

## Case Report &amp; Case Series

## Percutaneous posterior combined C2 translaminar and pedicle screws using Intraoperative O-arm Navigation in an atypical traumatic spondylolisthesis: Technical notes



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## ABSTRACT

**Introduction:** Traumatic spondylolisthesis is the second most common C2 fractures, no Class I or Class II evidence exists regarding the management of traumatic spondylolisthesis of the axis.

**Case presentation:** A 74-year-old German male presented to our emergency room with complaints of severe neck pain and difficulty in neck movements following a domestic accident 3 days ago.

CT-cervical spine showed a pedicle fracture in the right side without displacement or angulation and fracture of the lamina in the contralateral side. We considered the fracture as potentially stable. Conservative treatment was recommended. The patient refused the immobilization with the neck collar. The patient underwent a combination of PD and TL percutaneous screw, as navigated instrumented fusion of the craniocervical junction using O-arm Navigation.

During surgical approach, the surgeons used realtime images and reference-guiding device to decide the trajectory of the screws, two small skin incisions are placed posteriorly paramedian, the first to stabilize the lamina, the second to pass the right pedicle of C2. Operation time was 45 min and blood loss about 50 ml. The patient was discharge in day 3 and return to normal daily activity.

**Conclusions:** Percutaneous translaminar and pedicle screws stabilization in complex hangman's fractures using Intraoperative O-arm Navigation is a treatment option, provides a rapid return to normal life activity among patients who refuse the external immobilization or present difficult to apply external immobilization.

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### 1. Introduction

Traumatic spondylolisthesis (hangman fracture) is the second most common C2 fractures, approximately 10% of the upper cervical fractures occur in the body C2 [1].

Various treatment modalities are being used for C2 fractures but no Class I or Class II evidence exists regarding the management of traumatic spondylolisthesis of the axis [1,2].

Pseudarthrosis, whether as nonunion or malunion are the major complications of conservative treatment. Repeated imaging studies during follow-up period are essential [3].

Pedicle (PD) and translaminar (TL) screws are an accepted form of surgical treatment. They provide an efficient stabilization for all 3 columns of the spine and the posterior elements of C2 [1]. Percutaneous cervical instrumentation using O-Arm Navigation is a helpful method.

The feasibility and safety of percutaneous posterior cervical screws has been reported [4].

Here we are highlighting the technical details of surgical management of an atypical traumatic spondylolisthesis for which a percutaneous combined C2 translaminar and pedicle screws fixation was done.

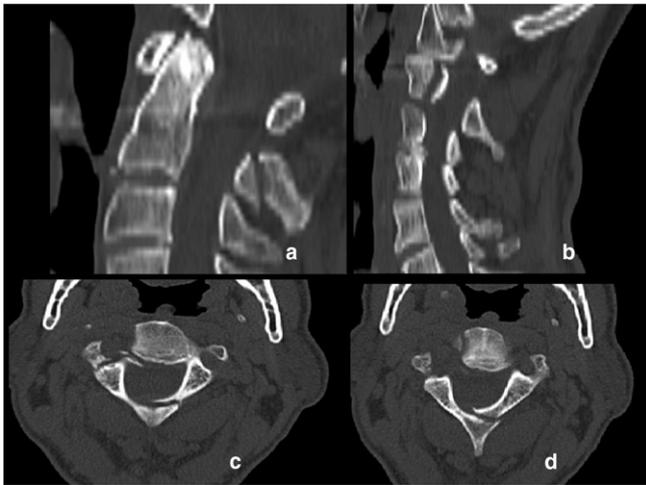
### 2. Case presentation

A 74-year-old German male presented to our emergency room with complaints of severe neck pain and difficulty in neck movements following a domestic accident 3 days ago. Cervical radiography showed a C2 fracture (Fig. 1). Cervical immobilization with a Philadelphia collar was performed following referral to our emergency department. Physical examination revealed massive neck stiffness without neurological findings.

CT-cervical spine showed a pedicle fracture in the right side without displacement or angulation and fracture of the lamina in the contralateral side (Fig. 1).

The imaging findings were discussed with the patient along with conservative and operative management. The patient was refraining the conservative therapy, refusing the external immobilization with

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**Fig. 1.** Shows a posteriorly located fracture involving the lamina superiorly and fracture on the opposite side involves the pedicle.

the neck collar. After team discussion we decided to use a combination of PD and TL percutaneous screw, as navigated instrumented fusion of the craniocervical junction is standard of care in our institution with the O-Arm Navigation system.

### 3. Surgical procedures

- General anesthesia with nasotracheal tube was given.
- The patient was placed in the prone position with appropriate padding and sterile preparation.
- Head fixed in the carbon Mayfield skull clamp.
- The Stealth reference arc was affixed to the Mayfield skull clamp.
- The 3DCT images were obtained by the O-arm system and then transferred to a workstation (StealthStation, Medtronic) (Medtronic Inc., Minneapolis, MN, USA).
- The registration was made automatically.
- The surgeons used the realtime images and reference-guiding device to decide the trajectory of the screws. The Medtronic screw system (Vertex) has its own navigation screwdriver.
- Insertion of two K Wires using 2 small skin incision about 3 cm paramedian was performed, the first to stabilize the lamina, the second to pass the right pedicle of C2.
- As TL screw we used a standard trauma screw with continuous thread (4.0 mm × 40 mm) Medtronic, Minneapolis, USA.
- As PD screw we used a 4.5 × 38 mm fenestrated polyaxial pedicle screw (Vertex, Medtronic Inc. Minneapolis, MN, USA).
- After the screws had been placed, they were checked intraoperatively (Fig. 2).
- Operation time was 45 min and blood loss about 50 ml.



**Fig. 2.** Postoperative O-arm image showing the transpedicular and translaminar screws.

The patient was pain-free after surgery and his neurology was unchanged. He was immediately mobile without neck collar. The hospital duration was three days.

### 4. Discussion

According to the recommendation of the congress of neurological surgeons, the initial management of traumatic spondylolisthesis (hangman's fracture) should be external immobilization; surgical stabilization and fusion in cases with severe angulation, disc disruption or inability to use the external immobilization. There are no class I or class II evidence [2].

Effendi et al. classified C2 fracture into three types according to radiological displacement and stability. An atypical variant of traumatic spondylolisthesis has been described, with either unilateral or bilateral fractures in the coronal plane through the posterior body of C2 [5].

Our case showed a fracture of pedicle in one side and lamina in the contralateral side. Isolated fractures of one or both laminae are generally uncommon and mechanically stable. According to Effendi classification was our case a type 1 with additional lamina fracture. We considered the fracture as potentially stable. MRI has been not done due to refusal of conservative treatment from the patient.

The indication to surgery was based on several factors: 1 – the patient was not willing to any type of external immobilization, 2 – the availability of O-arm Navigation technology with supporting data related to its accuracy in terms of pedicle/lateral mass screw placement, 3 – the longtime experience of our team in similar unstable cases with shorted the operation time and complication rate, 4 – published data supporting the application of TD and TL screw, and 5 – published data showing a comparable mortality and complication rate in surgically and conservatively treated patients [1–5].

Our technique in this case has several advantages: avoidance of neck collar and the short hospital stay.

### 5. Conclusion

Percutaneous translaminar and pedicle screws stabilization in complex hangman's fractures using Intraoperative O-arm Navigation is a treatment option, provides a rapid return to normal life activity among patients who refuse the external immobilization or difficult to apply external immobilization.

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