LOA were analyzed for each etiology separately.

Results

Mean age of patients was 8.7±3.4 years and the etiology was congenital/structural (n=20), idiopathic (n=19), neuromuscular (n=13) or syndromic (n=8). Overall inter- and intrarater LOAs were ±12.8° and ±11.1° for MCA, ±20.6° and ±17.3° for kyphosis and ±17.4° and ±14.7° for APR, respectively. Interrater LOA for MCA was ±19.1° for neuromuscular, ±12.4° for congenital/structural, ±9.4° for syndromic and ±8.5° for idiopathic patients. Interrater LOA for kyphosis was ±23.4° congenital/structural, ±22.9° for neuromuscular, ±20.1° for syndromic and ±15.3° for idiopathic patients. For APR, interrater LOA was more than ±11.5°/year regardless of etiology.

Conclusion

Our study shows considerable measurement errors for MCA, kyphosis and APR in EOS patients only. We found large variation in LOA between different etiologies, largest for neuromuscular patients. Further, LOA for APR was larger than the 10°/year steps in the C-EOS suggesting that the minimum time interval between radiographs may need to be longer.

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QF99

NEUROLOGIC DEFICIT IMPROVED WITH THE CORRECTION OF ROTATORY SUBLUXATION USING PRE-OPERATIVE HALO-GRAVITY TRACTION IN SEVERE NEUROFIBROMATOSIS TYPE 1 AND CONGENITAL SCOLIOSIS

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Hypothesis
The pre-operative HGT is helpful for the improvement of neurologic deficit in severe NF1 and CS patients with RS.
Design
Retrospective review
Introduction
The RS is associated with more severe spinal deformity and more neurologic deficits in kyphoscoliosis. The pre-operative HGT has been proven to be effective for severe kyphoscoliosis secondary to different etiologies. However, little is known about the efficacy of HGT in the improvement of neurologic deficit in severe NF1 and CS patients with RS. The objective of this study is to evaluate the efficacy and safety of pre-operative HGT in the treatment of neurologic deficit in severe NF1 and CS patients with RS.
Methods
NF1 and CS patients with neurologic deficit and RS undergoing HGT between June 2001 and September 2016 were reviewed. The coronal Cobb angle, sagittal global kyphosis (GK), RS measured on coronal plane (CRS) and on sagittal plane (SRS), and axial rotation (AR) were measured at pre-, post-traction and post-operation. The forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) were recorded at pre- and post-traction. The neurologic function at pre-traction, post-traction and post-operation were assessed according to the Frankel score. The comparison between pre-traction and post-traction was performed using paired samples t test.
Results
A total of 15 patients (9M and 6F) including 8 NF1 and 7 CS patients were included in the study, of whom the average age was 15.7±4.0 years. The average duration of HGT was 69.3±12.6 days, during which the average Cobb angle improved from 109.8±30.1° to 87.7±30.2° (P<0.001), and the GK decreased from 80.9±19.4° to 62.4±20.7° (P=0.003), respectively. At pre-traction, the CRS and SRS values were 9.9±5.5mm and 6.8±3.1mm, which significantly improved to 6.0±3.9mm (P<0.001) and 5.4±1.9mm (P<0.001), respectively. The average improvement in FVC and FEV1 were from 40.7% to 51.7% predicted and from 41.8% to 49/5% predicted, respectively. The Frankel scores were C in 5 patients and D in 4 patients at pre-traction. After HGT, the Frankel scores improved from C to D in 3 patients, from D to E in 2 patients. The Frankel scores of 2 patients with C and 2 patients with D were not significantly improved, and no deterioration in neurologic function was observed during HGT.
Conclusions
HGT can improve the coronal and sagittal curvature, pulmonary function, RS and neurologic deficit in NF1 and CS patients. The pre-operative HGT is a safe option for severe NF1 and CS patients with neurologic deficit and RS.

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QF100

RISK ANALYSIS OF VARIOUS AGE GROUPS OF CONGENITAL HEMIVERTEBRA RESECTION BEFORE TEN YEARS OLD

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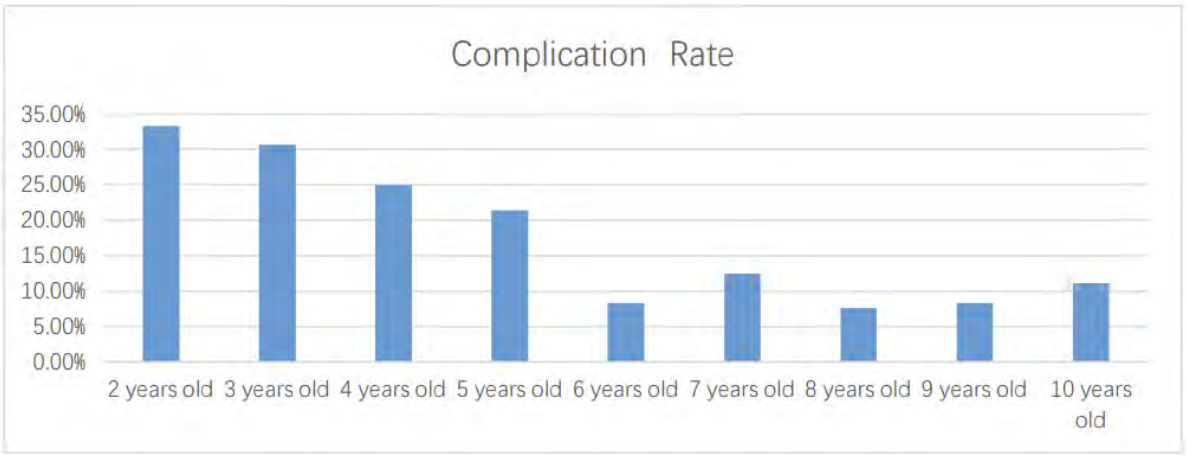
Background: Hemivertebra resection is one of the most important treatments for congenital hemivertebra. However, the development of children's systemic system has not been perfected, and the tolerance to surgery is poor. The risk of surgery is higher than that of adults. There is no analysis of the risk of surgery in all ages before the age of 10 years.
Objective: Compare the risk of each age group less than 10 years of congenital hemivertebra resection and determine the main characteristics of each age group.
Methods: A retrospective analysis of the database from November 2010 to December 2018. All patients with posterior hemivertebra resection and single-segment fixation. By age 10 -2 years old were divided into nine groups. Compare all ages between perioperative non-neurological complications rate(does not include hemorrhage and hypoproteinemia), the blood loss, blood loss to total blood volume ratio(BL/TBV ratio), albumin within 24 hours after surgery.
Results: 139 patients enrolled in the study, 67 males, 72 females, with an average main bend Cobb angle of 51.2 degrees. 10-year-old group (n=18), perioperative non-neurological complication rate was 11.1%, the average blood loss was 319.4 ml, BL/TBV ratio was 0.134;9-year-old group(n=12) 8.3%,316.7ml,0.149; 8-year-old group(n=13) 9.1%,296.1ml,0.142; 7-year-old (n=16)13.3%,297.1ml,0.159; 6-year-old(n=12)10%,270.8ml,0.187; 5-year-old (n=14)33.3%,271.4ml,0.194; 4-year-old (n=12)27%,255.4ml,0.198,3-year-old(n=13) 40%,245.8ml,0.206,2-year-old(n=9)42.9%,227.8ml,0.215. The BL/TBV ratio and albumin within 24 hours after surgery of the children with complications was 0.254,26.37g/L and the non-complication was 0.157,30.04g/L. Respiratory complications accounted for 75% of the total complications , 92.3% before the age of 5 and 42.8% after the age of 5.Figure (1-3)
Conclusion: Before the age of 5 years, hemivertebra resection has a higher BL/TBV ratio and complications rate. Complication rate tends to be stable after 6 years old. Complications in children before the age of 10 were mainly respiratory complications and higher before the age of 5, which may be related to the gradual development of lung vesicles after 6 years of age. Perioperative enhancement of the prevention and treatment of respiratory complications is necessary. Most patients have different degrees of hypoproteinemia at 24 hours after surgery and lower albumin levels have a higher risk of complications. A lower BL/TBV ratio reduces the incidence of complications.

Key words: Congenital Hemivertebra; Complication; Hypoproteinemia; Blood Loss



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QF101

THE SURGICAL STRATEGY OF TREATMENT LUMBOSACRAL HEMIVERTEBRA: COMPARATIVE ANALYSIS OF UNDER 10 YEARS OLD AND OLDER THAN 10 YEARS OLD GROUPS WITH 5 YEARS FOLLOW UP

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Background:The lumbosacral hemivertebra usually lead to the early rapid progress of spinal deformity ,trunk shift and large compensatory curve. However, the timing and strategy of lumbosacral hemivertebral surgery are still controversial.
Objective :To analyze and compare the surgical strategies and long-term outcomes of lumbosacral hemivertebra deformities in different age groups.
Methods :Eighteen patients with lumbosacral hemivertebra deformity were retrospectively reviewed between 2004 and 2013. Patients were received a minimum 5 year follow up and assigned into two groups: Group A (N = 8, mean age 6.6 years old) patients who were under 10 years old and underwent hemivertebral resection and short segment fixation , Group B (N =10, mean age 14.3 years old) patients who were older than 10 years old and underwent hemivertebral resection, long segment fixation including compensatory curve. Clinical and imaging data were collected for statistical analysis.
Results:Mean follow up was 6.2 years. In group B all patients were treated with long segment and iliac screw fixation while no iliac screw fixation in group A.The Cobb angle of coronal main curve in group A improved from 31.3° to 9.3° post-op, and to 9.5° at final follow-up. The Cobb angle of coronal main curve in group B improved from 51.5° to 15.5°post-op, and to 16.3°at final follow-up.The Cobb angle of compensatory cranial curve in group A was 23.5° before operation, 13.7°after operation, 16.2° at final follow-up, while in group B 40.5° before operation, 13.3°after operation, 13.8° at final follow-up . CSVL in group A improved from 1.5cm before operation to 0.7 cm at final follow-up and in group B improved from 2.1 cm to 0.9 cm. Fixed fusion segments were 2.1 in group A and 5.6 in group B. The mean operative time and blood loss in Group A was 189 minutes and 380 ml, respectively, and in Group B 265 minutes and 750 ml, respectively.
Conclusion:Lumbosacral hemivertebra deformity under 10 year old with flexible compensatory curve undergo short-segment fixation can achieve satisfactory correction, long term maintenance.While older than 10 years old with structural compensatory curve requires long segmental and iliac bone fixation in order to achieve trunk balance and deformity correction and more operative time, blood loss and complications .Early surgical treatment is recommended for lumbosacral hemivertebral deformity.
Keywords: lumbosacral hemivertebra, different age, surgical strategy.

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QF102

OS ODONTOIDEUM IN CHILDREN: TREATMENT OUTCOMES AND NEUROLOGIC RISK FACTORS

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Background: Treatment outcomes and risk factors for neurologic deficits in pediatric os odontoideum are unclear.

Methods: We reviewed data from 102 children (mean age 9.8 years, range 0.2 to 18 years) with os odontoideum treated at 11 centers between 2000 and 2016, who had minimum 2-year follow-up. Thirty-one children underwent nonoperative treatment, and 71 underwent instrumented posterior cervical spinal fusion for C1-C2 instability. Nonoperative treatment consisted of observation (n = 29) or immobilization (cervical collar, n = 1; halo body jacket, n = 1). Surgical treatment consisted of atlantoaxial (n = 50) or occipitocervical (n = 21) arthrodesis. One patient also underwent transoral odontoidectomy.

Results: Thirty children (29%) presented with neurologic deficits, 28 of whom had radiographic atlantoaxial instability (atlantoaxial distance [AAD] ≥5 mm) or limited space (≤13 mm) available for the spinal cord (RR, 7.8 [95%CI, 2.0 to 31] compared with children with no radiographic risk factors). The 27 children without neurologic deficits or atlantoaxial instability at presentation underwent nonoperative treatment and remained asymptomatic. One child developed atlantoaxial instability, and another had a persistent neurologic deficit; both children underwent spinal fusion during the study period. One child with cervical instability declined surgery and remained asymptomatic. Spinal fusion had occurred in 68 patients in the surgical group by the end of the study period (mean, 3.7 years; range, 2.0 to 11.8 years). Surgical complications were observed in 21 (30%) children, including nonunion in 12, new neurologic deficits in 4, and vertebral artery injury in 1. Nine (13%) children underwent revision surgery. In the surgical group, Japanese Orthopaedic Association neurologic function scores improved significantly from preoperatively to final follow-up for the upper extremities ($p = 0.026$) and lower extremities ($p = 0.007$).

Conclusions: Nonoperative treatment was safe for asymptomatic patients without atlantoaxial instability. One child out of thirty-one conservatively treated patients developed cervical instability during follow-up justifying clinical and radiographic surveillance. Radiographic risk factors (atlantoaxial instability or limited SAC) were associated with an 8-fold higher risk for neurologic deficits; therefore, children with these risk factors should undergo cervical spinal fusion. Spinal fusion resolved the neurologic deficits of children with symptomatic os odontoideum, but was associated with 30% risk of complications.

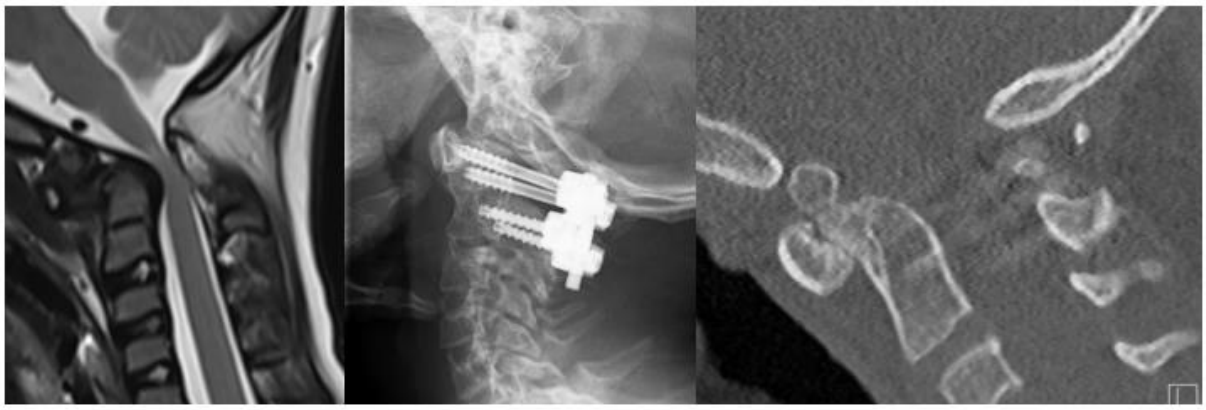

Fig. 1. 5-yr-old girl with os odontoideum and cervical instability. One-yr FU after C1-C2 spinal fusion shows well aligned cervical spine. 2-yr sagittal reformat shows fusion of the os odontoideum with the rest of axis.

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QF103

A STUDY OF ATLANTOAXIAL ROTATORY FIXATION TREATMENT

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Background: Although conservative treatment is typically chosen for treating atlantoaxial rotatory fixation (AARF), no norms have been established regarding issues such as the optimal timing for inpatient treatment.
Purpose of the study: To conduct a retrospective study of the course of AARF treatment.
Materials and Methods: A retrospective study of cases of patients with AARF treated in this hospital between April 2011 (when the hospital was opened) and March 2017. In this study, we excluded cases involving third-party actions at the point of injury, wherein it is difficult to judge the timing of pain disappearance. Patients were investigated in terms of age, sex, Fielding classification, treatment duration, treatment method, and outcome.
Results: In total, 104 patients with AARF were treated during the target period mentioned above. These consisted of 51 males and 53 females with an average age of 5 years (range: 1-13 years old). The courses of 81 cases (77.9%) were followed to the point of cure, whereas 19 cases were discontinued, and 4 were referred to other hospitals. In terms of the cause of onset, 43 cases—the majority—were not attributable to any known cause (41.3%), 26 cases were caused by minor trauma (25.0%), 7 arose during treatment of Kawasaki disease (6.7%), and 28 during treatment for inflammatory diseases such as colds, mumps, or quinsy. All cases fell into Fielding classification types 1 and 2, with no cases into types 3 or 4. Treatment lasted for an average of 15 days (range: 2-70 days). Recurrence was confirmed in 9 cases (8.7%), with repeat recurrence on 4 occasions in one case and on 3 occasions in another. In addition, of the 1,469 patients with Kawasaki disease treated in the pediatric medicine department at our hospital during the same period, 9.48% required referral to our department after they were diagnosed with AARF. In terms of the treatment method, 44 cases were treated with collar fixation (42.3%), 43 cases with bed rest alone (41.3%), 16 cases with Glisson's traction (15.4%), and 1 case with bed rest upon hospitalization (1.9%). Bed rest was indicated at the time of patients' initial visit to the outpatient clinic, with admittance to our hospital taking place for cases continuing for 1-2 weeks after onset or in cases of extreme pain. No cases were found during the study period that required reduction or surgical treatment under general anesthesia.
Conclusion: Although the treatment success rate during the study period for Glisson's traction at our hospital was 100%, these were minor cases that improved after only collar fixation or directed rest; hence, it was not possible to confirm indications constituting appropriate judgment for beginning traction. However, the study did not include cases of Fielding classification types 3 and 4 and obsolete cases, which will need to be examined in future.

Disclosures:
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EVALUATION OF CLINICAL OUTCOMES OF ONE-STAGE ANTERIOR AND POSTERIOR SURGICAL TREATMENT FOR ATLANTOAXIAL TUBERCULOSIS COMPLICATED WITH NEUROLOGICAL DAMAGE: TEN-YEAR CASE REVIEW WITH MINIMALLY FIVE-YEAR FOLLOW-UP

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Background: Surgical treatment is mainly used for atlantoaxial tuberculosis with neurological damage. However, the anatomic structure around the atlantoaxial joint is complex, and the position of vertebral body is deep, which increases the difficulty of the operation and it is challenging for the surgeon to develop surgical strategy. The purpose of this study was to evaluate the clinical outcomes of one-stage combined anterior and posterior surgical treatment approach for atlantoaxial tuberculosis with neurological impairment.
Methods: From January 2005 to January 2015, 12 patients suffering from atlantoaxial tuberculosis with neurological impairment were surgically treated by one-stage combined anterior and posterior approach. Preoperative CT scanning and MRI imaging showed unilateral or bilateral lateral mass destruction of the atlas, and varying destruction degrees of odontoid process, loss of atlantoaxial stability, and tuberculosis focus into the spinal canal resulting in the corresponding spinal cord compression in all patients. The preoperative neurological classifications were Class C for 4 cases, D for 8 cases according to the American Spinal Injury Association (ASIA) system. Quadruple sensitive anti-TB drug treatment was used in all 12 patients preoperative and postoperative. Patients' clinical symptoms and neurological function recovery were evaluated by comparing the Visual Analogue Scale (VAS) score, Neck Disability Index (NDI), Japanese Orthopedic Association (JOA) score and ASIA grading before operation and at the final follow-up.
Results: Mean surgical duration was 263.3±43.6 minutes. Intraoperative blood loss was averagely 529.2±169.8 milliliters. The average fusion period was 7.3±1.5 months. No instrumentation loosening, migration or breakage was observed during the follow-up of 6.5±2.9 years. The VAS, NDI and JOA scores were significantly changed to 1.00±0.95, 9.50±3.34 and 15.42±1.44 at last follow-up ($P<0.05$). The neurological function of all 12 patients was recovered to Class E according to the ASIA grading system.
Conclusions: In the treatment of atlantoaxial tuberculosis with neurological impairment, one-stage combined anterior and posterior surgical approach have the ability to complete debridement and decompression, and reconstruction of the stability of the upper cervical spine. In that case, good clinical outcomes will be obtained through medium and long term follow-up observation.
Key words Spinal tuberculosis; Atlantoaxial; Neurological impairment; Surgical approach.

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QF105

TWO ATTENDING SURGEONS IMPROVE OUTCOMES OF ANTERIOR CERVICAL DISCECTOMY AND FUSION (ACDF)

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Summary: The use of a two-attending surgeon team has been shown to have improved perioperative outcomes in spine procedures such as deformity correction. This matched cohort comparative study investigated the effect of a two-attending surgeon team in single level ACDF procedures. A two-attending surgeon team demonstrated reduced anesthesia/surgical time and blood loss, without an increase in complications or pseudarthrosis. These findings further highlight the benefits of having two experienced surgeons present.

Design: Retrospective matched cohort study

Introduction: ACDF is one of the most common procedures performed by spine surgeons, but it is not without complications. The involvement of a two-attending surgeon team has been shown to have improved perioperative outcomes in complex spine procedures such as deformity correction. The purpose of this study was to assess the effect of two attending surgeons on patients undergoing single level ACDF procedures.

Methods: A retrospective matched cohort study of patients undergoing 1-level ACDF for degenerative cervical spondylosis, with minimum 2-year follow-up. Patients were subdivided into 2 cohorts: (A)cases performed by one attending surgeon assisted by resident, fellow, physician assistant or other medical staff, and (B)cases performed by an attending surgeon with another attending surgeon as first-assist. Patients were matched by age, sex, BMI, ASA and CCI. Perioperative data including anesthesia, surgical time, blood loss, postoperative complications and rate of fusion were compared. Standard binomial and categorical comparative analysis were performed. A p-value <0.05 was deemed significant.

Results: 42 patients were included (21 in each group). There were 22 males and 20 females, with a mean age of 47.7 years and mean follow-up of 43.4 months. There were no differences in any demographic variable between the two groups, indicating successful matching. Cohort B had decreased anesthesia time (114.9 vs 157.1 minutes, $p<0.001$), operative time (58.1 vs 98.9 minutes, $p<0.001$) and blood loss (14.8 vs 24.3 mL, $p=0.012$). There were no significant differences in terms of post-operative complications including dysphagia, wound infection, neurologic or cardiovascular related complications. All patients achieved successful fusion at final follow-up.

Conclusion: A two-attending surgeon team significantly reduces anesthesia time, surgical time, and blood loss, in 1-level ACDF procedures, without an increase in complications, or decrease in fusion rates, further highlighting the benefit of having two experienced surgeons present.

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