

Efficacy of Anterior approaches in Type2 & 2a Traumatic spondylolisthesis of Axis

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I. Introduction

“Hangman’s fracture” and Traumatic Spondylolisthesis of Axis(ATS)are terms described for bilateral pars fracture of C2.Traumatic spondylolisthesis of the axis (TSA) was first described by Haughton in 1866⁽¹⁾. Wood-Jones described in 1913, in cases of judicial hanging.⁽²⁾ In 1964, Garber⁽³⁾ described C2 pedicle fractures with the forward dislocation of the C2 body in patients who were victims of motor vehicle accidents, what was denominated “Axis Traumatic Spondylolisthesis”. In 1965, Schneider et al ⁽⁴⁾ coined the term “Hangman’s Fracture”.

Hangman’s fracture is the second most common fracture of the second cervical vertebra. These cases account for 4-7 % of cervical fractures, and form 20 to 23% of (C2) axis’ fractures.^(5,6)All these are classified according to the fracture patterns and translation and angulation of the C2 over C3 and was first proposed by Levine- Edwards based on the suggestions of Effendi et al and has been widely accepted in the literature.^(1,20) Life-threatening sequel in hangman’s fractures is rare, because the vertebral canal is sufficiently wide at this level and the fragments tend to separate thereby often decompressing the spinal canal.

Management of the hangman’s fractures is controversial. As such, early surgical intervention has been increasingly reported for the initial management of Hangman’s fractures due to complications of halo-vest treatment.^(7,8) Published managements for unstable TSA includes anterior surgery at C2–C3, posterior surgery, and global approach.⁽⁴⁻¹¹⁾Treatment is aimed at near normal cervical alignment. In this study the authors studied the surgical outcomes in 10 cases of Hangman’s fractures treated by anterior approaches.

II. Aim Of The Study

To determine the treatment efficacy and surgical outcome of anterior fusion in cases of unstable Hangman’s fractures. (Levine and Edwards, type II, type IIA)

III. Materials And Methods

This is a retrospective and prospective study. All type 2 &2a of hangman’s fractures Operated from March 2004 to Dec 2010 were included in the study. A total of 10 patients (9 men and 1 women, aged 18–60 years diagnosed with unstable hangman’s fracture, treated and followed up in our Neurosurgery department are included in this study. 9 patients were injured in vehicle accidents and 1 was injured due to accidental fall from height.

All cases are evaluated clinically & Radiologically. X Ray parameters measured were translation of C2 over C3 and C2-C3 angulation . CT cervical spine was done to look for associated fractures; MRI-C spine was done to see the disc fragmentation, cord compression and ligamentous injury. Hangman’ fractures were classified according to the Levine- Edwards classification, One patient had associated fractures of the of C3 body.

Pre operatively all patients were put on 2 kg of cervical traction. Using a high cervical extra-pharyngeal approach in all 10 patients cervical discectomy and autologous bone fusion of C2-C3 with a titanium plate was performed.

IV. Surgical Techineque

High cervical extra-pharyngeal approach anterior cervical discectomy and autologous bone fusion with a Titanium plate was performed in each patient. The patients were placed in the supine position with the neck slightly extended and 2 kg of axial traction. An inverted L shaped flap was taken in all the cases were made, midway between the angle of the jaw and the thyroid cartilage. C2–3 anterior exposure was obtained, and a tear

of the anterior and posterior longitudinal ligaments and disc disruption were observed in most cases. After the C2–3 discectomy was completed, iliac bone was taken to graft intervertebral space.

An appropriate Titanium plate was selected to allow sufficient purchase on the C2 and C3 vertebral bodies, and final alignment was achieved by tightening the screws. The wounds were closed, and the drainage tube was removed after two days. Cervical support was used for six weeks. All the patients were reevaluated with an X-ray C-spine after three months, six months, one year, and neurological examinations were performed during the follow-up period.

Mean surgical time was 3 hrs, we have not encountered any major neurological complications, Transient cervical branch of facial nerve weakness in initial three cases was noted

V. Results

Total number of patients included in the study were 10, age range from 18-60 yrs, male to female ratio is 9:1. All patients presented with neck pain, and neurological deficits were present in 1 patient.

The patient were classified according into Type 2(9 cases)(fig2), Type 2a (1 case)(fig3). C2-C3 average angle in Type 2 is 9.5 degrees; angle in type 2a is 13 degrees.

All patients were treated with anterior approach

In Type 2 and 2a cases we have done anterior approach in 10 cases, where reduction was achieved with traction, In anterior cases reduction was maintained after fixation(fig4) .

TYPE	PREOP ANGLE	TRANLATION DISTANCE	REDUCTION AFTER POST TRACTION achieved OR NOT	SURGERY	FOLLOW-UP FUSION
TYPE 2	9.5 deg	4.mm	Achieved	Anterior fusion(9)	Fusion achieved at 4.8 months(Average)
TYPE 2 A	13 deg	3.mm	Achieved	Anterior fusion(1)	Fusion achieved at 4.5 months

All cases were followed for an average period of one year and noticed to have bony fusion and sagittal alignment. Neck pain subsided in all the 10 patients, which was present preoperatively. Patients recovered well after surgery and no complications were noted.

No bone graft or plate screws complications were observed in any of the cases during the follow-up period.

VI. Discussion

The hangman’s fracture has also been named as C2–C3 traumatic spondylolisthesis or TSA. It accounts for 4% to 7% of all cervical fractures and 23% to 27% of axis fractures. 50 to 80% of the axis’ traumatic lesions are resulting from motor vehicle accidents, and 10 to 40% are due to falls.^(4,9,10) In our study 9cases (90%) had motor vehicle accidents and 1 cases (10%) had sustained accidental falls similar to the incidence in the literature.

The capacious diameter of the spinal canal at C2 level and the typically centrifugal burst pattern of the fracture fragments make the incidence of spinal cord compression less likely.⁽¹¹⁾ As a result, hangman’s fractures are rarely associated with neurologic deficits and carry an excellent clinical prognosis after treatment. In our study 1 patient had neurological deficits and all patients had neck pain.

Because of the good healing properties of the cancellous bone at the fracture sites, the reported union rates of these injuries have been relatively high whether the reduction is achieved or not.

Several classification schemes for hangman’s fracture have been proposed. The Levine-Edwards classification is most widely used and separates the fractures into four types based on consideration of trauma mechanisms.⁽¹²⁾ In our study According to the Levine- Edwards classification, all cases were unstable with type II (9 cases), type IIA (1 case).

Management :

Levine and Edward type2 and type2a hangman’s fractures have been considered unstable due to translation and angulation of C2-C3.⁽¹³⁾The treatment for unstable hangman’s fracture is still controversial. Most cases of hangman’s fractures responded to conservative treatment comprised of mild skeletal traction and external immobilization in a halo brace. Surgery is only necessary under certain conditions .⁽⁸⁾

Conservative:

Patients were managed conservatively by various authors with halo immobilization; literature revealed the union rates of conservative treatments were nearly 100% in type I, 60% in type 2, 45% in type 2a, and 35% in type 3.⁽¹³⁾

Conservative management failed to achieve total reduction in type 2 cases in various reports, Halo vest treatment results in recurrence of translational reduction by 65% and angulation by 40 % (Levine and Edwards).⁽⁸⁾

Incomplete reduction of C2-C3 results in kyphosis, persisting neck pain in 60% of cases.⁽⁸⁾ and decreased range of motion if angulation is more than 10°.⁽⁶⁾

Indeed, accurate fracture reduction and realignment of C2–3 was seldom achieved with conservative treatment in unstable hangman's fractures.

Surgical Management:

Failures and complications associated with conservative treatment can be definitely addressed through surgical treatment.

Surgery is recommended if radiological controls demonstrate an increasing anterior displacement at the C2–3 level in spite of rigid immobilization. Further conditions necessitating surgical therapy include the dislocated type IIA fractures (angulation >11° and anterior translation >3 mm); in exceptional cases of dislocated type II fractures (anterior translation >3 mm), and type III hangman's fractures.⁽⁸⁾ Lesions combined with a traumatic C2–3 disc herniation compromising the spinal cord and established non unions may also require surgery.^(14,15)

Surgically treated patients with type2 and 2a requires collar for 4 weeks postoperatively, however conservatively treated patient require Halo-vest for 3 months, hence surgical treatment is definitely beneficial over conservative therapy in terms of early ambulation.⁽¹⁾

Surgery:

Anterior, posterior and combined approaches are employed to treat hangman's fractures.

Among the different posterior approaches, direct repair of the pars fracture has the advantage of preserving motion of the axis. Unfortunately, direct pars repair does not address instability at the disc and cord compression, hence when cord compression was noted it is advised to do anterior approach.^(16,17,18)

The risk of vertebral artery injury precludes pars screwing in every case of Hangman's fracture. It has been shown that the course of the vertebral artery through the body of C2 is variable in 4% of cases and the rate of injury to critical structures is between 11% and 66%. Ludwig, Kramer *etal*(19.20.21). Individual axis pedicle anatomy need to be considered before contemplating C2 pars screw.

C2-C3 posterior stabilization strategy uses a C2 pars screw connected to C3 lateral mass screw. This technique addresses the detached posterior arch of C2 by pinning the fractured pars while simultaneously addressing instability at the disc by immobilizing C2 relative to C3. C2-C3 fixation preserves rotation movement of neck^(16,22) angulation at C2-C3 and associated discal herniation is not addressed by this approach. Other approaches like C1–C3 wiring, occipito-cervical fixation techniques have also been described. Posterior approaches were mandatory in type 3 hangman's fractures in cases where preoperative reduction was not achieved.⁽¹⁰⁾

Since posterior procedures are risky, many surgeons prefer the anterior approach and achieve interbody fusion of C2–3 using a graft and plating. Also, this technique is in atypical hangman's fracture with fracture line traverses anteriorly. In the C2 body Traumatic disc herniation and cord compression warrants anterior approach. In our series only 3 cases has significant disc disruption.

Literature shows the evidence of almost 100% fusion rates by anterior approach in type 2 and 2a cases because of large fusion surface for the graft^(6,23). The anterior approach offers high primary stability, anatomical preservation of spinal alignment with reconstruction of cervical lordosis as it directly addresses the C2-C3 translation and has favorable clinical outcome.⁽²³⁾ In our study we successfully managed all the cases by anterior approach only.

ACDF is feasible and used widely for cervical spine disease, technically familiar to many neurosurgeons. Hence anterior surgery may be sufficient in cases where pre operatively anterior reduction was achieved.^(25,26) In our experience in the 10 cases, the anterior approach offered excellent exposure and arthrodesis.

VII. Conclusions

1. In our experience the anterior approach with primary internal stabilization is appropriate option for unstable type 2, type 2a hangman's fracture in cases where preoperative reduction could be achieved.

2. Using the anterior approach with primary internal fixation of these fractures, solid fusion was achieved in all cases.

Limitations: Limited number of cases,

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