

spinal parameters. This study aimed to report the natural history of spinopelvic parameters in achondroplasia.

Methods: Lateral standing spine radiographs of children with achondroplasia were reviewed. Children who had spinal surgery were excluded. A cross sectional analysis included one radiograph per patient per year. Radiographs were divided into yearly age groups. Measurements included thoracic kyphosis, lumbar lordosis LL, thoracolumbar kyphosis TLK: T10-L2, pelvic incidence PI, T1 pelvic angle TPA and sagittal balance SVA. A comparison between the age groups was performed.

Results: Records of 315 children were reviewed, 33 had surgery and were excluded. In the cross sectional analysis, 745 radiographs from 282 children were measured. During the first 3 years of age, TLK decreased and LL and sacral slope increased significantly. After age 3 years, TLK decreased gradually until age ten and remained stable. PI increased gradually after age ten (Figure). In the longitudinal subgroup, 81 children were followed for an average of 8.7 (5-19) years. TLK decreased and LL and PI increased significantly (Table). This was consistent with the cross sectional data. TPA and SVA remained within the normal range although changes with growth were statistically significant.

Conclusions: In children with achondroplasia, improvement in thoracolumbar kyphosis occurs primarily before three years of age and hyperlordosis at the lumbosacral level is the compensatory mechanism. Pelvic alignment and hip positioning are directly affected by this mechanism. Significant changes in the sagittal spinal parameters occur early in life suggesting the importance of attention to sagittal malalignment to prevent any possible clinical sequelae of severe hyperlordosis.

Children with minimum 5 year follow up (81 Children)	First Radiograph		Last Radiograph		p values
	Mean	SD	Mean	SD	
Age (years)	4.4	3.3	13.1	4.3	<0.0001
Thoracic Kyphosis	18	12	16	10	0.221
Lumbar Lordosis	57	17	63	18	0.037
Thoracolumbar Kyphosis	22	15	12	13	<0.0001
Sacral Slope	48	12	52	13	0.058
Pelvic Tilt	-5	13	-3	14	0.259
Pelvic Incidence	43	15	49	16	0.016
T1 Pelvic Angle	-5	11	-9	8	0.010
Sagittal Balance (mm)	7	28	-8	26	0.0004

Table: Tabular summary of longitudinal data of 81 children with a mean follow up of 8.7 years.

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Paper #25

Juvenile Idiopathic Scoliosis: Brace Treatment to Skeletal Maturity



Amanda Whitaker, Alexandra Grzywna, Timothy Hresko, Lawrence Karlin, John Emans, Daniel Hedequist, Michael Glotzbecker

Summary: This is a retrospective review of 102 patients with juvenile idiopathic scoliosis (JIS) who had undergone brace treatment to skeletal maturity or operative intervention. This is the largest series of JIS patients with a standardized treatment protocol. Age at curve progression, degree of

curve, curve correction in brace, lumbar modifier C, and noncompliance are all risk factors in JIS undergoing surgical correction.

Hypothesis: Risk factors of curve progression can be identified in JIS, such as correction in brace, curve pattern, or family history.

Design: Retrospective Review.

Introduction: Juvenile idiopathic scoliosis (JIS) treatment outcomes are limited in the literature. Young age, long follow-up, and varying treatment methods make studying this population difficult.

Methods: This is a retrospective review of 178 patients with JIS who underwent brace treatment between the ages of 4-10, with 102 patients to skeletal maturity. Family history, MRI results, curve type, Cobb angle, brace type, duration of wear, number of brace changes, compliance by report, and surgical procedures were recorded.

Results: Standard protocol for a child with a Cobb angle $>20^\circ$ is treatment in a brace for 18-20 a day (81%). MRI was obtained in the majority (97%) of patients and demonstrated abnormalities in 29 patients (16%). 23/29 intraspinal anomalies required operative intervention and were excluded. Family history of scoliosis was positive for 48% of patients, 29% with a history of surgical correction. Of the positive family history of surgical correction, 40% of children underwent surgery. Noncompliance was 72% in the operative group and 25% in the nonoperative group. Overall, patients who underwent surgical correction (46%) had a greater mid-thoracic Cobb angle ($p<0.01$), less correction in the brace ($p=0.01$), and were younger at age of bracing ($p<0.05$) but not at presentation ($p=0.6$). The curve characteristics at presentation most common were main thoracic and lumbar modifier B curves. Double thoracic and triple major curves or lumbar modifier C were most likely to undergo surgery, while main thoracic, double major and thoracolumbar curves or lumbar modifier B were least likely to undergo surgery. At the end of growth, both operative and non-operative curve patterns were main or double thoracic or lumbar modifier B.

Conclusions: This is the largest series of JIS patients with a standardized treatment protocol. Age at curve progression, degree of curve, curve correction in brace, lumbar modifier C, and noncompliance are all risk factors in JIS undergoing surgical correction.

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Paper #26

Hemoglobin Levels Pre- and Post-Treatment as a Surrogate for Disease Severity in Early Onset Scoliosis



Michael Glotzbecker, Joshua Pahys, Patrick Cahill, Jeffery Sawyer, Michael Vitale, Alexandra Grzywna, Patricia Miller

Summary: The purpose of this study was to prospectively 1) quantify the prevalence of elevated Hgb in patients with EOS who require surgery and 2) quantify the response of Hgb levels to treatment. Hgb laboratory values were prospectively collected in a multicenter database prior to initial implantation and following surgery at 6, 12, and 18 months. Patients with elevated Hgb before surgery respond differently to VEPTR and GR implantation than those with non-elevated Hgb, but appear to eventually have similar results.

Hypothesis: Elevated Hgb are abnormal in patients with EOS and abnormal levels will respond to surgical treatment.

Design: Prospective Cohort.

Introduction: Elevated hemoglobin (Hgb) is associated with hypoxia and may be a surrogate for preoperative hypoxia in patients with Early Onset Scoliosis (EOS) and Thoracic Insufficiency Syndrome. Previous retrospective studies have noted EOS patients with elevated Hgb decrease 6-24 months following treatment with vertical expandable prosthetic titanium rib (VEPTR) with expansion thoracostomy or growing rod (GR) surgery. The purpose of this study was to prospectively 1) quantify the prevalence