Asian Journal of Orthopaedic Research

6(2): 33-38, 2021; Article no.AJORR.73573

Anterior Fusion Combined with Posterior Sublaminar Wire Fixation for the Treatment of Unstable Hangman's Fracture

Rieva Ermawan[1,2], Bintang Soetjahjo[1,2], Rhyan Darma Saputra[1,2], Ibnu Yudistiro[3*] and Yosafat Arief[3]

[1]Departement of Orthopaedic & Traumatology, Faculty of Medicine, Sebelas Maret University, Indonesia.
[2]Departement of Orthopaedic & Traumatology, Moewardi Hospital, Surakarta, Indonesia.
[3]Faculty of Medicine, Sebelas Maret University, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Parth Trivedi, C.M. Patel College of Physiotherapy, Civil Hospital Campus, India.
Reviewers:
(1) Mevlüt Özgür Taşkapılıoğlu, Bursa Uludag University, Turkey.
(2) Bheemsingh Samorekar, India.
(3) Florin Filip, University of Suceava, Romania.
Complete Peer review History: https://www.sdiarticle4.com/review-history/73573

Case Study

Received 10 July 2021
Accepted 20 September 2021
Published 25 September 2021

ABSTRACT

Aims: To report the management strategies and surgical treatment for unstable hangman's fractures.
Study Design: Case report study.
Place and Duration of Study: Dr. Moewardi Hospital, Surakarta in 2021.
Presentation of the Case: A 22-year-old female with multiple injuries following a motor vehicle accident. The patient was diagnosed with unstable hangman's fracture, multiple fractures of left costae, and left hemothorax. The patient was treated by surgical treatment using a combination of anterior fusion and posterior sublaminar wire fixation for cervical fracture, conservative for costae fractures, and intercostal drainage for left hemothorax.
Results: The patient recovered well after the surgery, with a good clinical outcome and a satisfactory radiograph result.
Conclusion: Anterior fusion of C2-3 combined with posterior sublaminar wire fixation of C1-2 is effective in the treatment of unstable Hangman's fracture.

**Corresponding author: Email: iyudistiro@gmail.com;*

Keywords: Hangman's fracture; type III; surgery.

1. INTRODUCTION

Hangman's fracture was initially noted by Schneider et al in 1965 [1]. It is described as trauma-induced fractures of the pedicles, lamina, articular facets, or pars of the axis vertebra (e.g., diving, falling, or motor vehicle accidents). The current management strategies and surgical indications for hangman's fractures, particularly Type II and Type III according to Effendi, Levine, and Edwards, are still debatable [2,3]. In this article, we present the management of an unstable type III hangman's fracture in a young aged patient without any neurological deficits that was treated by anterior stabilization of C2-3 and posterior stabilization of C1-2.

2. MATERIALS AND METHODOLOGY

2.1 Case Report

A 22-year-old female was brought to the emergency department due to multiple injuries following a motor vehicle accident 1 day prior. The patient felt severe pain in his neck and left hemithorax. She did not lose consciousness and her neurological status was intact. The patient was graded E according to the American Spinal Injury Association (ASIA) score.

An urgent X-ray of the cervical spine and thorax revealed the presence of spondylolisthesis of the axis with significant translation, and fracture of costae at level 8th, 9th, and 10th with hemothorax on the left side (Fig. 1). Intercostal drainage was done for hemothorax evacuation. An initial reduction and stabilization by using Gardner-Wells tongs (GWT) with 3 kgs of weight was performed on this patient and followed by a plain x-ray evaluation 1 day after (Fig. 1). GWT was applied for 3 days until the operation was performed.

Computerized tomography (CT) studies showed that the C-2 body was displaced anteriorly over C-3. Bilateral fractures of the pars interarticularis were present, and the lamina is still intact (Fig. 2).

A sagittal T1-weighted magnetic resonance (MR) image showed widening of the spinal canal at the level of the C-2 body as a result of its anterior dislocation, and mild compression of the spinal cord by the posterosuperior edge of the C-3 body and C2-3 disc material (Fig. 3 left). A series of T2-weighted MR images showed increased signal intensity within intervertebral disc of C2-3, suggestive of hematoma.

The patient was treated conservatively for fractures of 8th, 9th, and 10th left costae and operatively for cervical fracture.

2.2 Operation

The patient was placed in the supine position with the neck slightly extended. A standard horizontal incision was made, midway between the angle of the jaw and the thyroid cartilage. In this case, C2–3 anterior exposure was obtained, and a tear of the anterior longitudinal ligaments and disc disruption were observed. After the C2–3 discectomy was completed, the cage was filled with synthetic bone graft and put into the disc space with distraction force applied. Subsequently, the anterior cervical plate was implanted with compression force applied under fluoroscopic guidance.

Fig. 1. Left: Lateral cervical radiograph showing complete anterolisthesis of C-2 over C-3; Middle: Lateral cervical radiograph with 3 kgs of GWT applied. Translation and angulation were reduced; Right: thorax radiograph showing left hemothorax

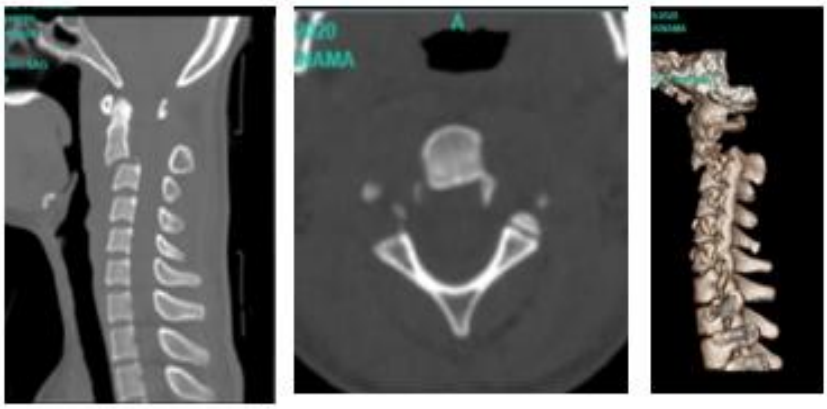

Fig. 2. Left: CT scan sagittal plane showing anterior displacement. Center: Bilateral fracture of pars interarticularis. Right: CT 3D, showing C2 over C3 anterolisthesis much more clearly

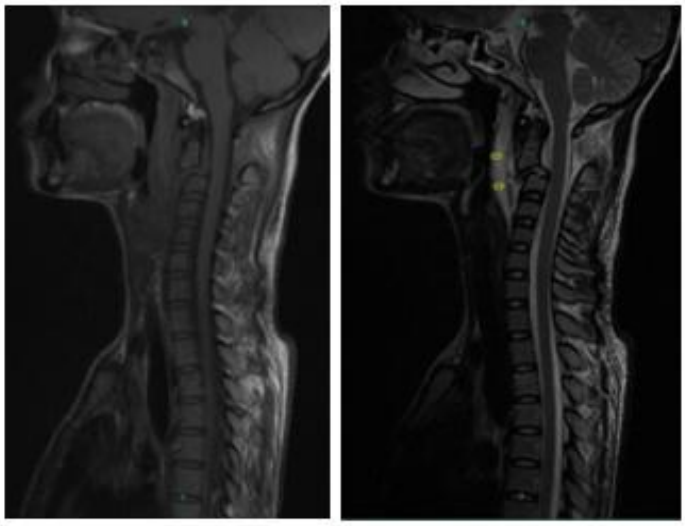

Fig. 3. Left: MRI T1 sagittal showing mild compression of the spinal cord at level C2-3 and widening of the spinal canal. Right: T2 MRI of C2-3 reveals a hematoma

Following the anterior surgery, the patient was put in the prone position. The neck was in slight flexion with the posterior midline incision to expose the C1 and C2. The bone graft was wired from C-1 to C-2 with sublaminar wire cables at each level and on both sides (Fig. 4). Drainage was used and a Philadelphia cervical collar was put on the patient at the end of the procedure and used for postoperative neck immobilization for 6 to 8 weeks.

3. RESULTS AND DISCUSSION

3.1 Results

The postoperative radiograph showed good reduction and positioning of the implants (Fig. 5). One day after surgery, we checked the neurological status of the patient by physical examination. There was no significant difference in the neurological status of the patient between before and after the operation.

One week after the operation, the patient started ambulation without any assisted devices (Fig. 6). There was also normal autonomic function, no disturbance in defecation or micturition.

3.2 Discussion

Hangman's fractures are uncommonly associated with neurological impairments or complications because they decompress the spinal canal [4,5,6]. As a result, the most

effective treatment for the unstable hangman's fracture is still up for debate. Surgical reduction and stabilization are performed in cases of severe displacement and instability, usually by posterior fusion of the upper cervical vertebrae or anterior fusion of the second and third vertebrae. The surgical treatment of an unstable hangman's fractures aims for reduction, stabilization, and alignment maintenance [7].

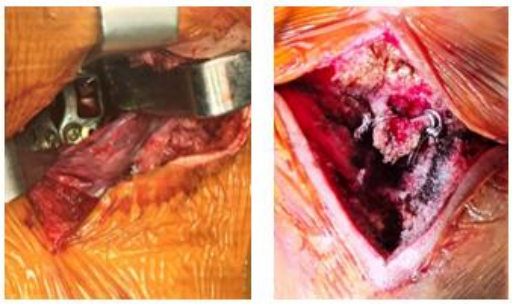

Fig. 4. Left: Post-ACDF clinical image of C2-3; Right: Sublaminar wire of C1-2

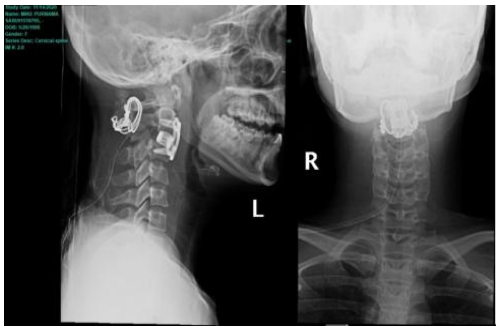

Fig. 5. Postoperative radiograph

Fig. 6. Patient started ambulation one week after the operation

Anterior, posterior, and double approaches are the three types of surgical interventions [8]. Anterior surgery involves removing the C2 C3 intervertebral disc, implanting autologous iliac bone or other materials into the fracture space, and afterwards fixing the fracture with steel plates [9,10]. The removal of the disc tissue in the spinal canal, as well as the excision of the cataclastic intercalated disc, is a major benefit of this procedure.[11] Simple anterior surgery, on the other hand, does not reduce the fracture malposition and frequently needs additional postoperative external fixation [11].

C2 cervical pedicle screw fixation, combined C2 pedicle and C3 lateral screw fixation, posterior fixation extended to C1, sublaminar wire, and occipital cervical fusion are all types of posterior surgery [12-16]. The posterior approach is used more often than any other method. This method could also avoid flexion deformity and correct local kyphosis [17].

We considered the combination anteroposterior to achieve a good reduction and stabilization. The combination of anterior-posterior surgery for Levine-Edwards types II, IIA, and III results in strong fixation and immediate stability, which allows patients to sit up or walk immediately after surgery and return to normal life as soon as possible. To achieve a high fusion rate, a bone graft is used.[11] In the anterior approach, an interbody fusion cage and anterior cervical plate were required due to the patient's progressive instability over time due to a young patient [18].

4. CONCLUSION

In the treatment of unstable Hangman's fractures, anterior fusion of C2-3 combined with posterior sublaminar wire fixation of C1-2 is effective in achieving cervical spinal stability and offers good clinical outcomes for axial neck pain. Because of short segment fusion, motion can be preserved. More research is needed to compare its clinical and radiological results to those of other fixation methods.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Schneider RC, Livingston KE, Cave AJE, Hamilton G. “Hangman’s Fracture” of the cervical spine. J Neurosurg. 1965;22:141 54.
2. Effendi B, Roy D, Cornish B, Dussault RG, Laurin CA. Fractures of the ring of the axis. A classification based on the analysis of 131 cases. J Bone Joint Surg Br. 1981;63-B(3):319-27.
   DOI: 10.1302/0301-620X.63B3.7263741. PMID: 7263741.
3. Levine AM, Edwards CC. The management of traumatic spondy-lolisthesis of the axis. J Bone Joint Surg Am. 1985;67(2):217-26.
   PMID: 3968113
4. Hadley MN, Browner C, Sonntag VK. Axis fractures: a comprehensive review of management and treatment in 107 cases. Neurosurgery. 1985;17(2):281-90.
   DOI: 10.1227/00006123-198508000-00006. PMID: 4033879.
5. Choi WG, Vishteh AG, Baskin JJ, Marciano FF, Dickman CA. Completely dislocated hangman's fracture with a locked C2-3 facet. Case report. J Neurosurg. 1997;87(5):757-60.
   DOI: 10.3171/jns.1997.87.5.0757.
   PMID: 9347986.
6. Seljeskog EL, Chou SN. Spectrum of the hangman's fracture. J Neurosurg. 1976;45(1):3-8.
   DOI: 10.3171/jns.1976.45.1.0003
   PMID: 932798.
7. Xu H, Zhao J, Yuan J, Wang C. Anterior discectomy and fusion with internal fixation for unstable hangman's fracture. Int Orthop. 2010;34(1):85-8.
   DOI: 10.1007/s00264-008-0658-0.
   Epub 2008 Oct 14
   PMID: 18853157
   PMCID: PMC2899270
8. Xie N, Khoo LT, Yuan W, Ye XJ, Chen DY, Xiao JR, Ni B. Combined anterior C2-C3 fusion and C2 pedicle screw fixation for the treatment of unstable hangman's fracture: a contrast to anterior approach only. Spine (Phila Pa 1976). 2010;35(6):613-9.
   DOI: 10.1097/BRS.0b013e3181ba3368. PMID: 20150833.
9. Bristol R, Henn JS, Dickman CA. Pars screw fixation of a hangman's fracture: technical case report. Neurosurgery. 2005;56(1Suppl):E204; discussion E204.
   DOI:10.1227/01.neu.0000144172.84111.a6. PMID: 15799815.
10. Ying Z, Wen Y, Xinwei W, Yong T, Hongyu L, Zhu H, Qinggang Z, Weihong Z, Yonggeng C. Anterior cervical discectomy and fusion for unstable traumatic spondylolisthesis of the axis. Spine (Phila Pa 1976). 2008;33(3):255-8.
    DOI: 10.1097/BRS.0b013e31816233d0. PMID: 18303456.
11. Liu J, Li Y, Wu Y. One-stage posterior C2 and C3 pedicle screw fixation or combined anterior C2-C3 fusion for the treatment of unstable hangman's fracture. Exp Ther Med. 2013;5(3):667-672.
    DOI: 10.3892/etm.2013.898. Epub 2013 Jan 16. PMID: 23408668; PMCID: PMC3570178.
12. Kim SM, Lim TJ, Paterno J, Hwang TJ, Lee KW, Balabhadra RS, Kim DH. Biomechanical comparison of anterior and posterior stabilization methods in atlantoaxial instability. J Neurosurg. 2004;100(3 Suppl Spine):277-83.
    DOI: 10.3171/spi.2004.100.3.0277. PMID: 15029916.
13. Termansen NB. Hangman's fracture. Acta Orthop Scand. 1974;45(4):529- 39.
    DOI: 10.3109/17453677408989176. PMID: 4451060.
14. Verheggen R, Jansen J. Hangman's fracture: arguments in favor of surgical therapy for type II and III according to Edwards and Levine. Surg Neurol. 1998;49(3):253-61; discussion 261-2.
    DOI: 10.1016/s0090-3019(97)00300-5. PMID: 9508111.
15. Taller S, Suchomel P, Lukás R, and Beran J: CT guided internal fixation of a hangman's fracture. Eur Spine J. 2000;9: 393 397.
16. Samaha C, Lazennec JY, Laporte C and Saillant G: Hangman fracture: the relationship between asymmetry and instability. J Bone Joint Surg Br 2000;82: 1046 1052.
17. Li XF, Dai LY, Lu H, Chen XD. A systematic review of the management of hangman's fractures. Eur Spine J. 2006;15(3):257-269.

18. Nishimura Y, Ellis MJ, Anderson J, Hara M, Natsume A, Ginsberg HJ. Progressively unstable c2 spondylolysis requiring spinal fusion: case report. Neurol Med Chir (Tokyo). 2014;54(9):761-7.
DOI: 10.2176/nmc.cr.2013-0223. Epub 2014 Feb 28.
PMID: 24584279;
PMCID: PMC4533371.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/73573