Growing spine profiler – a new device in the treatment of progressive spinal deformities, early results

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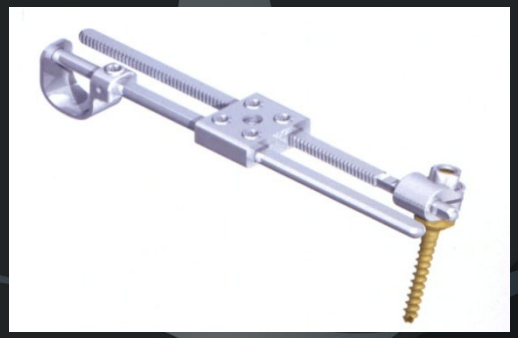
ICEOS 5th International Congress on Early Onset Scoliosis and Growing Spine
November 18-19, 2011 Hilton Bonnet Creek Hotel • Orlando, FL

Introduction

- Treatment of progressive spinal deformities in "growing" population remains a challenge
  - Length of the T1-s1 segment more than doubles from birth to end of growth period[1]
  - The thoracic growth is the fourth dimension of the spine
    - As the curve progresses the size of the chest cavity is diminished [1,2]
    - Lung development is fully completed by the age of 8 years, with a golden period of maximum growth occurring before 5 years of age [1]
- The goal of management is to control spinal deformity without impending spinal and thoracic growth

Introduction

- Available solutions include single or double growing rods, expandable prosthetic rib and techniques not requiring staged surgery[2-6]
  - All techniques have their limitations and are not free of complications
    - Most common problems include: rod breakage, deep infection, skin problems due to protruding hardware, premature fusion[6,7]
- Growing Spine Profiler (GSP™) is a distractible rib-vertebra construct designed for pediatric population
  - The construct includes a pedicle poly-axial screw in the caudal extremity of the device, a rib clamp in the cranial extremity, two rods and a rod connector that serves also as a distraction unit



Aim of study

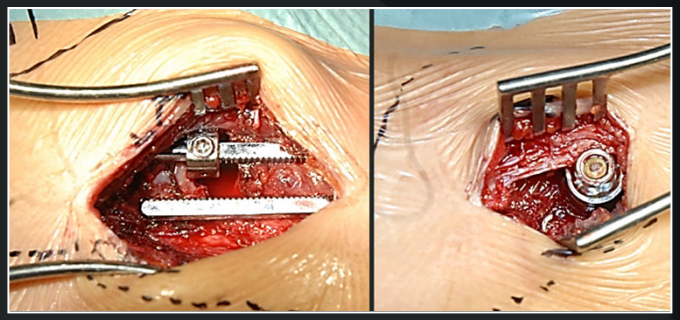
- Aim of paper is to present the efficacy and safety of GSP instrumentation in the treatment of progressive spinal and thoracic deformities

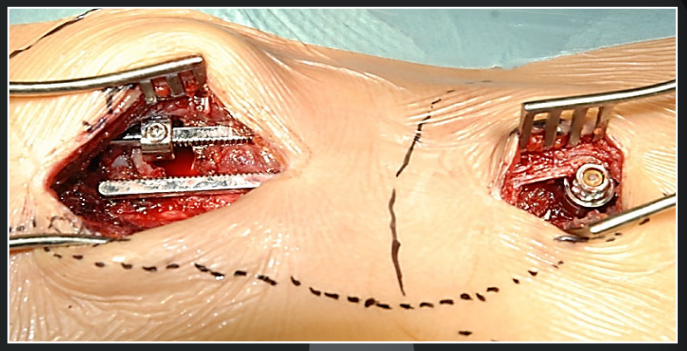
Material

- All patients were skeletally immature at the time of surgery (absence of ossification of the iliac apophyses and the triradiate cartilages)
- Study group consists of 27 patients, 18 girls , 9 boys with following spine deformity etiology:
  - Group A, 13 patients: congenital multiple hemivertebrae or vertebral bars
  - Group B, 8 patients: syndromic scoliosis (Recklinghausen disease, Ehlers-Danlos syndrome, spina biffida etc.)
  - Group C, 6 patients: idiopathic juvenile scoliosis
- Mean age at surgery was 7.1 years (3-13)
- Mean follow-up was 8.3 months (6-22)

Operative procedure

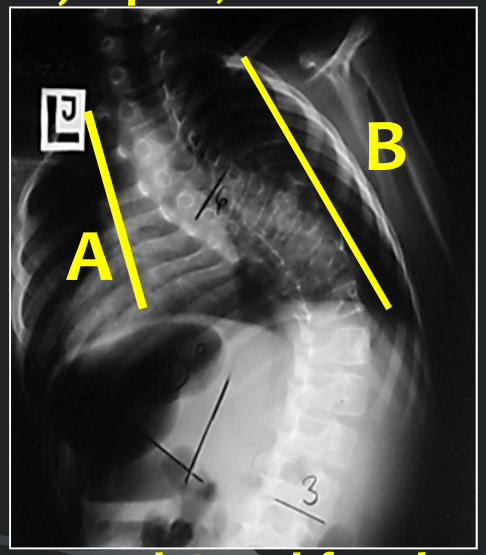
- In order to establish the points of fixation a supine traction film was performed
  - Implantation was performed using two incisions, above the upper and lower end of the construction
  - Following that the connector and rods were passed under the fascia, then distraction was performed and final the nuts were tightened
- Screws were inserted using a paramedian approach preserving the perisoteum
- Lengthening procedures were performed every 6 months using a stab incision located over the rod connector
- No external support was used





Methods

- Following data was evaluated:
  - Course of surgery (compliactions, blood loss, time of surgery)
  - Number of additional interventions
  - Obtained direct postoperative correction, loss of correction
  - T1-T12 and T1-S1 length, apical vertebral translation (AVT), apical vertebral height, space available for lungs ratio (SAL) – pre-, and postoperatively
    - SAL ratio is calculated by taking the ratio of the distance from the apex of the most cephalad rib to the highest point of the concave side divided by the convex side[2]
    - A/B*100% = SAL ratio

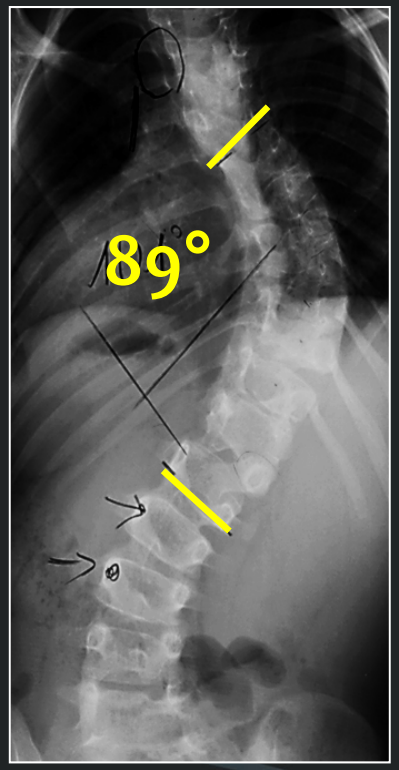


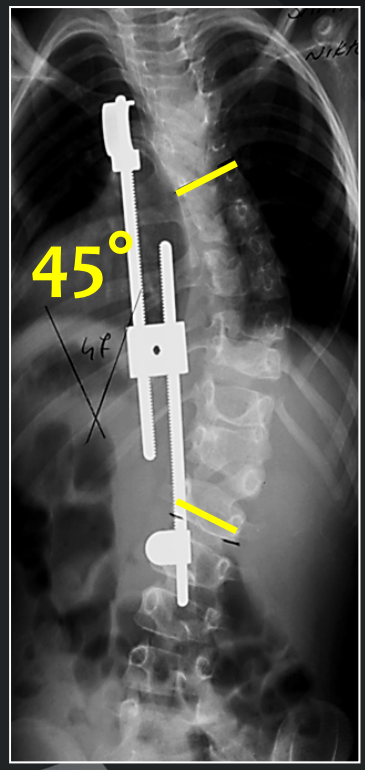
- Resluts were analyzed indenpendantly in groups A, B and C and for the whole study group

Results (1)

- Results in group A (congenital deformity)
  - Number of additional interventions – 2/13 patients, 15%
  - Mean follow-up: 10.3 months (6 - 22 months)

	Pre-op	Post-op	Follow-up
Cobb angle	89.5° (65-125)	57.9° (38-71)	59.1° (38-78)
AVT	69.8mm (53-94)	52.1mm (32-80)	47.6mm (20-85)
T1-T12 length	150.7mm (111-195)	163.5mm (106-207)	174.4mm (137-203)
T1-S1 length	239.6mm (182-319)	275mm (209-355)	291mm (211-317)
SAL ratio	79% (65-88%)	90% (74-100%)	89% (82-98%)
Vertebral body height	13.1mm (9-19)	13.1mm (9-19)	15.3mm (10-19)



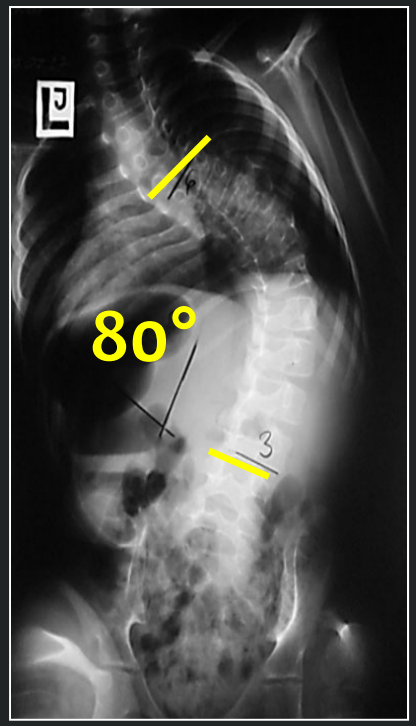


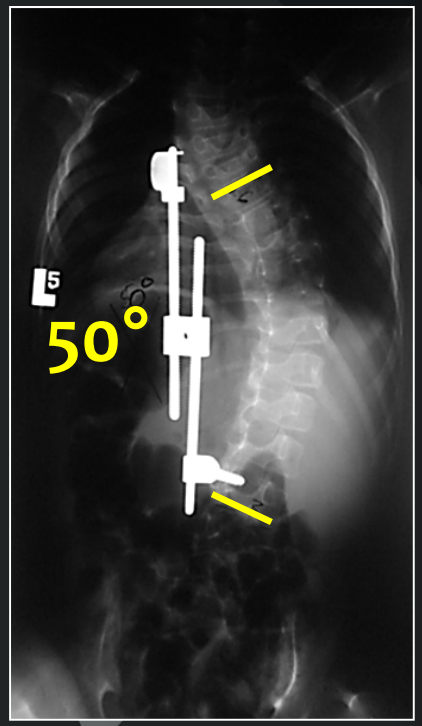
Patient, age 5, female, Congenital scoliosis, follow-up 10 months. 1 lengthening procedure

Results (2)

- Results in group B (syndromic scoliosis)
  - Number of additional interventions – 2/8 patients, 25%
  - Mean follow-up: 7.2 months (6 - 12 months)

	Pre-op	Post-op	Follow-up
Cobb angle	82.4° (51-112)	45.6° (23-67)	52.4° (45-61)
AVT	61.7mm (28-87)	34.7mm (6-54)	27.8mm (11-40)
T1-T12 length	175.4mm (150-197)	198.7mm (175-215)	191.2mm (160-219)
T1-S1 length	277.3mm (218-320)	319.3mm (270-357)	307.2mm (265-355)
SAL ratio	92% (75-100%)	92% (84-100%)	94% (90-100%)
Vertebral body height	13.3mm (9-18)	13.3mm (9-18)	15.2mm (13-19)



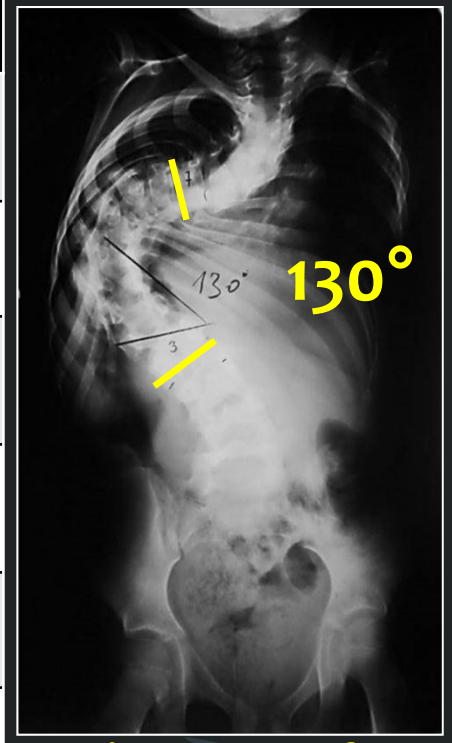


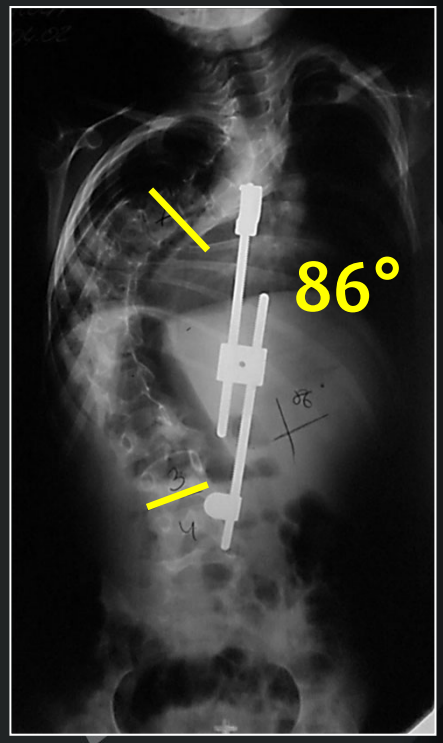
Patient, age 7, male, syndromic scoliosis, congenital myopathy, follow-up 12 months. 2 lengthening procedures

Results (3)

- Results in group c (infantile idiopathic scoliosis)
  - Number of additional interventions – 0
  - Mean follow-up: 7.9 months (6 - 19 months)

	Pre-op	Post-op	Follow-up
Cobb angle	81.5° (58-125)	46.7° (36-70)	51.3° (38-61)
AVT	61.3mm (29-90)	38.7mm (6-64)	35.7mm (11-50)
T1-T12 length	165.7mm (133-195)	190.8mm (157-227)	195mm (167-218)
T1-S1 length	270.8mm (182-310)	313.2mm (245-365)	318.3mm (264-357)
SAL ratio	80% (67-94%)	89% (81-97%)	89% (85-91%)
Vertebral body height	13.3mm (10-18)	13.3mm (10-18)	15 mm (11-18)





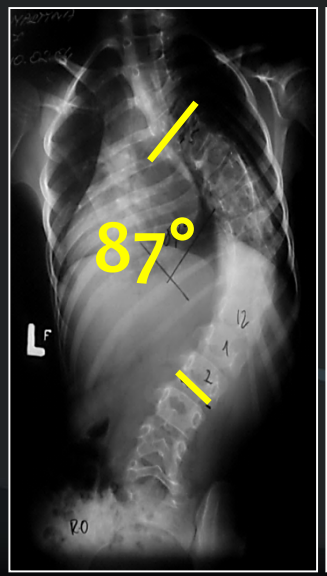
Patient, age 7, female, infantile idiopathic scoliosis, follow-up 12 months. 2 lengthening proceduresc

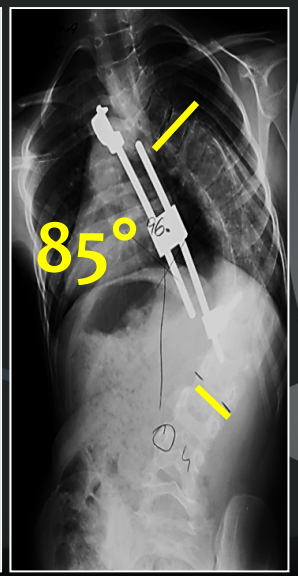
Results (4)

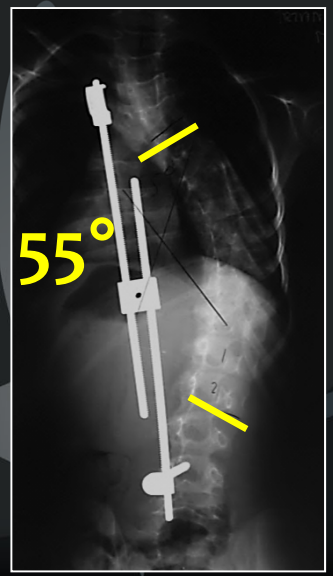
	Group A	Group B	Group C	All patients
Final correction	31.3% (13-51)	40.2% (23-60)	35.4% (23-52)	34.5% (13-60)
Change in SAL ratio	11.4% (-1-26)	2.1% (-7-16)	9.5% (-11-17)	7% (-7-25)
Change in T1-T12 length	10.9% (3-28)	6.4% (3-11)	15.4% (11-20)	9.9% (3-28)
Change in T1-S1 length	11.7% (6-27)	11.6% (7-18)	11.9% (7-15)	11.9% (6-27)

- Final coronal balance
  - 23.9mm (5-56)
- Final sagittal balance
  - 29.6mm (10-71)
- Change in apical vertebra height
  - 1.4mm (0-6)

- **Complications:**
  - screw pull-out – 1 case
  - rib hook dislodgement – 2 cases
  - wrong selection of insrtumentation levels – 1 case

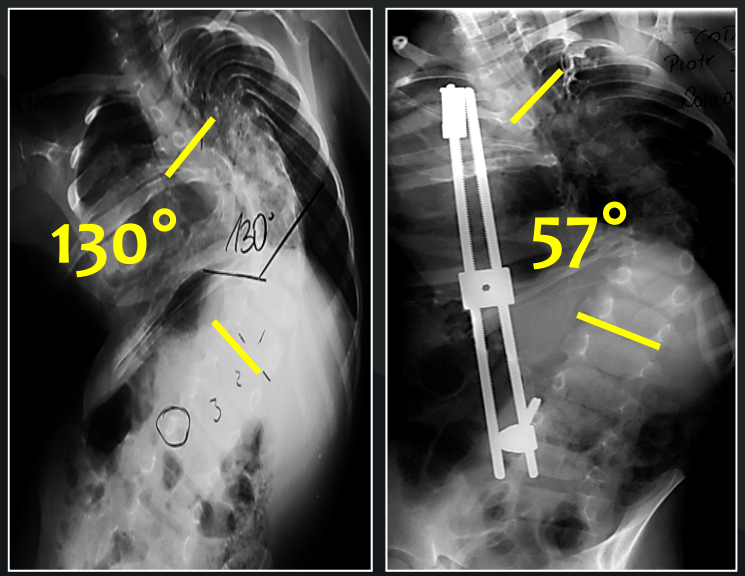






Conclusion

- GSP provides decent direct correction comparable with other systems[5-8]
- No cases of hardware failure was noted what is characteristic for different techniques and previous version of this construct[9]
- The lengthening procedure is very simple utilizing a stab incision
- The change in radiographic parameters is stable
- This rib-vertebra system seems to be of value especially in young children where spine constructs may fail and in cases where the main pathology is located in the rib cage
- A longer follow-up is needed to fully evaluate the role of GSP in the treatment of progressive spine deformities in pediatric population



Patient, age 5, male, congenital scoliosis, GSP implantation with rib osteotomy and opening wedge thoracostomy , follow-up 12 months. 2 lengthening procedures.

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