



Case Report

Failure of C2-3 anterior arthrodesis for the treatment of atypical Hangman's fractures: A three case series

Zaid Aljuboori¹, Samer Hoz², Maxwell Boakye¹

Departments of ¹Neurosurgery, University of Louisville, Louisville, Kentucky, ²Neurosurgery Teaching Hospital, Baghdad, Iraq.

E-mail: *Zaid Aljuboori - zaid.aljuboori@yahoo.com; Samer Hoz - hozsamer2055@gmail.com; Maxwell Boakye - maxwell.boakye@ulp.org



*Corresponding author:

Zaid Aljuboori,
Departments of Neurosurgery,
University of Louisville,
Louisville, Kentucky.

zaid.aljuboori@yahoo.com

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ABSTRACT

Background: Hangman's fractures (HF) are defined by bilateral fractures of pars interarticularis of the axis. Most can be treated with a collar. However, the treatment strategies for atypical HF (AHF) involve the pedicles, are unstable, and require fusion. Here, we present three cases of AHF that failed anterior arthrodesis warranting repeat anterior (one case), and posterior fusions (three cases).

Case Description: One female and two males, ranging from 48 to 69 years of age, presented with AHF. All three were originally treated with C2-3 anterior cervical discectomy/fusion, and all three failed (e.g., resulted in pseudarthrosis/ anterolisthesis/instability). The first patient required a secondary C3 corpectomy/C2-4 arthrodesis, with C1-C4 posterior instrumentation. The latter two patients required secondary C1-C3 posterior fusions. For all three patients, 3–12 months follow-up X-rays confirmed the excellent alignment of the instrumentation and bony fusion.

Conclusion: Anterior arthrodesis can be utilized to treat AHF, but often fail when addressing AHF. All AHF warranted secondary posterior fusions (e.g., C1-C3 two cases; and C1-C4 one case) and a subset may additionally require more extensive anterior fusions (e.g., C2-C4 with corpectomy of C3).

Keywords: Anterolisthesis, Arthrodesis, Atypical, Hangman's fracture, Instrumentation, Spine, Trauma

INTRODUCTION

Traumatic spondylolisthesis of the axis hangman's fractures (HF) involves fracture of the pars interarticularis bilaterally. These are the second most common type of axis fractures.^[3,4] Most patients with typical HF are neurologically intact; only 6.5% present with neurological injury.^[2,6,7] However, atypical HF (AHF) that includes fractures of the pedicle, lamina, and/or posterior vertebral body, result in instability often warranting more extensive anterior fusion, and uniformly multilevel posterior fusions.^[5] Here, we describe three cases of AHF that failed following C2-3 anterior cervical discectomy/fusion (ACDF); one required a secondary C2-C4 anterior corpectomy/fusion with C1-C4 posterior arthrodesis, while two were managed with C1-C3 fusions alone.

CASE PRESENTATIONS

Three patients presented with AHF; these included one female and two males, ranging in age from 48 to 69 years of age [Figure 1a-1c]. All three were originally managed with C2-C3

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ACDF, and all three resulted in pseudarthrosis/increased anterolisthesis [Figure 2a-2c]. The first patient secondarily required a C3 corpectomy with a C2-4 anterior arthrodesis followed by a C1-C4 posterior fusion. The second and third patients had pseudarthroses requiring fracture reduction and secondary C1-C3 fusions [Table 1]. Postoperatively, all patients remained neurologically intact, and there were no complications. On follow-up 12 months later, all patients showed fusion on dynamic X-rays [Figures 3a-3c].

DISCUSSION

Here, we analyzed three cases of AHF that failed following C2-C3 ACDF variously all attributed to: (1) involvement

of the C2 pedicle/posterior vertebral body (one case), and disc disruption (two cases). All patients were treated with C2-3 ACDF shortly after injury and received rigid cervical orthoses.

Failure recognition

The failure of the anterior arthrodesis was evident in the initial postoperative imaging in two cases and on the 2 months follow-up exam for the third patient [Table 1]. The failures were not associated with screw pull-out or breakage. One required anterior/posterior fixation, while two only underwent posterior spinal arthrodesis C1-C3.

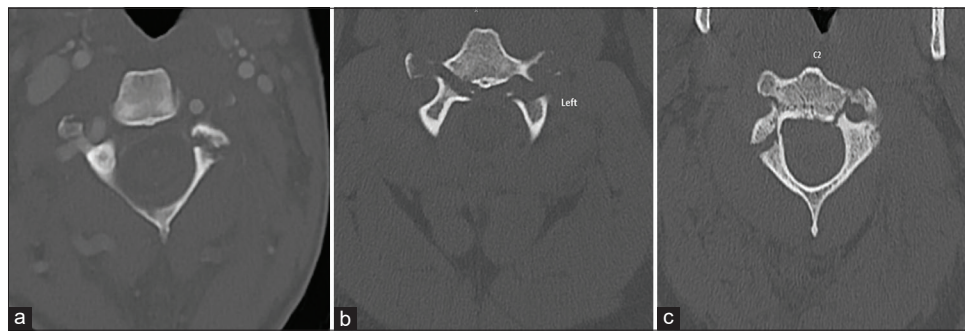


Figure 1: CT C-spine [axial] shows (a) left pars fracture, (b) bilateral pedicle fracture, (c) bilateral pedicle fracture.

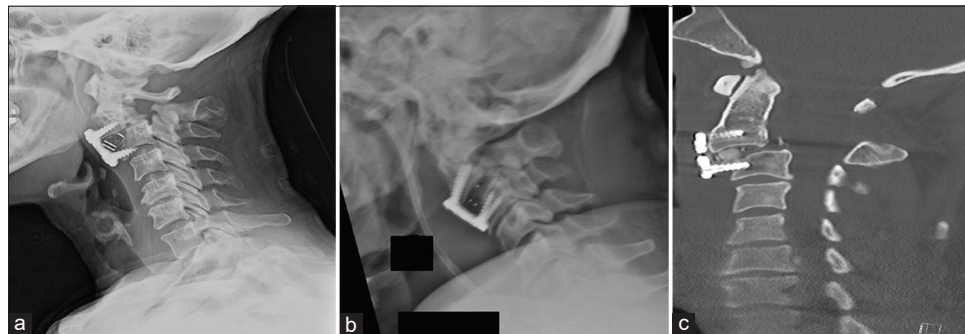


Figure 2: C-spine X-ray [lateral] shows (a) C2-3 arthrodesis with new anterolisthesis, (b) C2-3 arthrodesis with new anterolisthesis, (c) CT C-spine [sagittal] shows new C2-3 anterolisthesis.

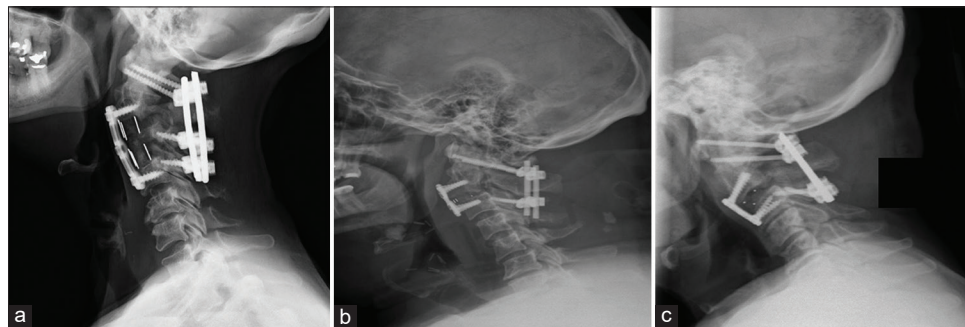


Figure 3: C-spine X-ray [lateral] shows (a) C3 corpectomy with C2-4 anterior and C1-C4 posterior arthrodesis, (b) reduction of C2-3 with C1-C3 posterior arthrodesis, (c) reduction of C2-3 with C1-C3 posterior arthrodesis.

Table 1: Summary of the data for all three patients.

Case number	Diagnosis acute heart failure X-ray or CT	Postoperative pseudarthrosis X-ray or CT time duration	Secondary surgery anterior posterior	Time to fusion postoperatively
1	C2 fracture left pars and right pedicle	C2/3 X-ray anterolisthesis 2 months postoperative	C3 corpectomy; C2-4 fusion C1-C4 posterior fusion	X-rays: stable alignment fusion 8 months postoperative Solid fusion 1 year
2	C2 fracture both pedicles and posterior vertebral body	C2/3 anterolisthesis, immediate postoperative CT scan	fracture reduction C1-C3 posterior fusion	X-rays-fusion 3 months postoperative
3	C2 fracture both pedicles	C2/3 anterolisthesis, immediate postoperative X-rays	fracture reduction C1-C3 posterior fusion	

CT: Computed tomography

Literature review

Al-Mahfoudh *et al.* reported a study of 41 patients with HF; 68.2% were atypical.^[1] Some authors suggested that anterior arthrodesis was not ideal to treat AHF due to the asymmetric nature of the fracture (e.g., leading to unsatisfactory reduction, increased angulation, and/or anterior translation).^[8] In comparison, posterior C2-3 arthrodesis has been shown to have a biomechanical superiority to anterior fusion with higher stability documented on dynamic X-rays (e.g., lateral bending, flexion, and axial rotation studies).^[8] To ensure the success of posterior fusion, preoperative imaging analysis is crucial focusing on axial, coronal, and sagittal planes to better understand fracture anatomy.^[8] Furthermore, proper exposure with adequate reduction followed by posterior arthrodesis increases the success of the procedure.

CONCLUSION

Anterior arthrodesis offers a >90% fusion rate for typical HF, but not for AHF. We suggest that AHF, especially with pedicle(s) involvement, be treated occasionally with anterior reoperations (e.g., if needed due to instrumentation displacement), but uniformly with secondary posterior stabilization.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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