Posterior Cervical Fusion for Atlanto-Axial Instability

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ABSTRACT: Posterior fusion is a relatively safe procedure for atlanto-axial instability. A retrospective study of our limited experience showed a high incidence of failure of fusion and spontaneous extension of the fusion mass. Factors which contributed were the operative technique, inadequate immobilisation and lack of patient compliance with the use of a cervical collar.

INTRODUCTION

Atlanto-axial instability is an uncommon but serious condition that may present with bizarre neurologic symptoms. It may be caused by various inflammatory, traumatic, neoplastic or congenital disorders. The stability of the atlanto-axial articulation is dependent mainly on the integrity of the dens, the arch of the atlas, and the transverse and alar ligaments.[1] Instability may result in cord compression, kinking of the vertebral arteries and lead to sudden death. The patient with atlanto-axial instability thus leads a precarious existence.

The main indications for atlanto-axial arthrodesis are atlanto-axial instability, especially if associated with neurologic deficit, persistent intractable neck pain, rotary deformities and Type II odontoid fractures. There have been many surgical approaches described for atlanto-axial fusion but the most widely practised is posterior fusion.

Various authors have reported quite different results with atlanto-axial fusion and it is the aim of this study to compare our results with other published experience.

MATERIALS AND METHODS

A retrospective study of all posterior cervical fusions for atlanto-axial instability in the Department of Orthopaedic Surgery, Singapore General Hospital during 1976 to 1986 was conducted. A total of 7 patients were found of which one was excluded as the case notes were not traceable. The data presented is based on the other 6 patients.

There were 5 males and one female and the ages ranged from 10 years to 53 years. The average age at surgery was 31.2 years. There were 3 patients with Type I, 2 with Type II and one with Type III atlanto-axial instability.[2] The 3 patients with Type I all had fractures of the odontoid (Anderson/D'Alonzo Type II). The underlying pathology in the Type II instability was rhumatoid arthritis in one and idiopathic in the other. The patient with Type III rotatory instability had eosinophilic granuloma with involvement of the arch of the atlas (Table 1).

The presenting features preoperatively was some form of neurologic deficit in all cases. Neck pain and stiffness was present in 5 patients and the average duration of symptoms was 20.8 months. Four patients had previously been admitted for treatment of the underlying pathology. Two had odontoid fractures, one of which had attempted fusion which failed. One patient had advanced rheumatoid arthritis with multiple joint involvement and the last had excision biopsy for the right seventh rib for Histiocytosis X.

Radiologic Findings

All patients had standard antero posterior, lateral and open mouth views of the cervical spine. Three patients had tomograms of the C1 C2 region. Two were for odontoid fractures and the remaining one for tumour. CT scan was done in the patient with eosinophilic granuloma.

The displacement was anterior in 4 patients (66%). The average slip was 8 mm in these patients. One patient had rotatory instability whilst the other had no displacement. The indication for surgery in this case was transient tetraplegia with an odontoid fracture.

The 3 odontoid fractures were all Type II by Anderson and D'Alonzo's classification. As observed by many authors, this fracture failed to unite despite immobilisation and fusion had to be undertaken to prevent neurologic sequelase.[4,5]

The patient with rotatory instability had no antero posterior displacement on tomograms and

TABLE 1
Preoperative Assessment.

Case	Age/Sex	Fielding Classification	Underlying Pathology	Symptoms	Subluxation (mm)
1	16/M	I	Trauma	Neck stiffness, transcient retention of urine.	7
2	44/M	I	Trauma	Neck pain, incomplete tetraparesis. Bladder intact.	8
3	28/M	I	Trauma	Neck pain, Transcient tetraplegia.	–
4	45/M	II	Idiopathic	Occiput numbless in upper limbs.	9
5	53/M	II	Rheumatoid Arthritis.	Neck pain, Hypereflexia.	8
6	10/F	III	Eosinophilic Granuloma.	Acute torticollis, Dysphagia.	–

TABLE 2
Postoperative Assessment.

Case	Age/Sex	Fusion Attempted	Fusion Attained	Results	Duration of F.U. (year)
1	16/M	C1 – C2	–	Persistent neck pain/stiffness.	6
2	44/M	Occiput – C2	–	Gradual progression of neurologic deficit.	1
3	28/M	C1 – C3	Occiput – C3	Asymptomatic	2
4	45/M	Occiput – C2	Occiput – C2	Asymptomatic	4
5	53/M	C1 – C2	C1 – C2	Asymptomatic	6
6	10/F	C1 – C2	Occiput – C3	Asymptomatic	2

FU = Fellow Up

CT scan. There was erosion of the anterior arch of the atlas but no evidence of cord compression by the tumour. She was judged to have Type I rotatory instability.[2]

Operative Procedure

The patient was intubated in the supine position and tongs were applied. The patient was turned in one piece taking care not to flex the neck. The position and level of the atlanto-axial joint was confirmed with radiology.

The posterior approach was used in all cases. The level of fusion attempted was from occiput to C2 in two cases, C1 to C2 in three and C1 to C3 in the last one. A combination of wiring and cancellous bone grafting was used in all but one individual, who had only bone graft placed over the occiput to C2. He had previously suffered from failure of fusion of C1 and C2 when he removed his collar before solid union had occurred.

Postoperatively most patients were left lying free in bed, immobilised by sand bags or a collar. The individual without wire stabilisation had immobilisation in Cone's Calipers for 6 weeks postoperatively. All were then allowed to mobilise in a cervical orthosis. This was maintained until radiologic evidence of fusion had occurred.

RESULT

There was no postoperative mortality and in no patient did the neurologic deficit worsen as a direct result of surgery. One patient suffered from an abscess developing over the donor site of the bone graft. This was surgically drained and subsequent resolution of the infection occurred. There were no other early postoperative complications. (Table 2)

Of the 6 patients undergoing surgery, 2 failed to attain solid fusion. Both were men who had suf-

fered Type II fractures of the dens which had failed to unite with conservative measures. One was the above mentioned individual who had failed atlanto-axial arthrodesis and incomplete tetraparesis. In this case onlay bone graft from occiput to C2 and immobilisation postoperatively with Cone's Calipers for 6 weeks was done. He was subsequently kept on a cervical collar but the graft failed to consolidate.

This patient was followed up for another 6 years during which he continued to deteriorate neurologically. His muscle power fell from Grade 4/5 to Grade 3/5 in the upper limbs and from Grade 3/5 to Grade 2/5 in the lower limbs. He developed retention of urine but retained some control of his bowel movements.

The other case of non-union was a young man who had been immobilised postoperatively in a collar. He was discharged 3 weeks after surgery with advice to continue use of the collar but he removed it within one month. He subsequently refused further surgery and had no neurologic deficit when last seen.

Spontaneous extension of fusion occurred in two patients – both with arthrodesis from occiput to C3. One case had fusion attempted from C1 to C2 and the other from C1 to C3. All four patients with solid fusion had relief from symptoms and improvement of the neurologic status. None complained of neck pain or stiffness, though this was a symptom which continued to bother the two failures.

The results were considered satisfactory if solid union was obtained and there was relief of symptoms. By these criteria there were 66.7 per cent satisfactory results and 33.3 per cent failures.

DISCUSSION

This study, though small serves to remind us of the potential pitfalls of posterior cervical fusion for atlanto-axial instability. There was a high incidence of failure and extension of fusion (33.3% each). The patients with extension of fusion however had full neurologic recovery and relief from pain, and were thus considered to have a satisfactory result. These figures have to be taken with caution as random factors can certainly bias such a small study.

In Sherk's review of posterior fusion for atlantoaxial instability, he stated that failure rate was at least 10 per cent.[6] He also pointed out that the level of fusion attempted, the surgical technique employed, the underlying pathology and postoperative immobilisation were determinant factors as to whether fusion would be obtained.

Certainly in our study, the two cases of failure confirm this. The first case was non-compliant with the use of a cervical orthosis and excessive mobility contributed to the non-union. The other had failed previous posterior fusion and technical factors excluded the use of wires for immobilisation. Only bone graft was laid over the area and in spite of postoperative immobilisation with Cone's Calipers, there was failure to achieve fusion. On retrospect, an anterior spinal fusion or lateral transarticular screw fixation should have been selected instead.[7,8] Thompson has emphasised the importance of adequate stabilisation of the spine for attainment of solid fusion.[9]

The other possible factor is the operative technique. Fielding reported good results with Gallie type fusion but there are other reports which have not been so favourable.[1,10,11] Brooks has criticised the lack of stability in Gallie's wiring technique and devised a "wedge compression" arthrodesis of the atlas and axis using sublaminar wires.[12,13] His technique is reported to have a fusion rate of 93 per cent and allow early postoperative mobilisation. Mitsui has reported even better results with his compression hook and screw device.[14] However these techniques may not be suitable if deficient laimnae are present.

The number of vertebrae included is also a factor to consider. Posterior fusion of just the atlas and axis has a higher success rate than occipital-axial fusion.[6] The inclusion of the occiput also greatly decreases the range of rotation possible in the neck.[15] With increasing vertberae included in the fusion, a long lever arm is produced which greatly raises the vetebrae at each end. For these reasons, it is preferable to fuse only the atlas to the axis unlesss circumstances dicate ortherwise.

In our study, two cases had spontaneous extension of fusion upwards to include the occiput. The extension of fusion may be attributed to excessive stripping of periosteum. Both these patients were young and thus more prone to this complication. Though both cases did not have further neurologic complications, diminished neck movement was noted.

On the whole, our results with posterior fusion have been less than satisfactory. Contributary factors were our limited experience and inadequate immobilisation postoperatively. Posterior fusion is a procedure not without risks and the co-operative patient is certainly one who will contribute significantly to his final result.

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