Technical Report

Atlantoaxial joint distraction for treatment of basilar invagination secondary to rheumatoid arthritis

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We present our experience of treating two cases of rheumatoid arthritis involving the craniovertebral junction and having marked basilar invagination by an alternative treatment method. In both the cases, the facets were osteoporotic and were not suitable for screw implantation. The patients were 66 and 72 years of age and both patients were females. Both the patients presented with complaints of progressively increasing spastic quadripareisis. Surgery involved attempts to reduce the basilar invagination and restore the height of the 'collapsed' lateral mass by manual distraction of the facets of the atlas and axis and forced impaction of titanium spacers in the joint in addition to bone graft harvested from the iliac crest. The procedure also provided stabilization of the region. No other fixation procedure involving wires, screws, plate and rods was carried out simultaneously. Following surgery both the patients showed symptomatic improvement and partial restoration of craniovertebral alignments. Follow-up is of 2 and 24 months. Both the patients were investigated with magnetic resonance imaging (MRI), computerized tomography (CT) scanning and dynamic plain radiology. Both the patients were on long-term steroids for the rheumatoid arthritis.

Material and methods

Two 66- and 72-year-old females, seropositive for rheumatoid arthritis, were treated with the above-mentioned technique. The case selection was based on the extent of destruction of the facets of the atlas or axis by the disease process and their nonsuitability for screw implantation. Follow up is of 2 and 24 months. Both the patients were investigated with magnetic resonance imaging (MRI), computerized tomography (CT) scanning and dynamic plain radiology. Both the patients presented with progressively worsening spasticity in the limbs were able to walk with support and could perform routine activities only with considerable difficulty. There was no sensory deficit in both patients. Both the patients were on long-term steroids for the rheumatoid arthritis.

Radiographic studies

Both the patients had severe basilar invagination. The tip of the odontoid process was 13 and 9 mm above the Chamberlain’s line, 11 and 7 mm above the digastric line and 20 and 15 mm above the Wackenheim’s clival line, respectively. There was no evidence of any radiographic presence of mobile subluxation with flexion resulting in an increase in the atlantodental or clivodental interval, increased compromise of the canal diameter, or reduction in the girth of the brainstem. The facets of atlas and axis were osteoporotic in both cases and were not suitable for screw implantation. There was no retroodontoid pannus in both cases.

Surgical technique

Both patients underwent distraction of the facets of atlas and axis and attempts towards reduction of basilar invagination. Anterior transoral decompression or a posterior foramen magnum bony decompression was not carried out.

Cervical traction is given prior to induction of anesthesia and the weights are progressively increased to approximately four to five kilograms or one-eighth of the total body weight. The patient is placed
prone with the head end of the table elevated to about 35°. The atlantoaxial facet joints are widely exposed on both sides after sectioning of the large C2 ganglion. The exposure of the joint in cases with basilar invagination was significantly difficult as it was rostrally located in relationship with the occipital bone. The joint capsule is excised and the articular cartilage is widely removed using microdrill. The joint on both sides is distracted using an intervertebral spreader used in the anterior cervical disc surgery. The joint space is assessed and the largest size of titanium spacer suitable for the region and allowing maximum reduction in the basilar invagination is impacted into the joint space using suitable instruments. The average sized spacers used in the presented cases measured 12 mm in length, 10 mm in breadth and 8 mm in height. Customized titanium spacers had multiple small holes and were tapered at one end for easier placement during insertion in the joint space. Large pieces of corticocancellous bone graft harvested from the iliac crest are stuffed into the space available within the spacers and all around it [Figure 1]. Additional bone graft was placed between the posterior elements of C1 and C2 after decorticating the host bone area with a burr. The stability achieved after the impaction of the spacers was firm and the need for an additional midline surgical procedure was not felt necessary. Postoperatively the traction is discontinued and the patient is placed in a four-post hard cervical collar for three months and all physical activities involving the neck are restrained during the period.

**Results of surgery**

The follow up is of 2 and 24 months. Both patients have improved in the symptoms to varying degrees following surgery. There were no intraoperative or postoperative vascular, neurological or infective complications. There was significant, but incomplete, reduction of basilar invagination in both cases. Following surgery, the odontoid process was 6 and 5 mm above the Chamberlain’s line, 5 and 3 mm above the digastric line and 14 and 10 mm above the Wackenheim’s clival line. During the period of follow up, both patients did not suffer a delayed neurological worsening meriting the need for a transoral or a posterior decompression or any other kind of surgical procedure. Immediate postoperative and follow-up radiographs confirmed fixation and fusion and reduction of the basilar invagination. The patients did not complain of numbness in the suboccipital region, but on a leading question agreed to have a patch of suboccipital numbness.

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**Figure 1a:** Preoperative CT scan showing marked basilar invagination

**Figure 1b:** Coronal view showing the atlantoaxial joint and the lateral masses

**Figure 1c (Left):** Postoperative CT scan showing partial reduction of the basilar invagination. **Figure 1d (Centre):** Postoperative coronal view showing the spacers in the facet joint on both sides. **Figure 1e (Right):** Postoperative sagittal image showing the spacer in the joint space
We had described a technique of interarticular plate and screw method of atlantoaxial fixation in the year 1988 and had recently discussed distraction and realignment of the atlantoaxial joint for basilar invagination and fixed atlantoaxial dislocation for cases with congenital malformations of the region and for rheumatoid arthritis.[1][8] In the latter technique, the atlantoaxial joint was opened widely after sectioning of the C2 ganglion and the two facets were then distracted and the distraction was maintained with metal spacers and bone graft. Plate and screw fixation of the joint was subsequently done by the interarticular plate and screw method. In both our presented patients, the facets of the atlas and axis were strong enough to sustain the impaction of the metal implant but were osteoporotic and were not suitable for screw implantation. The cause of basilar invagination appeared to be a lateral mass ‘collapse’ resulting in its reduced height.[6][10][13] We observed that the distraction and impaction of the titanium spacer within the joint cavity increased the height of the lateral masses, reduced the basilar invagination and restored the craniovertebral alignments. It was observed that after the impaction of the implant and bone graft within the joint cavity, the region was significantly stable and any kind of fixation procedure could be avoided. Wide removal of atlantoaxial joint capsule and articular cartilage by drilling and subsequent distraction of the joint by manual manipulation provided a unique opportunity to obtain reduction of the basilar invagination and of atlantoaxial dislocation. Multi-holed titanium spacers were chosen in order to allow bone incorporation and fusion across the distracted joint space. Following surgery, the alignment of the odontoid process, anterior arch of the atlas and the clivus and the entire craniovertebral junction improved towards normalcy. The tip of the odontoid process receded in relationship to the Wackenheim’s clival line, Chamberlain’s line and digastric suggesting reduction in the basilar invagination. The stabilization was affected by jamming the motion fulcrum of the region. As no wire, screws, plates and rods were used for fixation, as is conventionally the norm; the extent of stability provided by the implant will have to be assessed by a larger experience over a longer period of time. In the postoperative phase, the patients used a hard cervical collar and were advised to limit activities related to neck movements for a period of three months. During the period of follow-up, both patients had shown neurological recovery and there was no indication of implant failure, suggesting the effectiveness of the operation. The procedure is technically demanding and anatomically precise,[16][17] but if it is learned adequately and performed successfully, the neurological outcome is extremely gratifying.

**References**