

# Conservative Treatment in Patients With Type 2 Odontoid Fracture - Functional Outcome Following Halo Vest Immobilization

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## ABSTRACT

**Objective:** to assess the severity of neck pain and functional status (neck motion and return to pre-injury daily activity) in patients with type 2 odontoid fracture following conservative treatment by halo vest immobilization. **Methodology:** A retrospective cohort study of 21 patients with type 2 odontoid fracture treated conservatively with halo vest immobilization from January 2007 and followed-up till December 2009. Fracture union and complications related to treatment were documented. At the final follow up visit (1 year post injury), the patient's neck pain, neck range of motion and return to pre-injury daily activities were assessed. **Result:** Twenty-one patients were included in the study. Fracture union was documented in 17 patients (81%); only 4 suffered from nonunion. Despite the good union rate, only 8 patients (38.1%) achieved a good neck range of motion and returned to pre injury daily activity. Neck pain was minimal in all patients. **Conclusion:** Type 2 odontoid fractures treated with halo vest results in good union and minimal residual neck pain; however, it causes neck stiffness.

### Key Words:

*Type 2 Odontoid Fracture, Halo Vest, Union Rate, Function and Neck Pain*

## INTRODUCTION

Odontoid fractures continue to pose clinical challenges. These injuries are classified into type 1, II or III according to the location of fracture of the odontoid process. The Cervical Spine Research Society had used the Anderson and D'Alonzo classification to decide on the mode of treatment and predict prognosis of the healing process<sup>1,2</sup>.

While most authors have agreed that fracture involving the body of the axis (type III) can be successfully managed conservatively, the major controversy is concerning the treatment of type II odontoid fractures. Nonunion is common in type II dens fracture and ranges from 11% to 63% of all cases<sup>3</sup>.

Nonoperative treatment of odontoid fractures should be considered when possible, especially in elderly patients. The goal of management with these fractures is to achieve clinical or radiological union. However, good radiological outcome (union) does not necessarily provide good functional outcome.

The main objective of this study was to identify association between fracture union and functional outcome among patients with type 2 odontoid fractures who were been treated conservatively with halo vest immobilization. Two aspects of treatment outcomes were measured: i) neck pain and function including neck range of motion; and, ii) return to pre injury daily activity. In addition, we attempted to determine the various factors that result in poor functional outcome. Several other authors have published similarly designed studies<sup>4</sup>.

## MATERIALS AND METHODS

### Study sample

This is a retrospective cohort study conducted in our institution starting from 1 January 2007 with last follow-up occurring on 31 December 2009. Twenty-eight patients with type 2 odontoid fractures are included in the sample. Four patients underwent an anterior screw fixation, and 24 patients were treated conservatively. However, only 21 patients were successfully followed up at regular intervals for 1 year. Of these 21 patients, the age range was from 19 to 77y (5 patients were over 60). Sixteen were male (76.2%) and 5 (23.8%) were female. Motor vehicle accident and fall from a height were the two main causes of injury leading to the odontoid fracture.

These 21 patients were treated conservatively with halo vest immobilization. The halo vest was applied to all patients within 2 weeks of the injury. The halo vest was applied in the spinal care unit with the patient in the supine position. Halo pins were inserted under local anaesthesia (lignocaine 1%) and the halo was connected to the chest piece of the device (vest) with the neck held in a neutral position. Plain radiograph was used to confirm the satisfactory reduction

Table I: Assessment for neck range of motion <sup>4</sup>

Points	Flexion/Extension (Degrees)	Axial Rotation (Right/Left) (Degrees)	Lateral Bending (Right/Left) (Degrees)
1	0-15	0-20	0-15
2	15-30	20-40	15-30
3	30-45	40-60	30-45

Interpretation: Good if total score 16 to 18 points ; Fair –Poor if total score 15 points or less.

Table II: Association between age group and Neck ROM

Age Group	Range of Motion		Total
	Good	Not Good	
<60	8	8	16
60 and above	0	5	5
Total	8	13	21

Table III: Association between fracture union and neck pain

Fracture Healing		Pain Score		Total
		No Pain	Moderate Pain	
Fracture Healing	United	13	4	17
	Non-Union	0	4	4
	Total	13	8	21

and position. Patients wore the halo vest for twelve weeks followed by four weeks in a Philadelphia collar.

All patients were assessed clinically and radiologically at our clinic at 6 weeks, and then 3, 6 and finally 12 months following the injury. All the complications (both minor or major) were documented, throughout the period of halo vest immobilization. Minor complications included: localized discomfort at the pin insertion site; sleep disturbance; allergic rashes; other skin irritations; and, scarring. Major complications included pin loosening with subsequent loss of reduction position and instability as well as pin tract infection.

**Radiological Measures**

Fracture union, stability, and reduction position were determined by plain radiograph. Trabeculation across the fracture site and absence of abnormal movement on lateral radiographs made in flexion and extension signifies an osseous union.

**Functional Outcomes**

During the final follow up visit at the clinic, all study subjects were interviewed. The severity of neck pain for each patient was assessed by using a visual analogue scale (VAS). Each patient was asked about their state of daily activity; whether they have returned to their pre-injury occupation and activities. The patients were required to choose, partial or full recovery.

Neck range of motion (ROM) of each patient was assessed by the first or second author. A preliminary training session was conducted prior to initiation of the study. A goniometer was used to assess ROM with measurement was performed during the final followed up visit at the clinic (one year post-

injury). The modified scoring system from the American Academy of Orthopaedic Surgeons was utilised as shown in Table I<sup>4</sup>. Patients with a total score of 16 points or more (maximum score =18) were considered to have good neck motion and those who scored 15 points or less were considered to have fair or poor residual neck ROM.

**Statistical Analysis**

Data were analyzed using the SPSS software, version 11.5 for Windows. The chi-square test was used to compare groups of risk factors including the prevalence of union rate and neck range of motion. A p value of < 0.05 was considered significant.

**RESULTS**

Twenty-one patients between 19 and 77 years old (5 patients were over 60) successfully followed up and completed the study. The study group consisted of Malay (35%), Chinese (25%) and Indian (40%) patients; 16 were male (76.2%) and 5 (23.8%) were female.

**Radiological Assessment**

Fracture union was documented in 17 patients (81%); only 4 of the patients had nonunion results.

**Clinical Assessment**

*Neck Range of motion (ROM):* Despite the good union rate, only 8 patients (38.1) achieved good neck range of motion as shown in Table II. The remaining patients experienced fair to poor neck range of motion. There was an association between poor neck ROM and elderly patient (> 60 years old), however, this result was not statistically significant (p= 0.131).

*Visual Analogue Scale for Neck Pain:* Neck pain was minimal in all of patients ( $p=0.016$ ) (VAS  $<5$  in all patients). The patients were further subclassified into 2 groups; group A consisted of patients with insignificant or no neck pain and group B consisted of patients with occasional mild-moderate neck pain. Generally, patients who demonstrated nonunion experienced mild to moderate pain score as compared to patient with united fracture' this finding was also not statistically significant as shown in Table III.

*Complication following halo vest immobilization:* A majority of patients experienced some adverse effect from the conservative treatment. Fourteen patients (66.7%) developed minor complications whereas two (9.5%) developed major complications.

*Return to pre-injury daily activity:* Regardless of the type of occupation before the injury, a majority (13 patients or 61.9%) were noted to have some degree of limitation in their daily activity, related to their daily work. Only 8 patients returned fully to pre-injury daily activity.

## DISCUSSION

The management of type II dens fracture is indeed controversial and should be individualized after consideration of various factors. The nonunion rate in the present study (29%) is comparable to other series, where the range was between 32 and 41 percent<sup>2,3</sup>. The presence of significant fracture angulation (ten degrees or more) and displacement (five millimetres or more) has been associated with higher risk for non-union or malunion<sup>2</sup>. The incidence of nonunion in the elderly ( $>60$  years) has been reported to be generally higher and ranged between 53 percent and 77 percent after non-operative treatment<sup>5,6</sup>.

Conservative treatment using halo vest immobilization successfully showed a satisfactory treatment outcome in our study. In vitro biomechanical study had proven the effectiveness of halo vest fixation in maintaining the reduction of dens fracture while union takes place. A significant reduction in motion has been observed at C0/1 and C1/2 in flexion-extension and axial rotation with the halo vest alone used as treatment<sup>7</sup>.

Despite the good union rate, only 8 patients (38.1%) achieved a good neck range of motion and successfully returned to their pre-injury state of daily activity. The incidence of neck stiffness was higher in our study (more than 60 %) as compared to the study by Stoney et al (40 %)<sup>8</sup>. The association between elderly age (over than 60 years old) and nonunion also correlates with a higher incidence of residual neck stiffness. Poor neck motion among elderly patients would probably be due to the coexisting cervical spondylosis. However, all patients experienced minimal neck pain (VAS  $<5$ ).

Complications, though common are mostly minor<sup>9</sup>. A majority of cases (66.7%) developed minor complications and less than ten percent of cases developed major complications. Discomfort from the hot and humid climate in Malaysia, poor cosmetic appearance and discomfort during treatment were among various complaints from patients.

Since there are problems with the various treatment modalities for type II odontoid fracture, no single method has yet become universally accepted as the gold standard.

Anterior screw fixation provides a good treatment option for type II dens fracture with satisfactory outcome. The odontoid screw directly fixates the dens and vertebral body thus restoring physiologic neck rotation. Union rates ranging between 83% and 100% have been reported, with greater success in the younger patient population<sup>10</sup>. Inappropriate fracture geometry (reverse oblique), osteoporotic and pathologic fracture are contraindications for odontoid screw fixation<sup>11-13</sup>. In one study, anterior screw fixation alone was associated with a higher rate of fracture nonunion (11%) and a greater potential for reoperation (due to technical failures), but the problem can be solved by using inlay bone grafting or a posterior stabilization / fusion<sup>14</sup>.

A posterior fusion (posterior wiring and strut grafting) can result in reasonably good radiological outcome (fracture union, stable), but this advantage is offset by poor neck of motion, especially the axial rotation<sup>14</sup>. There is a higher infection rate, wound dehiscence, and potentially higher blood loss that should be taken into consideration before deciding for the posterior approach surgery. Importantly, functional results with this technique were worse than those using anterior screw fixation<sup>15</sup>.

This clinical study successfully showed treatment outcome following halo vest immobilization with special focus on type 2 odontoid fracture. Longer follow up (more than 1 year) was not practicable in most Government hospitals in Malaysia due to the state of the health care system. The study has several limitations. First, the sample involved a small number of patients and there was a disparity between the number of elderly and younger patients. Therefore, most conclusions drawn made were not statistically significant. Certainly, prospective controlled clinical studies are needed.

## CONCLUSION

Halo vest immobilization for type 2 odontoid fractures remains a reasonable treatment option in most cases. Fracture union can be expected in most cases. However, a majority of patients developed neck stiffness and fail to return to pre-injury daily activities even those without significant residual neck pain.

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