

Headless Fully Threaded Screw (headless screw) Versus Headed Partially Threaded Screw (headed screw) Fixation Techniques For Odontoid Fracture Type II- A Case Series

Kanniah Thuraikumar¹, Kwong-Lee Wan¹, Sze Wei Lim¹

Abstract

Odontoid type II fracture is managed with various methods from non-operative such as Halo-vest to operative such as via anterior or posterior approaches and fixation. Posterior fixation of C1-C2 reduces the rotational range of motion significantly. Anterior odontoid fixation is typically done with screws. We present a case series of anterior odontoid screw fixation comparing three cases of headed partially threaded screw (headed screw) to two cases of headless fully threaded screw (headless screw). The headless screw had the advantages of easier technicality, better compression effect and biomechanical strength compared to a headed screw.

Keywords: Anterior odontoid fixation, Odontoid screw, Headless screw

Introduction:

Odontoid fracture constitutes 10-15% traumatic cervical spine injuries [1]. The fracture is classified as Type I, II and III by Anderson and D'Alonzo [2]. Type II fracture occurs at the waist of the odontoid. The inherent 'water-shed' area of vascularity and instability cause a higher non-healing rate [2]. The management for odontoid fracture type II varies which includes halo-vest, posterior C1-C2 fixation and fusion, anterior odontoid screw fixation via transoral or extended Smith-Robinson's approaches. Halo-vest and posterior C1-C2 fixation and fusion reduce the head rotation range of motion (ROM). Anterior odontoid screw fixation allows a better rotational ROM preservation. Sasso et al and Graziano et al reported biomechanical studies that one or two screws had similar strength [3,4]. Chi et al even reported percutaneous method of anterior odontoid screw fixation [5]. In

our centre, we compare case series of anterior odontoid screw fixation with cannulated headed partially threaded screw (headed screw) and cannulated headless fully threaded screw (headless screw).

Material and Methods:

A total of five cases of odontoid fracture Type II were fixed with anterior odontoid screws in 2018-2019. Three cases were fixed with headed screws and the other two were fixed with headless screw. All five patients were male, aged between 22 to 29 years old and the injury was caused by motor vehicle accidents. All patients did not have any neurological deficit. Fixation operation waiting time varied from four to twelve days due to the availability of operation slot and stabilization of concomitant life threatening. All patients had rigid trauma cervical collars with 'sandbags' to limit the rotational movement. All patients

were screened with pre-operative computed tomography (CT) cervical spine to assess the fracture pattern and to estimate the implant size for suitability of anterior odontoid screw fixation. All patients had two parts fracture pieces. A standard operating table was used and the patient was prepared as per standard cervical spine injury. Mouth bracket was applied to maintain the open mouth view. Two 2-dimensional image intensifiers (II) were positioned for simultaneous anterior-posterior (AP) and lateral views as shown in Figure 1. An extended Smith-Robinson's anterior cervical spine approach was used to reach C1/C2 intervertebral space. Anterior longitudinal ligament (ALL) were split vertically and the guidewire was inserted under image intensifier guidance followed by the screw insertion. The first three cases (A, B and C) were fixed with cannulated headed partially threaded titanium screws (headed

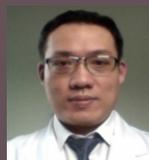
¹Department of Orthopaedics surgeon, Sungai Buloh Hospital, Jalan Hospital, 47000 Sungai Buloh, Selangor, Malaysia.

Address of Correspondence

Dr. Kwong-Lee Wan,
Department of Orthopaedics surgeon, Sungai Buloh Hospital, Jalan Hospital, 47000 Sungai Buloh, Selangor, Malaysia
Email: wankwonglee@yahoo.com



Dr. Kanniah Thuraikumar



Dr. Kwong-Lee Wan



Dr. Sze Wei Lim

© 2019 by International Journal of Spine | Available on www.ijsonline.co.in | DOI: 10.13107/ijsp.2019-v04i02.003

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



Figure 1: Positioning of the image intensifier (II) machine. Two machines were needed for simultaneous anterior-posterior (AP) and lateral views for anterior odontoid screw fixation.

screws) diameter 4.5mm (Smith & Nephew, USA) and the subsequent two cases (D and E) were fixed with cannulated headless fully threaded titanium screws (headless screws) diameter 4/5mm (Acutrak, Acumed, USA). All patients were put on semi-rigid Vista-Aspen cervical collar immediately after the fixation.

Results:

A total of five patients with odontoid type II fracture were fixed with anterior odontoid screws. The mean age of the patients was 23.8 years old. Four patients were motorcycle riders and one was a passenger in a sedan car with fastened seat belt. All five patients also had other injuries. Patients' waiting time to surgery was five to twelve days. Estimated blood

loss for each case was less than 200 ml for the procedure. The operation duration averaged 61.7 minutes and ranged from 45 to 70 minutes. The length of screws used for both headed and headless screws were similarly between 34mm to 36mm. The headed screws diameter was 4mm and the headless screws diameter was 4mm/5mm. Examples of fixation were shown in radiographs as per Figure 2 and Figure 3.

All five cases did not have direct intra-operative complications such as perforation into the spinal canal or basal skull nor injury to the oesophagus or trachea. One patient had post intubation hoarseness of voice due to the endotracheal tube-related vocal cord weakness which resolved a month later.

Discussion:

In our case series, all patients were young adults and were considered as polytrauma and thus, low threshold of CT Cervical was called which explained the association in polytrauma. The Smith-Robinson's anterior approach of the cervical spine was an adequate exposure because of the trajectory of the screw which was more caudal than anterior cervical plating at that C1/C2

level. This avoided the potential risks related to transoral anterior approach. The estimated blood loss was favourable as extensive dissection was not required. There were several challenges with regards to this technique of anterior odontoid fixation. Significant amount of image guidance was required. Thus, two image intensifiers were used to obtain simultaneous AP and lateral views projection and the positions of the machines were demonstrated in Figure 1. The duration of the operations were related to severity of displacement of the fracture pieces. Some obese patients presented a difficulty in obtaining a clear image and perhaps a 3-dimensional type of image guidance may be useful. Reduction was mainly done by gentle head manipulation and in some cases, the assistant had to maintain the head position until the screw was fully inserted and this subjected the assistant to be near to the radiation source. Obese patients posed an additional challenge as the 'thick' neck soft tissue limited the screw trajectory. A small cannulated power drill with the shortest wire coupler was favored. A specialized 'L-shape' power drill would be beneficial to increase the freedom of guidewire movement. Half threaded cannulated screw with the head with or without a washer was described in various articles for anterior odontoid screw fixation. The threaded part of the screw needed to pass the fracture line before a compression effect



Figure 2: Radiographs 'open-mouth' anterior-posterior (AP) view and lateral view that shows the odontoid fracture that was fixed with headed partially threaded screw (headed screw).

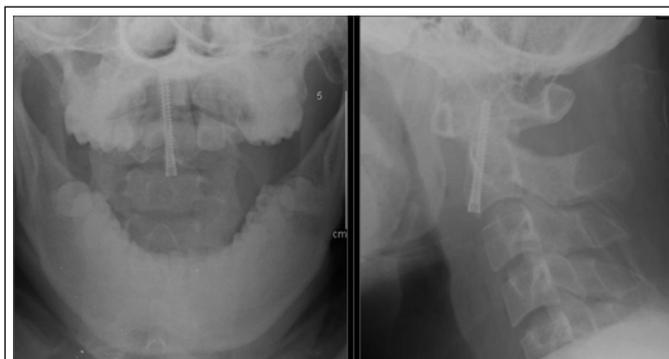


Figure 3: Radiographs 'open-mouth' anterior-posterior (AP) view and lateral view that shows the odontoid fracture that was fixed with headless fully threaded screw (headless screw).

Table1: Results of the five case series of anterior odontoid screw fixation with either headed partially threaded screw (headed screw) or headless fully threaded screw (headless screw).

	Age	Waiting time to operation (days)	Duration of Operation (minutes)	Screw Length and type of screw	Concomittant Injuries
Case A	24	8	45	34mm headed screw	Intra-cranial bleed
Case B	22	11	65	36mm headed screw	Intra-cranial bleed C7 burst fracture
Case C	26	7	70	36mm headed screw	Rib fracture Pneumothorax Thoracic spine compression fracture
Case D	20	5	50	34mm headless screw headless screw	Pelvic fracture Femur shaft fracture
Case E	22	12	60	34mm headless screw	Lumbar spine burst fracture Rib fracture

could be achieved. There was a challenge in ensuring this factor when the screw trajectory was directed too acutely posterior, which must not be perforated. Acutrak headless fully threaded screw was chosen due to several features. The screw could be embedded further to compensate for the length discrepancy in which a shorter length could be chosen if measurement was in doubt. The screw

could be embedded further than a headed screw to reduce the risk of C2/C3 disc disruption and prominent hardware (screw head) that could cause dysphagia. The compression effect at the fracture site started the moment the advancing tip of the screw passed the fracture site hence the bigger "window of compression" [6,7]. Whereas, the headed screw advancing thread must pass the fracture

site before compression effect could take place. The biomechanical study on the pullout strength, resistance to cyclic loading and resistance to torsional loading all three were superior in strengths for acutrak screws compared to AO headed screw [6,7].

The limitation of this study is the lack of long term clinical data with regards to the performance of this headless fully threaded screw in particular with cyclical load implant failure.

Conclusion

Anterior odontoid screw fixation is one of the techniques in stabilising an odontoid type II fracture. The headless screw had easier technicality and theoretical better compression effect and biomechanical strength.

References

1. Maak TG, Grauer JN : The contemporary treatment of odontoid injuries. *Spine (Phila Pa 1976)* :31(11 Suppl) : S53-60,2006
2. Anderson LD, D'Alonzo RT : Fractures of the odontoid process of the axis. *J Bone Joint Surg Am* :Dec;56(8):1663-1674,1974
3. Sasso R, Doherty BJ, Crawford MJ, Heggeness MH : Biomechanics of odontoid fracture fixation. Comparison of the one and two screw technique. *Spine* : 18:1950-1953,1993
4. Graziano G, Jagers C, Lee M, Lynch W : A comparative study of fixation techniques for type II fractures of the odontoid process. *Spine* : 18:2383-2387,1993
5. Chi Y-L, Wang X-Y, Xu H-Z, Lin Y, Huang Q-S, Mao F-M, Ni W-F, Wang S, Dai L-Y : Management of odontoid fractures with percutaneous anterior odontoid screw fixation. *Eur Spine J* :Aug; 16(8):1157-1164,2007
6. Wheeler DL, McLoughlin SW : Biomechanical assessment of compression screws. *Clinical Orthopaedics and Related Research* :May;(350):237-45,1998
7. Lenehan B, Street J, Murphy B, Brennan L, McHugh P, Curtin WA : Biomechanical Study Comparing the Compressive Forces Generated by a Conventional 4.5 AO/ASIF Cortical Lag Screw with a Differentially Pitched Cortical Compression Screw. *Acta of Bioengineering and Biomechanics* :11(1): 31-5,2009

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Thuraikumar K, Wan K-L, Lim S W | Headless fully threaded screw (headless screw) versus headed partially threaded screw (headed screw) fixation techniques for odontoid fracture type II- A Case Series | *International Journal of Spine* | July-December 2019; 4(2): 7-9.