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Spinal Fusion with Sacral Alar Iliac Pelvic Fixation in Severe Neuromuscular Scoliosis

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Published outcomes of this procedure can be found at: *J Bone Joint Surg Am.* 2018 Apr 4; 100(7):556-63, and *Spine (Phila Pa 1976)*. 2010 Sep 15;35(20): 1887-92.

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Abstract

Background: Neuromuscular scoliosis is characterized by rapid progression of curvature during growth and may continue to progress following skeletal maturity. Posterior spinal fusion in patients with cerebral palsy and severe scoliosis results in substantial improvements in health-related quality of life[1]. Correction of pelvic obliquity can greatly improve sitting balance, reduce pain, and decrease skin breakdown. The sacral alar iliac (SAI) technique has key advantages over prior techniques, including the Galveston and iliac-screw techniques. The SAI technique eliminates the need for subcutaneous muscle dissection over the iliac crest, does not require the use of connectors from the rod to the iliac screw, and decreases the risk of implant prominence[2].

Description: We demonstrate how to perform posterior spinal fusion with SAI pelvic fixation in a patient with cerebral palsy. In correcting the scoliosis, we utilize the segmental 3-dimensional technique, which includes compression, distraction, transverse approximation to 1 rod at a time, and derotation around 2 rods. We also demonstrate SAI pelvic fixation with identification of the screw starting point on the lateral-caudal border of the first sacral foramen and trajectory toward the anterior inferior iliac spine.

Alternatives: Nonoperative alternatives include bracing, trunk support, contouring of sitting surfaces (such as wheelchairs), and physical therapy to slow curve progression during growth periods and delay the need for surgical treatment[3,4]. Decision-making is shared with the family following education about the risks and benefits. Families who are satisfied with the function of the child at baseline should not be persuaded into pursuing surgical treatment.

Rationale: Neuromuscular scoliosis can include difficulty sitting secondary to increased pelvic obliquity, along with poor trunk control and balance. Surgical intervention is considered in patients with curves exceeding approximately 50°, as these curves will often continue to progress even after maturity[5]. In patients with neuromuscular scoliosis, indications for pelvic fixation include pelvic obliquity of >15°, poor control of the trunk as indicated by lack of independent sitting or standing, and location of the apex of the curve in the lumbar

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spine. SAI screws are utilized as a low-profile option for pelvic fixation to avoid implant prominence and an increased risk of skin breakdown and infection, which are associated with traditional sacroiliac screws[2,6].

Expected Outcomes: Miyanji et al. reported quality outcomes in patients with cerebral palsy and Gross Motor Function Classification Scores of ≥4[1]. In that study, caregivers completed a validated disease-specific questionnaire grading the health-related quality of life of the patient preoperatively and at 1, 2, and 5 years postoperatively. Complication data were prospectively collected for each patient and preoperative outcome scores were compared at each of the postoperative time points. Survey scores at 1, 2, and 5 years postoperatively were significantly higher compared with baseline preoperative values.

Sponseller et al. compared the 2-year postoperative radiographic parameters of 32 pediatric patients who underwent SAI fixation and 27 patients who underwent pelvic fixation with the sacroiliac technique[2]. Among patients who underwent SAI fixation, the mean correction of pelvic obliquity was 20° ± 11° (70% correction) and the mean Cobb angle 42° ± 25° (67%). Among patients who underwent pelvic fixation with the sacroiliac technique, those values were 10° ± 9° (50%) and 46° ± 16° (60%), respectively. SAI screws provided significantly better pelvic obliquity correction ($p = 0.002$) but no difference in Cobb correction or complications compared with other traditional techniques.

Important Tips:

- Family discussion prior to surgical treatment is paramount.
- Perform preoperative neurologic examination[7].
- Examine the cranium carefully for a ventriculoperitoneal shunt or prior cranial reconstruction prior to cranial traction.
- Transcranial neuromonitoring may be useful. Use descending neural motor evoked potentials when no signals from transcranial monitoring are obtained[8].
- Sink the SAI screw until it lines up with the S1 screw. Bury the SAI screw so it is not prominent.
- Measure rods longer in order to ensure adequate length for compression and distraction in correction of the pelvic obliquity.
- Use a T-square to verify adequate spinopelvic alignment[9].
- Postoperatively, the use of incisional vacuum-assisted closure can decrease soiling in these patients.

Acronyms and Abbreviations:

SAI = Sacral alar iliac
CP = Cerebral palsy
AIS = Adolescent idiopathic scoliosis
SMA = Spinal muscular atrophy
IONM = Intraoperative neuromonitoring
GMFCS = Gross Motor Functional Classification System
DNMEP = Descending neural motor evoked potential
TXA = Tranexamic acid
FFP = Fresh frozen plasma
ASIS = Anterior superior iliac spine
AIIS = Anterior inferior iliac spine
PJK = Proximal junctional kyphosis

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References

1. Miyanji F, Nasto LA, Sponseller PD, Shah SA, Samdani AF, Lonner B, Yaszay B, Clements DH, Narayanan U, Newton PO. Assessing the risk-benefit ratio of scoliosis surgery in cerebral palsy: Surgery is worth it. J Bone Joint Surg Am. 2018 Apr 4;100(7):556-63.

2. Sponseller PD, Zimmerman RM, Ko PS, Pull Ter Gunne AF, Mohamed AS, Chang TL, Kebaish KM. Low profile pelvic fixation with the sacral alar iliac technique in the pediatric population improves results at two-year minimum follow-up. Spine (Phila Pa 1976). 2010 Sep 15;35(20):1887-92.

3. Brooks JT, Sponseller PD. What's New in the Management of Neuromuscular Scoliosis. J Pediatr Orthop. 2016 Sep;36(6):627-33.

4. McCarthy RE. Management of neuromuscular scoliosis. Orthop Clin North Am. 1999 Jul;30(3):435-49: viii.

5. Thometz JG, Simon SR. Progression of scoliosis after skeletal maturity in institutionalized adults who have cerebral palsy. J Bone Joint Surg Am. 1988 Oct; 70(9):1290-6.

6. Abousamra O, Sullivan BT, Samdani AF, Yaszay B, Cahill PJ, Newton PO, Sponseller PD. Three Methods of Pelvic Fixation for Scoliosis in Children With Cerebral Palsy: Differences at 5-year Follow-Up. Spine (Phila Pa 1976). 2019 Jan 1;44(1):E19-25.

7. Chang TL, Sargent MC, Sponseller PD. Postoperative orthopaedic neurovascular monitoring in the pediatric population. J Pediatr Orthop. 2009 Jan-Feb; 29(1):80-4.

8. Mo AZ, Asemota AO, Venkatesan A, Ritzl EK, Njoku DB, Sponseller PD. Why No Signals? Cerebral Anatomy Predicts Success of Intraoperative Neuromonitoring During Correction of Scoliosis Secondary to Cerebral Palsy. J Pediatr Orthop. 2017 Dec;37(8):e451-8.

9. Andras L, Yamaguchi KT Jr, Skaggs DL, Tolo VT. Surgical technique for balancing posterior spinal fusions to the pelvis using the T square of Tolo. J Pediatr Orthop. 2012 Dec;32(8):e63-6.