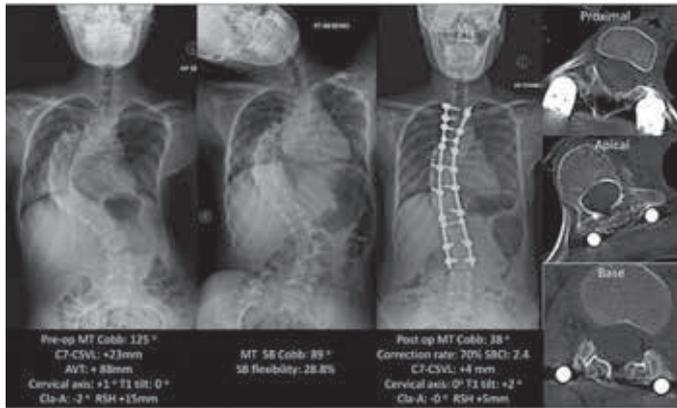Figure 1: Case illustration of severe AIS with good post-operative spinal balance and bony fusion

259. Outcomes of Growing Rod Graduates for Severe versus Moderate Early-Onset Scoliosis

Ilkka Helenius, MD, PhD; Paul D. Sponseller, MD; Anna Mc-Clung, RN, BSN; Jeff Pawelek, BS; Muharrem Yazici, MD; John Emans, MD; George Thompson, MD; Charles Johnston, MD; Suken Shah, MD; Behrooz Akbarnia, MD; Growing Spine Study Group

Summary

Comparative study of children with severe (major curve = MC) vs. moderate (MC <90°) early onset scoliosis (EOS) who completed growing rod treatment (completion of lengthenings with or without final fusion). Graduates in the severe group were significantly less likely to have ≤45° compared to the moderate group at latest follow-up. T1-T12 length was ≥18 cm in 73% MC≥90° and ≥22 cm in (49%) Final fusion increased T1-S1 height more compared to observation only in the severe group.

Hypothesis

Growing rod graduates with severe EOS present will have larger residual curves and shorter spinal height at FFU and may benefit more from final fusion procedure compared to patients with moderate EOS.

Design

Retrospective review of a prospective multicenter EOS database.

Introduction

Severe EOS represents a challenge regarding adequate deformity correction and spinal length.

Methods

Severe EOS (MC ≥90°) was present in 41 children who were treated with growing rods ≤10 years (mean age 5.5 yrs, follow-up 9.8 yrs) and who had minimum 2-year follow-up after the final lengthening with or without definitive spinal fusion. From the same database, 41 matched controls (for age, gender, and type) with moderate EOS (MC<90°) (mean age 5.4 yrs, follow-up 8.0 yrs). Twenty-eight patients (68%) in the severe group and 12 patients (29%) in the control group underwent final fusion at completion of treatment (FFU)(p=0.0010).

Results

Pre-operative MC was 102° in the severe vs. 64° in the control group (p<0.001) and was corrected to 56° and 36°, respectively (p<0.001) at FFU (Table). Fourteen patients (34%) in severe and 33 patients (80%) in control group had a residual MC ≤45° at FFU (RR 0.43, 95%CI 0.20–0.56, p<0.001). At FFU 30 patients (73%) in the severe and 36 patients (87%) in the control group had T1-T12 length ≥18 cm (RR 0.83, 95%CI 0.67–1.04, p=0.095). T1-S1 height improved more in children who had final fusion (mean 122 mm) vs. observation only (mean 87 mm) in the severe group (p=0.034). Thirty-six patients (88%) in the severe group and 27 patients (66%) in the control group sustained ≥1 complication during all treatment (RR 1.33, 95%CI 1.04–1.71, p=0.035) (2.7 [0-14] and 2.1 [0-10] total respectively).

Conclusion

Delaying surgery beyond 90° MC results in larger residual deformity and more complications than beginning at a lesser MC.

Table 1. Clinical and Radiographic Features and Results

Characteristics	Severe Graduates (N = 41)		Control Graduates (N = 41)		P Value
	N (%)	Mean (Range)	N (%)	Mean (Range)	
Age at surgery (yr)		5.5 (1.4-9.7)		5.4 (1.4-9.9)	0.85
Age at final follow-up (yr)		15.0 (10.2-24)		13.5 (9.8-20)	0.011
Follow-up (yr)		9.8 (3.4-21)		8.0 (3.3-13.4)	0.0091
Type of EOS					
Congenital	8 (20)		8 (20)		
Idiopathic	13 (32)		13 (32)		
Neuromuscular	13 (32)		13 (32)		1.0
Syndromic	7 (17)		7 (17)		
No. of lengthening procedures		7.0 (3-15)		8.2 (3-18)	0.11
Total no. of surgical procedures*		8.8 (3-20)		9.5 (3-23)	0.38
Final fusion	28 (68)		12 (29)		0.0010
Major Curve (°)					
Preoperative		102 (90, 139)		64 (33, 88)	<0.001
Final follow-up		56 (10, 91)		36 (12, 89)	<0.001
>45° residual MC at FFU	14 (34%)		33 (80%)		<0.001
Spinal height, T1-S1 (mm)					
Preoperative		226 (138, 380)		266 (145, 416)	0.0010
Final follow-up		337 (159, 447)		361 (260, 510)	0.093
Thoracic height, T1-T12 (mm)					
Preoperative		143 (73, 244)		157 (72, 257)	0.15
Final follow-up		213 (80, 291)		224 (139, 321)	0.27
≥18 cm at FFU	30 (73)		36 (87)		0.095
≥22 cm at FFU	20 (49)		23 (56)		0.51

*Includes index procedure, lengthening procedures, revisions, and final fusion, if applicable.

260. Paravertebral Muscles Show Cross Activation in Double but also in Single AIS curves, with a Correspondent Oxygen Consumption: An Electromyography and Near Infrared Spectroscopic Study†

Barbara Piovanelli, PT; Massimiliano Gobbo, MD; Jorge Villafañe, PhD; Sabrina Donzelli, MD; Fabio Zaina, MD; *Stefano Negrini, MD*

Summary

Using electromyography (EMG) to check muscle activity and Near Infrared Spectroscopy (NIRS) to check metabolic consumption during the Biering-Sorensen endurance test we found a correlation between the two. The most activated muscles were those on the convex side of scoliosis, associated with those on the opposite side above or below the curve (depending on whether it was thoracic or lumbar). This pattern was present not only in patients with double major curves, but also in individuals with a single curve.
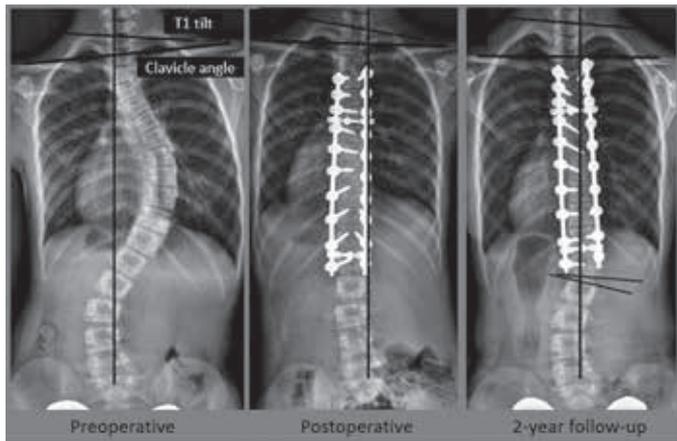
Hypothesis

To check the relationship between muscle activation and metabolic adaptation through a fatiguing protocol in Adolescents with Idiopathic Scoliosis (AIS)

Design

Cross-sectional study

Preoperative   Postoperative   2-year follow-up

286. The "Risser +" Grade. The "Risser +" Grade: A New Grading System to Classify Skeletal Maturity

Michael Troy, BS; Patricia Miller, MS; Nigel J. Price, MD; Vishwas Talwalkar, MD; Fabio Zaina, MD; Sabrina Donzelli, MD; Stefano Negrini, MD; *Michael T. Hresko, MD*

Summary

This study aims to propose and validate a new unified "Risser+" grade that combines the North American (NA) and European (EU) variants of the classic Risser score. The "Risser+" is a reliable scale to classify patients based on skeletal maturity when clinical data is known for participants in scoliosis research studies.

Hypothesis

The "Risser+" grade (RP) can effectively combine the North American and European Risser Classifications for skeletal maturity with adequate intra-rater/inter-rater reliability and agreement.

Design

Comparative study

Introduction

The Risser Plus (RP) scale is an 8 point system which combines the versions and assesses the triradiate cartilage (TRC) maturity; RP 0-(open TRC), 0+ (Closed TRC), 1, 2, 3, 3/4, 4 and 5.

Methods

Agreement and reliability were evaluated for 6 raters (3-NA, 3-EU) who assessed 120 pelvic radiographs from the BrAIST trial, all female, average age 13.4 (range 10.1-16.5 years). Blinded raters reviewed x-rays at two time-points. Intra- and inter-rater agreement (RA) were established with Krippendorff's alpha (k-alpha), while intra- and inter-rater reliability (RR) were established with intraclass correlation coefficients (ICC). Acceptable agreement and reliability were set a priori at 0.80.

Results

Inter-RA of RP sign for the 1st and 2nd readings was k-alpha of 0.72 (0.63-0.79) and 0.86 (0.81-0.90) respectively, and overall RA was alpha of 0.79 (0.74-0.84). EU raters exhibited slightly better agreement then NA Raters for both the first (EU: 0.78 vs NA: 0.66) and second readings (EU: 0.88 vs NA: 0.87) Intra-rater agreement was sufficient for 4 out of the 6 raters in the

study (all k-alpha > 0.80). One rater from each of EU and NA presented subpar intra-rater agreement (k-alpha = 0.64 and 0.74, respectively). Graded response modeling determined reducing the number of categories in the RP scale increased intra-RA substantially with coefficients ranging from 0.87 to 0.96. 16 readings were identified in which 1 rater recorded a rating that was more than 4 units from the other 5 raters. After removing these values, agreement improved substantially with interRA at alpha 0.85. Most variability occurred at Risser 2-4. The EU raters had a slightly higher reliability, EU: ICC = 0.93 (0.91 – 0.95), NA: ICC = 0.91 (0.88 – 0.93).

Conclusion

The Risser+ system showed excellent reliability across multiple reads and raters and demonstrated 79% agreement over all reads and ratings. Agreement increased to over 85% when raters could distinguish Risser 0+ from Risser 5.

Table 1: Visual representation of the Risser+ system.

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287. The Contribution of the Rib Deformity to the Pulmonary Dysfunction in Congenital Scoliosis

Wenbo Li; Shifu Sha, MD; Enze Jiang, MD, PhD; Zezhang Zhu, MD

Summary

The effect of rib deformity on the pulmonary has not been well described previously in the setting of congenital scoliosis(CS).

Hypothesis

The rib deformity could have various influences on the pulmonary function in CS patients on the basis of different complexity.

Design

Retrospective Cohort.

Introduction

Congenital scoliosis is usually accompanied with the rib deformity. Cobb angle and the rib deformity are both important factors to the pulmonary dysfunction. The effect of the cobb angle was well researched. However, no prospective studies have been