Occipitocervical and Atlantoaxial Fusions of the Pediatric Spine: A Review of Outcomes at a Single Institution

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Introduction

The purpose of this study is to determine the fusion rate in posterior instrumented fusions of the craniocervical junction in a pediatric population. Older studies have reported a 98-100% fusion rate based off flexion/extension x-rays; however, more recent studies have demonstrated much lower than anticipated fusion rates: 84-89% on computed tomography (CT). We now report our institutional fusion rates with a minimum of 3 month radiographic follow-up.

Methods

A retrospective review of 21 consecutive pediatric patients (25 procedures) who underwent posterior occipitocervical or atlantoaxial instrumented fusion from April 2004 to January 2015 at Doernbecher Children's Hospital was performed. 5 patients were excluded from further analysis because of insufficient follow-up data. Fusion was defined as no motion noted on post-operative flexion/extension x-rays (XR) obtained any time after 3 months. Other factors, such as patient age, body mass index (BMI), diagnosis, number of vertebral levels fused, graft material, and use of postoperative orthosis, were recorded. Half of the patients underwent additional CT scans (for a myriad of reasons), and thus XR and CT were compared in this cohort whenever possible.

Bony fusions as noted on CT were defined by the following grade schematic:

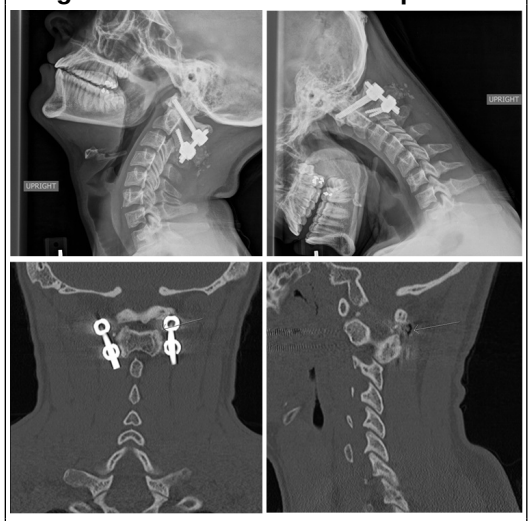
Grade	Description
1	Complete graft resorption
2-	Unilateral bridging bone with focal areas of graft resorption
2	Unilateral bridging bone
3-	Bilateral bridging bone with focal areas graft resorption
3	Bilateral bridging bone
4-	Evidence of bony fusion with focal areas of incomplete incorporation into fusion mass
4	Solid bony fusion mass

We defined complete bony fusion as Grade 4- or 4. Anything less than that was defined as incomplete fusion.

Results

16 patients (20 procedures) had postoperative flexion and extension x-rays obtained at least 3 months after surgery. The average patient age was 10 years, 3 months (range: 2 years, 6 months to 17 years). The mean radiographic follow-up per procedure was 17 months (range: 3 – 118 months; median 8.5 months). Radiographic (XR) fusion was achieved in 81% of patients. 4 revision procedures were required in 3 patients (19%). CT-confirmed rates of fusion were even lower; 11 patients with XR-consistent fusion also underwent CT, and only 7 of the 11 (64%) had documented bony fusion on CT (grade 4- or 4).

Fig 1. XR vs CT fusion discrepancies



Post-operative XRs demonstrate no segment mobility with flexion/extension cervical XRs. However, on CT, limited unilateral bridging bony material is seen (grade 3-), indicating failed fusion.

Conclusions

Our outcomes of spinal fusion in the pediatric population suggest that rates of fusion in posterior occipitocervical and atlantoaxial instrumented fusions are lower than predicted when compared to historical studies, and on par with more current studies. Flexion/extension x-rays as a means to evaluate fusion may overestimate the true bony fusion rate, as depicted by lower fusion rates on CT.

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