



October-December 2023
Vol. 1, no. 4 / pp. 252-255

Received: September 28, 2023
Accepted: September 30, 2023

doi: 10.35366/113727

Transpedicular screw fixation at C2 in the treatment of Levine-Edwards type III Hangman's fracture: an option to preserve motion

Fijación con tornillo transpedicular en C2 en el tratamiento de fractura de Hangman tipo III de Levine-Edwards: una opción para preservar el movimiento

Abrahan Alfonso Tafur-Grandett,^{*,‡} Luis Romeo Ramos-Hinojosa,^{*} José Ramón Olivas-Campos^{*}

Keywords:

type III Hangman's fracture, transpedicular screw, spinal cord trauma, preserved motion.

Palabras clave:

fractura de Hangman tipo III, tornillo transpedicular, traumatismo raquímedular, preservación de movimiento.

ABSTRACT

Introduction: bilateral pars interarticularis fracture of C2 due to traumatic spondylolisthesis accounts for 4 to 7% of cervical fractures and 20 to 22% of C2 fractures. The choice of surgical approach remains controversial; available options include C2-C3 ACDF, C2-C3 posterior fusion, C2 transpedicular screw alone, and 360° approach. **Case presentation:** male, 60 years old, after a rollover car accident, presents with neck pain VAS 10/10, radiculopathy in right C2-C5, strength 3/5 on the MRC Scale in right C4-C5, right bicipital reflex 1/+. CT with Hangman Type III fracture. We performed external cervical reduction with Mayfield head support, posterior cervical approach and transpedicular fixation of C2, polyaxial trans facet screws in C3 and lateral titanium bars. **Conclusions:** Hangman type III fractures must be diagnosed promptly due to the risk of neurological injury. These should be treated with fixation, if possible, with a transpedicular screw at C2, which is an excellent option for reduction and stabilization of the fracture, maintenance of cervical alignment and preservation of ranges of motion.

RESUMEN

Introducción: la fractura bilateral de la pars interarticularis de C2 por espondilolistesis traumática representa 4 a 7% de las fracturas cervicales y 20 a 22% de las fracturas de C2. La elección del abordaje quirúrgico sigue siendo controvertida; las opciones disponibles incluyen ACDF C2-C3, fusión posterior C2-C3, tornillo transpedicular de C2 solo y abordaje 360°. **Presentación del caso:** masculino, 60 años de edad, tras accidente automovilístico tipo volcadura, cursa con cervicalgia EVA 10/10, radiculopatía en C2-C5 derecha, fuerza 3/5 en escala MRC en C4-C5 derecho, reflejo bicipital derecho 1/+. TC con fractura de Hangman tipo III. Hicimos reducción cervical externa con apoyo de cabezal de Mayfield, abordaje cervical posterior y fijación transpedicular de C2, tornillos transmacizo facetario en C3 y barras laterales de titanio. **Conclusiones:** las fracturas de Hangman tipo III deben diagnosticarse oportunamente debido al riesgo de lesión neurológica. Estas deben tratarse con fijación, si es posible con tornillo transpedicular en C2, que es una excelente opción para la reducción y estabilización de la fractura, mantenimiento de la alineación cervical y preservación de los rangos de movimiento.

* Department of Neurosurgery and Spine Surgery, Regional Hospital Monterrey ISSSTE, Institute of Security and Social Services for State Workers, Monterrey, Nuevo León, Mexico.
‡ ORCID: 0000-0001-8874-372X

Correspondence:

Abrahan Alfonso Tafur-Grandett
E-mail: atafur.grandett@hotmail.com

How to cite: Tafur-Grandett AA, Ramos-Hinojosa LR, Olivas-Campos JR. Transpedicular screw fixation at C2 in the treatment of Levine-Edwards type III Hangman's fracture: an option to preserve motion. *Cir Columna*. 2023; 1 (4): 252-255. <https://dx.doi.org/10.35366/113727>



INTRODUCTION

The Hangman fracture is a bilateral fracture of the pars interarticularis of C2 due to traumatic spondylolisthesis. First described in 1965 by Schneider¹ in an avulsion fracture of the C2 lamina with dislocation and listhesis of the axis on C3, which was correlated with the fracture pattern described in judicial hangings that used a submental knot. These injuries account for 4% to 7% of all cervical spine fractures² and 20 to 22% of C2 fractures.³ 65% of C2 fractures are caused by motor vehicle accidents, 15% by falls from high impact and 6% from diving injuries.⁴ Due to unstable Hangman fractures, great caution is required when treating them and proper diagnosis of these injuries allows us to distinguish between stable and unstable fracture patterns and non-surgical vs surgical treatments.⁴ The choice of surgical approach remains controversial; available options include C2-C3 anterior cervical discectomy and fusion (ACDF), C2-C3 posterior fusion, C2 transpedicular screw alone, and 360° fixation and fusion.^{3,5,6}

PRESENTATION OF CASE

A 60-year-old male, who had a rollover-type car accident, while being the co-pilot and without safety measures, reported sudden right cervicobrachialgia of intensity 10/10, disabling, and loss of strength in the right thoracic limb. The neurological examination showed neck pain 10/10 on the VAS, as well as radiculopathy in C2, C3 right (pain and dysesthesia

VAS 10/10 in the occipital, temporal and right auricular region), C4 and C5 right (pain and dysesthesia in the clavicular and right shoulder), strength 3/5 on the MRC Scale in right C4-C5, right bicipital reflex 1/+.

We performed a simple CT of the cervical spine, in which we showed bilateral fracture of the pars interarticularis of C2, with C2 spondylolisthesis of 7.1 mm, C2-C3 angulation of 12.4° and dislocation of the bilateral articular facets (*Figure 1*). Simple MRI of the cervical spine with C2 spondylolisthesis and early data of spinal cord edema at the C2-C3 level (*Figure 2*). Angiography without evidence of injury to both vertebral arteries.

With the patient under balanced general anesthesia, in the prone position we carried out cervical reduction with Mayfield head support, we continued through a posterior cervical approach to perform transpedicular fixation of C2 and trans facet screws in C3 and lateral titanium bars (*Figure 3*). In the immediate postoperative period with total improvement of the right C2-C4 radiculopathy and recovery of MTD strength 5/5 on the MRC scale. At 3 months of follow-up, the patient is showing excellent neurological evolution, with preserved and complete ranges of motion in flexion, extension, lateral inclination and rotation.

DISCUSSION

The first Hangman's fracture classification was proposed in 1981 by Effendi.⁷ This classification system is based on the degree and type of displacement of the anterior and posterior fragments of the C2 fracture.

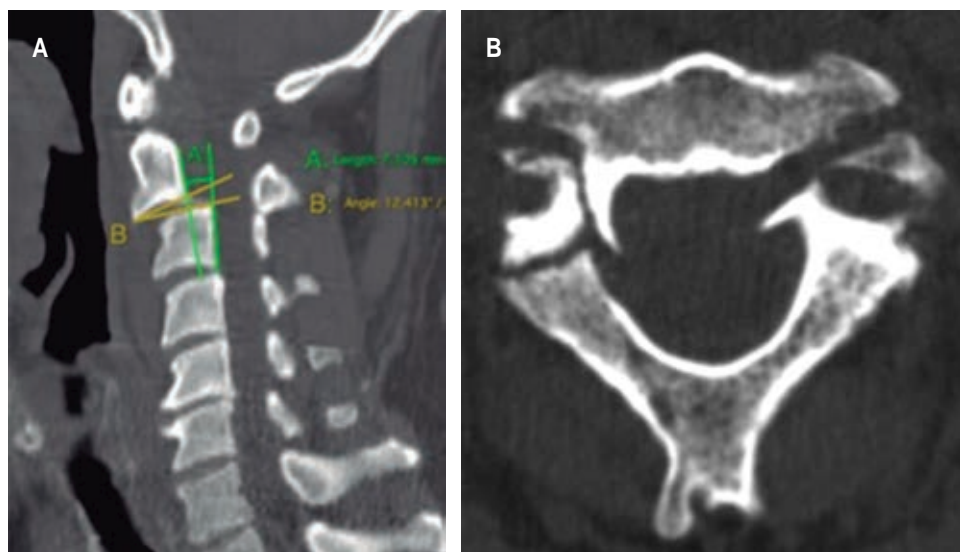


Figure 1:

Simple CT of the cervical spine. **A)** C2 spondylolisthesis of 7.1 mm and C2-C3 angulation of 12.4°. **B)** Bilateral fracture of the pars interarticularis of C2, with complete stenosis of the right neuroforamen.

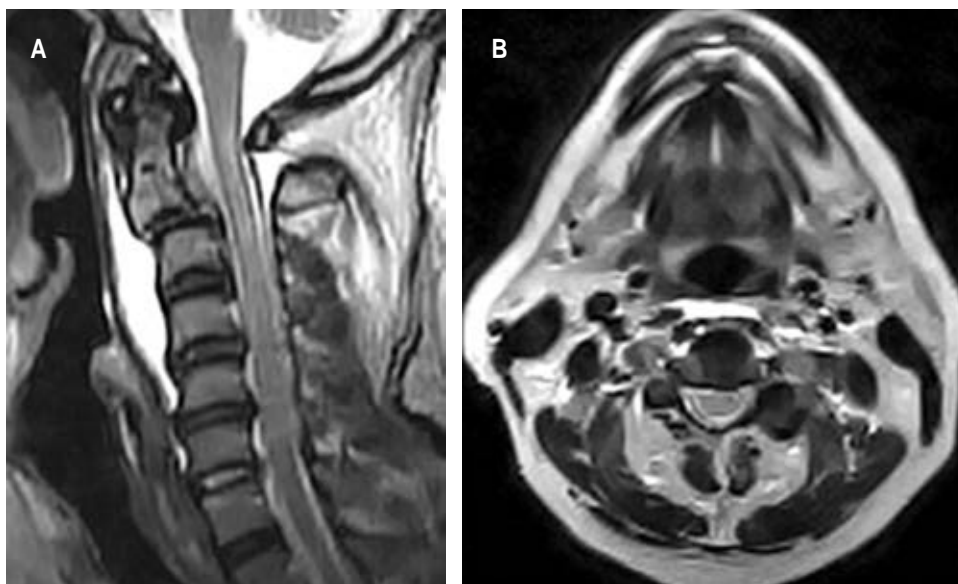


Figure 2:

Simple MRI of the cervical spine. **A)** Sagittal T2 with C2-C3 spondylolisthesis and early signs of spinal edema. **B)** T2 axial complete stenosis of the right neuroforamen of C2.

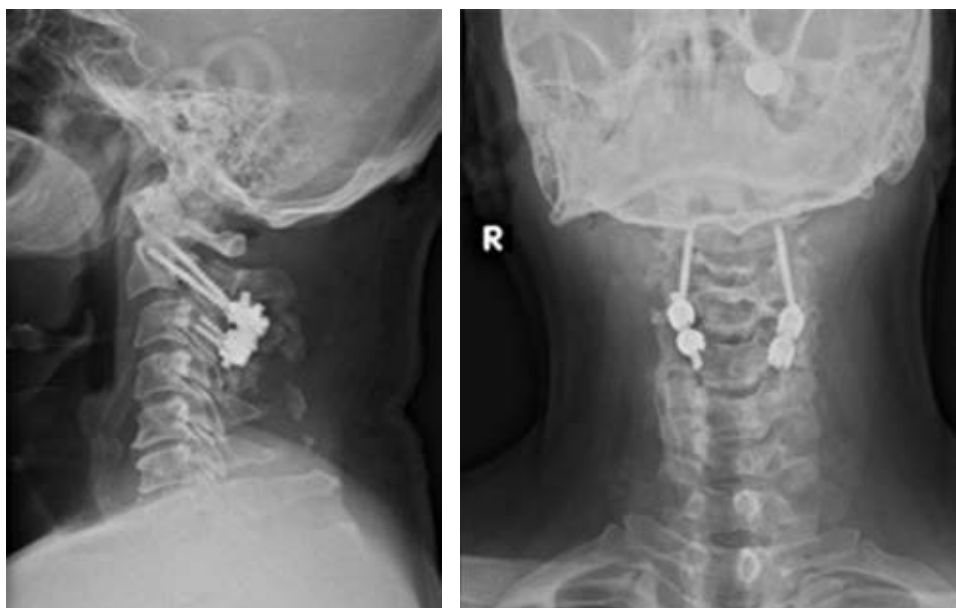


Figure 3:

Lateral and anteroposterior radiograph of the cervical spine, with reduction of C2-C3 spondylolisthesis and facet dislocation, with adequate placement of C2 transpedicular screws and C3 trans facet screws and lateral titanium bars.

The classification scheme proposed by Effendi was modified by Levine and Edwards⁸ in 1985, and is the most widely used classification system for typical Hangman's fractures. Type I injuries are non-angulated fractures with a displacement of < 3 mm, resulting from an axial loading force in hyperextension. Type II injuries present angulation < 11° and a displacement > 3 mm, resulting from an axial load force in hyperextension combined with flexion and anterior compression. Type IIa lesions present angulation > 11° and a displacement

> 3 mm. Type III injuries present angulation > 11° and a displacement > 3 mm with dislocation of the bilateral facet joints, due to a flexion-compression mechanism.⁸ It is widely accepted that type II, IIa and III fractures are unstable and must be treated surgically.⁹

Hangman's type III fractures should be diagnosed and treated promptly due to the risk of neurological injury. In 1964, Leconte¹⁰ described direct C2 transpedicular fixation for the Hangman's fracture, demonstrating its effectiveness. This C2 fixation is an excellent option

for reduction and stabilization of the fracture and is considered a “physiological operation”, preserving the movement of the normal segments.² The surgical objectives, in addition to the reduction, stabilization and maintenance of the alignment of the cervical spine, should be the preservation of the range of motion.^{9,11}

Different surgical approaches, both anterior and posterior, have been described for the treatment of Hangman's type III fracture.^{2,5,9,11} An anterior approach has the advantage of a technically simple and relatively short fusion involving a C2-C3 discectomy with interbody fusion and plating.¹² However, the anterior approach cannot address the detached posterior arch of C2 and may have approach-related problems. The high risks of the anterior approach are mainly injuries to vital structures, especially to the facial and hypoglossal nerves, branches of the external carotid artery, contents of the carotid sheath, and the superior laryngeal nerve.² The posterior approach is associated with a relatively simple exposure without important vascular or visceral structures, as well as a lower rate of complications. However, both discectomy and ACDF and posterior fixation with C1-C2 screws will lose mobility of the fused segment.^{2,9} Direct repair of the pars interarticularis fracture with a transpedicular screw across the fracture line has the advantage of preserve segment motion.^{2,13} However, traditional transpedicular screw fixation for Hangman fracture has several disadvantages. First, reduction cannot be easily achieved with a traditional transpedicular screw because the direction of the screw hole is usually not perpendicular to the fracture line, which can lead to loss of reduction during compression. Secondly, it could not offer enough stability (which is why in our case we decided to place trans facet screws in C3). Third, this method easily causes excessive compression, and the extent of compression depends on the experience of the surgeon. The healing rate of Hangman type III fractures treated by C2 transpedicular fixation is high (89.29%).^{9,13}

CONCLUSION

In the treatment of unstable traumatic spondylolisthesis of the axis, posterior fixation of C2-C3 is preferred, with a transpedicular screw in C2, obtaining open reduction of dislocations, as well as favorable clinical and radiological results. This procedure is technically demanding and must be performed with great care to avoid possible complications. Hopefully, with the availability of modern innovations in our developing countries, these dangers will be reduced to a minimum.

REFERENCES

1. Schneider RC, Livingston KE, Cave AJ, Hamilton G. Hangman's fracture of the cervical spine. *J Neurosurg.* 1965; 22: 141-154.
2. Liu Y, Zhu Y, Li X, Chen J, Yang S, Yang H, et al. A new transpedicular lag screw fixation for treatment of unstable Hangman's fracture: a minimum 2-year follow-up study. *J Orthop Surg Res.* 2020; 15: 372. doi: 10.1186/s13018-020-01911-3.
3. Murphy H, Schroeder GD, Shi WJ, Kepler CK, Kurd MF, Fleischman AN, et al. Management of hangman's fractures: A systematic review. *J Orthop Trauma.* 2017; 31: S90-95. doi: 10.1097/bot.0000000000000952.
4. Turtle J, Kantor A, Spina NT, France JC, Lawrence BD. Hangman's fracture. *Clin Spine Surg.* 2020; 33: 345-354. doi: 10.1097/bsd.0000000000001093.
5. Hur H, Lee J-K, Jang J-W, Kim T-S, Kim S-H. Is it feasible to treat unstable hangman's fracture via the primary standard anterior retropharyngeal approach? *Eur Spine J.* 2014; 23: 1641-167. doi: 10.1007/s00586-014-3311-1.
6. Muthukumar N. C1-C3 lateral mass fusion for type IIa and type III Hangman's fracture. *J Craniovertebr Junction Spine.* 2012; 3: 62-66. doi: 10.4103/0974-8237.116541.
7. 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: 319-327. doi: 10.1302/0301-620X.63B3.7263741.
8. Levine AM, Edwards CC. The management of traumatic spondylolisthesis of the axis. *J Bone Joint Surg Am.* 1985; 67: 217-226. doi: 10.2106/00004623-198567020-00007.
9. Zhang J, Li G, Wang Q. Is it feasible to treat unstable traumatic spondylolisthesis of the axis via posterior fixation without fusion? *BMC Musculoskelet Disord.* 2023; 122: 24. doi: 10.1186/s12891-023-06233-z.
10. Leconte P. luxation des deux premieres vertebres cervicales. In: Judet R (ed) *Luxation congenitale dela hanche: fracture du cou-de-pied rachis cervical.* Actualites de Chirurgie Orthopedique de l'Ho pital Raymond-Poincare Masson, Paris. 1964, 147-166.
11. Li G, Wang Q, Liu H, Hong Y. Individual surgical strategy using posterior lag screw-rod technique for unstable atypical hangman's fracture based on different fracture patterns. *World Neurosurg.* 2018; 119: e848-854. doi: 10.1016/j.wneu.2018.07.285.
12. Ge C, Hao D, He B, Mi B. Anterior cervical discectomy and fusion versus posterior fixation and fusion of C2-3 for unstable hangman's fracture. *J Spinal Disord Tech.* 2015; 28: E61-66. doi: 10.1097/BSD.0000000000000150.
13. Patel JK, Kundnani V, Kuriya S, Raut S, Meena M. Unstable Hangman's fracture: anterior or posterior surgery? *J Craniovertebr Junction Spine.* 2019; 10: 210. doi: 10.4103/jcvjs.jcvjs_112_19.

Funding: none.

Conflict of interests: there are no conflict of interest.