# Atlanto-axial subluxation case series

A retrospective study was conducted on 56 cases with irreducible atlantoaxial dislocation (IAAD) who underwent posterior fixation from January 2016 to December 2019. According to with or without cages, patients were divided into two groups, namely the cage group and the autograft group. These two groups were subjected to a comparison with respect to visual analog scale (VAS), Japan Orthopaedic Association (JOA) score, health-related quality of life (HRQoL), American Spinal Injury Association (ASIA) Spinal Cord Injury Grade, atlas-dens interval (ADI), space available for the cord (SAC), cervicomedullary angle (CMA) and fusion rate.

The medical follow-up continued for more than one year. There was no statistical difference in preoperative VAS score, JOA score, SF-12 score, ASIA grade, ADI, SAC and CMA between both groups, and the above indexes were significantly improved after surgery ($p<0.05$). The VAS score and ADI of the cage group were lower than those in the autograft group ($p<0.05$). The JOA score, SF-12 score, SAC and CMA of the cage group were significantly higher than those of the autograft group ($p<0.05$). The fusion rate of the cage group 4-6 months after surgery was higher than that of the autograft group ($p=0.068$). In terms of the ASIA grade, the cage group was higher than the autograft group, with a statistical significance ($p<0.05$).

During the 1-year follow-up, the results of neurological function improvement and atlantoaxial joint reduction were satisfactory. This lateral mass fusion device combined with a 3D printed model may be a technique worthy of clinical promotion [1)].

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Goel et al. reported an experience with 190 cases having os odontoideum. The management outcome following atlantoaxial fixation is analyzed.

During the period January 2000 to September 2018, 190 patients having os-odontoideum were surgically treated. There were 113 males and 77 females and their ages ranged from 2 to 68 years (average 24 years).The patients were divided into three groups depending on the nature of atlantoaxial dislocation (Group 1- mobile and partially or completely reducible atlantoaxial dislocation, Group 2- fixed or irreducible atlantoaxial dislocation and Group 3- presence of basilar invagination). Sixty- five patients were in pediatric age group (less than 18 years). All patients underwent atlantoaxial joint manipulation and lateral mass plate and screw fixation. The operation was aimed at segmental atlantoaxial arthrodesis. No transoral or posterior foramen magnum bone decompression was done. Occipital bone was not included in the fixation construct.

On direct bone handling and observation, atlantoaxial joint pathological hyperactivity related instability was identified in all patients. Atlantoaxial segmental stabilization resulted in clinical symptomatic and neurological improvement in 100 percent patients.

Os-odontoideum signifies chronic or longstanding atlantoaxial instability. Segmental atlantoaxial fixation is a reliable form of surgical treatment. Any form of bone decompression is not necessary. Inclusion of occipital bone and subaxial vertebrae in the fixation construct is not necessary [2)].

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Twenty-three patients who underwent C1 lateral mass screw (LMS)-C2 TLS and 29 who underwent C1 LMS-C2 pedicle screw (PS) fixation with ≥ 2 years of follow-up were retrospectively analyzed. Three-

planar (sagittal, coronal, and axial) radiographic parameters were measured. PROs including the Neck Disability Index (NDI), Japanese Orthopaedic Association (JOA) score and the Short Form 36 Physical Component Summary (SF-36 PCS) were documented. Factors potentially associated with PROs were identified.

The radiographic parameters significantly changed postoperatively except the C1-2 midlines' intersection angle in the TLS group ($p = 0.073$) and posterior atlanto-dens interval in both groups ($p = 0.283$, $p = 0.271$, respectively). The difference in bilateral odontoid lateral mass interspaces at last follow-up was better corrected in the TLS group than in the PS group ($p = 0.010$). Postoperative PROs had significantly improved in both groups (all $p < 0.05$). Thereinto, NDI at last follow-up was significantly lower in the TLS group compared with PS group ($p = 0.013$). In addition, blood loss and operative time were obviously lesser in TLS group compared with PS group ($p = 0.010$, $p = 0.004$, respectively). Multivariable regression analysis revealed that a change in C1-2 Cobb angle was independently correlated to PROs improvement (NDI: $\beta = -0.435$, $p = 0.003$; JOA score: $\beta = 0.111$, $p = 0.033$; SF-36 PCS: $\beta = 1.013$, $p = 0.024$, respectively), also age ≤ 40 years was independently associated with NDI ($\beta = 5.40$, $p = 0.002$).

Three-planar AAI should be reconstructed by C1 LMS-C2 PS fixation, while sagittal or coronal AAI could be corrected by C1 LMS-C2 TLS fixation. PROs may improve after atlantoaxial reconstruction in patients with chronic AAI. The C1-2 Cobb angle is an independent predictor of PROs after correcting chronic AAI, as is age ≤ 40 years for postoperative NDI [3].

## 2018

56 pediatric patients with CAAD were operated through a direct posterior approach in the last 4 years. The joints were drilled and manipulated to achieve multiplanar realignment. C1-2 joints were fused (short segment). The pre and post operative clinical and radiological data was compared.

Atlanto-axial dislocation was irreducible in 35 and reducible in 21 patients. Forty-nine (87.5%) patients were partially or totally dependent. The joints in the irreducible groups were oblique and deformed. Nine patients had lateral angular dislocation, 3 had C1-2 spondyloptosis and 5 had significant vertical dislocation. Drilling and manipulation was feasible in all cases. The bones were soft and partly cartilaginous in the pediatric population. Techniques were modified to achieve optimal bony purchase subsequent to drilling the relatively small bones and prevent screw pull-outs during intraoperative manipulation for the problems we had faced in our initial cases. Despite the challenges in initial cases, realignment could be achieved in all. There was a significant improvement in follow up modified JOA score and 28 patients were independent at 4-month follow up. Two patients had partial redislocation at 4-month follow up.

Pediatric patients have deformed and oblique joints, thereby making complete spondyloptosis, severe vertical dislocation and lateral tilt common in this age group. Though pediatric bones are soft and small, it is possible to achieve multiplanar realignment by drilling and manipulation of C1-2 joints. The realignment and short segment C1-2 fusion in these patients has a good radiological and clinical outcome [4].

## 2016

From 2007 to 2013, 174 patients with fixed AAD and BI underwent surgical reduction by posterior

atlantoaxial facet joint release and fixation technique.

There was 1 death in the series, and 3 patients were lost to follow-up. The follow-up period ranged from 12 to 52 months (mean: 35.2 months) for the remaining 170 patients. Neurological improvement was observed in 168 of 170 patients (98.8%), and was stable in 1 (0.06%) and exacerbated in 1 (0.06%), with the Japanese Orthopedic Association scores increasing from 11.4 preoperatively to 15.8 postoperatively ($P < .01$). Radiologically, complete or >90% reduction was attained in 107 patients (62.9%), 60% to 90% reduction was attained in 51 patients (30%), and <50% reduction was attained in 12 patients (7.1%), who underwent additional transoral decompression. Complete decompression was demonstrated in all 170 patients. Solid bony fusion was demonstrated in 167 patients at follow-up (98.2%).

This series showed the safety and efficacy of the posterior C1-2 facet joint release and reduction technique for the treatment of AAD and BI. Most fixed AAD and BI cases are reducible via this method. In most cases, this method avoids transoral odontoidectomy and cervical traction. Compared with the occiput-C2 screw method, this short-segment C1-2 technique exerts less antireduction shearing force, guarantees longer bone purchase, and provides more immediate stabilization [5].

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