Occipitocervical fixation

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For several reasons, occipitocervical fixation is a challenging surgical exercise. The procedure is performed infrequently, and the risks can be substantial. Vertebral artery injury can be catastrophic, bleeding during dissection can be a nuisance, and screw placement is often difficult. Surgery is even more complicated when the normal anatomy is obscured, or even missing. When this situation arises, novel techniques that have been well thought out can be a lifesaver for the practicing surgeon.

The authors of “Occipital condyle to cervical spine fixation in the pediatric population” have provided a useful solution to one such problem: How does the surgeon fixate to the skull if the anatomy is compromised, or not there? The authors looked to the cadaver lab and previous clinical experience for a solution. The problem consisted of finding a location in the skull to place bilateral screws when the suboccipital area was anomalous or had been previously removed, such as in the case of a previously resected tumor or Chiari malformation surgery. The occipital condyle as a fixation point had been described in the adult, and in a single pediatric patient. Before performing this procedure in the operating room, the authors noted that the condyle had been shown to be a feasible fixation point in a previous cadaveric study. They then performed the procedure, with good success, in 4 pediatric patients who either had previous surgery or craniovertebral junction anomalies. There were no intraoperative or postoperative complications, and all 4 patients attained fusion.

There are several other issues regarding this technique that deserve further emphasis. The use of intraoperative navigation cannot be overemphasized. Under the best of circumstances, cannulation of C-1 and/or C-2 is technically arduous. The task is even more challenging when the anatomy is abnormal, and downright daunting with the addition of the occipital condyle as a locus of fixation. Neuronavigation, such as with the O-arm or BrainLab, provides a measure of confidence and a margin for error during surgery. Feedback regarding screw placement can be obtained in real time, and screw trajectory can be altered before problems arise. Screw location and length can be assessed before the patient leaves the operating room. It is hard to imagine performing this procedure without this tool.

The authors used recombinant human bone morphogenetic protein (rhBMP) to aid fusion, and justify its use by noting that 1 of the patients had previously undergone radiation treatment, and in a second patient, no decompression was necessary, and thus no local bone was available. While complication rates from iliac crest or rib harvest can be high, there are other options beside this type of autograft that are available to the surgeon. It should also be noted that there is a high rate of fusion in the pediatric population, particularly in the cervical spine. Given the current controversy surrounding the use of rhBMP, and the unknown long-term effects in children, all other options for attaining fusion should be considered in this patient cohort.

Despite these concerns, this study extends our knowledge regarding the use of the occipital condyle as a site for screw placement. The authors have successfully translated a cadaveric and clinical finding to use in a specific patient population, and in the process have provided the pediatric spine surgeon another useful tool with which to successfully achieve occipitocervical fixation.

Disclosure

Dr. Arnold serves as a consultant for Cerapedics, Medtronic, Life Spine, Integra Life, Spine Wave, Stryker Spine, and AOSpine; was previously a board member for AOSpine; has grants pending from AOSpine North America to his institution; was previously a direct stock owner in Z-Plasty; and was previously a co-chair of the program committee for the Lumbar Spine Research Society.

References

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Editorial


Response

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We thank Dr. Arnold for his thoughtful analysis of our paper. He raises some good points regarding our use of rhBMP as an adjunct to fusion in our case series. In regard to other options available besides rhBMP to aid in spinal fusion, it is true that other bone substitutes exist. Additional options include allograft, ceramics, demineralized bone matrix, autogenous platelet concentrate, mesenchymal stem cells, and gene therapy. None of the mentioned materials have been tested in pediatric patients, and there is a paucity of Level I evidence to support the use of many of these adjuvants in spinal fusions.20 As is widely reported, rhBMP is only FDA-approved for use in an anterior lumbar interbody fusion within a titanium tapered cage.26 Any other use is considered off-label as is much of what we do in spine surgery, including placement of lateral mass screws, which is prevalent in any neurosurgical practice.

Recombinant human BMP has the benefit of being osteoinductive, osteoconductive, and has 2 Level-I studies in the literature showing a clear benefit for its use in anterior and posterior spinal fusion in adults.2,5 The advantage of using rhBMP in spinal fusion include decreases in operative time, blood loss, donor site morbidity,6 transmission of diseases when using allograft,4 and rate of pseudarthrosis.7 These advantages must be weighed against the potential safety concerns of using rhBMP, including bone overgrowth, interaction with exposed dura, cancer risk, systemic and local toxicity, immunogenicity, osteoclastic activation, and effects on distal organs.2 Two There has been a track record of safe use of rhBMP in pediatric spinal fusion.1,3,9,11 A recent article found no evidence that the use of rhBMP is associated with an increased cancer risk.8 Until we as pediatric neurosurgeons are able to design and carry out a randomized control trial testing the use of rhBMP in the pediatric spine, we need to rely on the experience of others as published in the literature to tailor our practice.

In order to minimize the adverse effects from harvesting a rib or iliac crest graft13 and to add to the sparse autograft we were able to harvest, we used rhBMP in our fixation constructs for our patients. In addition, 1 of our patients underwent radiation treatment after medulloblastoma excision, leaving behind abnormal irradiated bone. There is evidence in animal studies that radiation-induced impairment of skull bone healing can be overcome by using rhBMP.14 We were trying to do everything we could to help this child and minimize the number of procedures she would require. If using rhBMP could help her attain fusion and avoid pseudarthrosis, then we were willing to take the risk of using rhBMP.

If the clinician, patient, and family understand the risks of using rhBMP after receiving informed consent regarding such risks, then it may be used with caution. In this paper, we do not specifically aim to advocate the routine use of rhBMP in pediatric spinal fusion, but rather report it as a component of the procedure we successfully used in these cases. As with much of what we do in pediatric neurosurgery, time will reveal the true impact of using advancing technology on the growing spine.

References


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