UNIL | Université de Lausanne
Faculté de biologie
et de médecine

Medicine master thesis

The natural history of type II odontoid fractures in the elderly population. A retrospective study over a 14 years period.

Student

Alexis Bikfalvi

Tutor

Dr. J. Duff MD FACS

Expert

Dr PD Enrico Tessitore

Lausanne, January 2015

Introduction

Odontoid fractures are the most common cervical fractures in the adult population. They represent 9 to 18 % of all cervical fractures[1,2] and the type II is the most common[3]. The incidence of neurologic deficits (ND) in odontoid fractures varies between 3 to 25%[4,5,6,7,8]. A recent study showed that patients with ND had a mortality rate increased by 4.72 times and a complication rate higher of 1.18 times[8]. The most common complication in patients with ND was respiratory distress[8]. Surprisingly, although type II odontoid fractures are frequent cervical fractures, their natural history has been poorly described.

Surgery for odontoid fractures is well described. However, there are so far guidelines based on class II and class III evidence only regarding indications for surgery and regarding surgical techniques[9]. The class II guidelines recommend to consider surgical stabilization and fusion for type II odontoid in patients over 50 years of age[9]. The class III recommendations are to first manage non-displaced odontoid type II fracture with external immobilization and that translation of 5mm or more is associated with a high rate of non-union with the conservative treatment and should be treated surgically[9].

With regard to surgical technique, a study has reported that anterior and posterior operative approaches led to similar outcomes[10]. The most common major complications[10] after surgery are : cardiac failure (6.8%), deep vein thrombosis (3.2%), stroke (3.2%), pneumonia (9.9%), respiratory failure (7.7%), liver failure (6.7%) and infection (3.2%). The overall mortality after surgery is 10.1%[10]

Conservative treatments options include halo-vest immobilisation or cervical rigid or semi rigid collar. Halo-vest has been shown to be associated with a high rate of death and complications especially in the elderly[11]. In a second study that compared halo-vest immobilisation (HVI) to rigid cervical orthosis (CO), halo-vest showed a significant increase in mortality (42% in HVI versus 20% in CO) and morbidity (66% of major complication in HVI versus 36% in CO) [12]. Furthermore, the number of comorbidities is conversely linked with the likelihood of discharge to home[13]

In this study we will attempt to identify: 1) The long term natural history looking retrospectively at patients treated conservatively and followed up at our institution. 2) The risk factors of non-union and for poor outcome as defined by death, persistent neck pain and cervical myelopathy.

Material and methods

After obtaining ethics committee approval, a retrospective medical record based study of type II odontoid fractures treated at our institution from 1st January 1998 until the 31st December 2012.

Inclusion criteria for the study are 1) Odontoid type II fracture by Anderson and D'Alonso confirmed radiologically 2) Initial conservative treatment or no treatment 3) Inital conservative or no treatment, followed by subsequent surgical treatment 4) Age above 60 years

Exclusion criteria are 1) All the others cervical fractures 2) Type II odontoid fracture with initial surgical treatment. 3) Age under 60 years 4) Follow-up of less than 3 months in the absence of a fracture related complication. 5) Death occurring in the first 3 months.

We identified 90 patients with radiologically confirmed type II odontoid fracture during the defined time period. A total of 30 patients had first line surgery and were excluded from the study. A total of 60 patients had conservative or no treatment. The medical records of these 60 patients were reviewed. A total of 23 patients were excluded because of a follow-up of less than 3 month, 6 patients were excluded because they had insufficient documentation and 10 patients were excluded because they died within the first 3 months. A total of 21 patients remained after these exclusions.

At initial evaluation and at follow-up, clinical and radiologic data were recorded. Clinical data noted include the number of comorbidities, osteoporosis, associated head injury (Glasgow coma score) at presentation the likely mechanism of the fracture based on history and examination, the type of conservative treatment, the presence of cervical myelopathy, and the length of hospital stay. At follow up, the same data was recorded and additionally the presence of chronic neck pain.

Radiologic parameters include angulation, translation and union versus non-union of the fracture at initial presentation and at follow-up.

We entered this data in an Excel file, there were then statistically analysed using the software SPSS. The threshold for significant results was fixed at 5%.

Results

Of the 21 patients included in the study, 12 were female and 9 were male. For 17 of them the fracture was caused by a fall and the remaining 4 had a motor vehicule accident.

At the time of presentation, 5 patients had clinical evidence of associated closed head injury. Of these patients, 4 had a GCS at 14, and 1 had a GCS at 6. With regard to evaluation for traumatic myelopathy, 20 patients had an ASIA score of E, 1 had an ASIA score of D. For the patient with the ASIA D score it was linked to a weakness of the left arm. Additionally one patient had an event of stroke caused by a dissection of the left vertebral artery due to the fracture.

20 patients underwent initial cervical CT scan. 13 of them also had an MRI. The median posterior dens translation was 2 mm (range 0-7 mm), and the median posterior angulation was 10 degrees (range 0-45 degrees). Of the 21 patients included in this study, 9 patients who were first treated with conservative treatment were subsequently operated for non fusion, This was done after a mean of 3.7 months of conservative management (range 2-6 months). In the subgroup in which the patients underwent delayed surgery, the average median translation, at the entrance, was 1.5 mm (range 0-5.3 mm), the median angulation was 10 degrees (range 0-28mm) degrees, their average age was 76.3 years old (range 68-83 years old). In the subgroup who did not undergo a secondary operation, the median translation was 2 mm (range 0-7mm) and the median translation was 13 degrees (range 0-45 degrees), their average age was 86 years old (range 80-91 years). The p-value for age between the 2 groups was <0.001, the p-value for translation was at 0.808, the p-value for angulation was at 0.702.

	Operation group	Conservative group	P-value
Age (years)	76.3	86	<0.001
Median Translation (mm)	1.5	2	0.808
Median angulation (degrees)	10	13	0.702

Concerning associated cervical fractures, 5 had also a Jefferson fracture, 1 patient had a fracture of the left transverse processus of C1 and 1 a fracture of the anterior arc of C1.

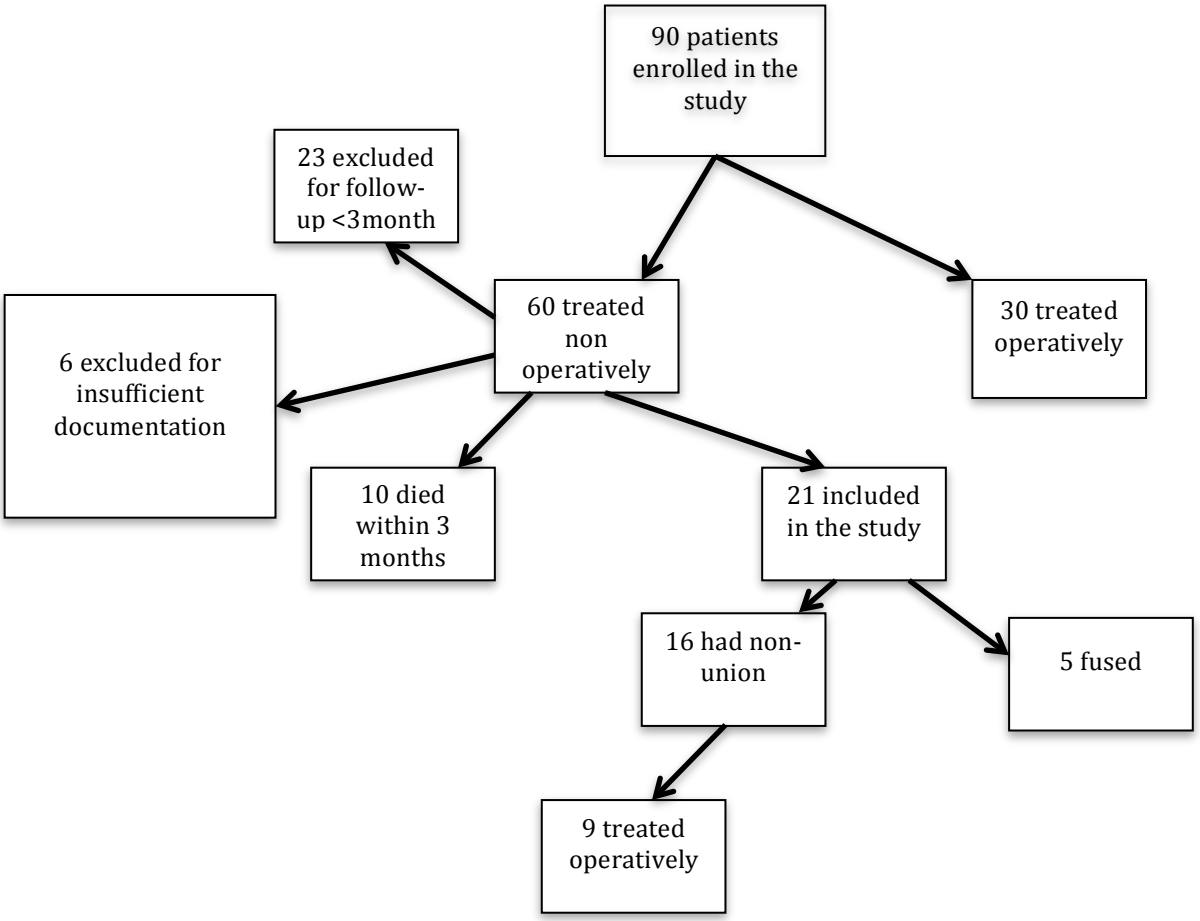
As regards non-surgical treatment, 17 were treated with a semi-rigid collar, 3 with a Halo-vest immobilization and 1 with a foam collar. The average stay in the hospital was 12.5 days (range 3-54).

The mean follow-up for conservative management (21 patients) was 5.4 months after the fracture (range 2-15 months). 4 patients experienced chronic cervical pain related to the

fracture. Five of the patients (23.8%) achieved complete fusion during the follow up period, and one patient had a fibrous union. For the 16 patients who did not fuse the median translation was 2 mm (range 0-7.2 mm), and the translation was 21 degrees (range 0-43 degrees). If we subdivide these patients in 2 groups, respectively 1 group for the conservative treatment only and 1 group for the delayed surgery. In the subgroup of conservative treatment (7 patients, 5 patients had fusion) the median translation was 4 mm (range 0-7.2 mm), and the angulation 30 degrees (range 16-43 degrees). In the subgroup for delayed surgery (9 patients) the median translation was 2 mm (range 0-5.4 mm), and the angulation was 10.5 degrees (range 0-35 degrees).

	Union	Non-union	P-Value
Age (years)	84.2	80.3	0.275
Median translation (mm)	2	1.8	0.842
Median angulation (degrees)	16	10	0.548
Median number of comorbidities	1	2.5	0.109

If we subdivide the patients in two groups, respectively one group who achieved fusion and one who had non-union, the group with fusion had, at the entrance, a median translation of 2mm (range 0-7 mm) and an angulation of 16 degrees (range 2-35 degrees), their median age was 84.2 years and had a median number of comorbidities of 1. The group who had non-union had, at the entrance, a median translation of 1.8 mm (range 0-7 mm) and an angulation of 10 degrees (range 0-45 degrees), their median age was 80.3 years and had a median number of comorbidities of 2.5. The p-value for translation between the two groups was at 0.842, the p-value for angulation was at 0.548, the p-value for age was 0.275 and the p-value for comorbidities was 0.109.



The last follow-up after surgery was at an average of 14.4 months (range 3-24 months). At this moment 8 of the 9 patients (88.9%) achieved fusion. Three of them had chronic pain. The average length of stay after surgery was 14.6 days (range 7-48 days). As complication, 1 patient had acute renal failure and laryngeal oedema (patient 13), another had pneumonia and cardiac failure decompensation (patient 16). 1 patient had a post operative wound infection (patient 17). There was no mortality.

Illustrative case

A 89 year old woman fell from her height with a reception on her head. She was admitted to the emergency room with a Glasgow Coma Score of 14 without any focal neurological deficit.

Fig. 1 Cervical CT scan at the entrance

The CT scan performed (Fig. 1) showed an odontoid type II fracture with a translation of 7 mm and an angulation of 16 degrees.

She was treated with a semi-rigid collar during 16 weeks. At the control at 11 months, she had not any pain or neurologic deficit. On the CT scan performed (Fig. 2) at this time she showed to have completely fused.

Fig. 2 Cervical CT scan at the control (11 months)

Conclusion

Despite the fact that odontoid type II fracture is the most common cervical fracture[3], there is no gold standard for treatment. Actually the current guidelines for the management of type II odontoid fractures are issued from a recent meta-analysis[9]. These guidelines are level II and level III evidence.

In this retrospective study we analysed 21 patients diagnosed with an odontoid type II fracture, including only patients who had a first conservative treatment. We wanted to study the safety of conservative treatment, and clinical and radiological factors that led to a secondary operation.

None of the patients died during the follow-up, it should be noted that we excluded the patients who died early (Follow-up <3 months). Four patients had chronic cervical pain at the conservative follow-up (5.4 months). Postoperatively 3 patients had chronic persistent cervical pain.

Concerning neurological deficit, 2 patients at time of diagnosis had an ASIA score at D. There was not any new neurologic deficit during the follow-up.

In our study we could not identify factors in the natural history that led to poor outcome or a secondary operation. There was not any statistical difference regarding initial fracture translation and angulation between the group fusion and non-fusion group. Comparing the conservative group with the delayed surgery group, the patients in the delayed surgery group were younger (76.3 years versus 86 years, p-value< 0.001), it can be explained by the fact that younger patients are more fit to undergo an operation and that the hope of recovery of quality of life is greater. The angulation and translation of the bone fragment was not statistically significant when comparing these 2 groups.

A limitation of this study is the small amount of patients which likely explains the lack of statistically significant data. Concerning outcome in term of mortality, our study suffered of bias of selection, we excluded the patients who died in the first 3 month and the patients who had a follow-up inferior than 3 months. The explanation for this lack of follow-up could also be that the patient died shortly after the fracture. As shown in a recent study[14], there was a high mortality, especially in the non-operated patients in the first 30 days. Therefore we are unable to conclude that translation and angulation of the bone fragment had an impact on the fusion or the occurrence of a secondary operation.

In this study, despite small number of patients, we conclude that conservative treatment in patients with type II odontoid fractures remains a viable treatment option.

To provide reliable guidelines about management, safety and outcome of odontoid type II fracture, further prospective multicentre studies are needed.

1. Subach, B. R. *et al.* Management of acute odontoid fractures with single-screw anterior fixation. *Neurosurgery* **45,** 812–9– discussion 819–20 (1999).

2. Maak, T. G. & Grauer, J. N. The Contemporary Treatment of Odontoid Injuries. *Spine* **31,** S53–S60 (2006).

3. Hadley, M. N., Dickman, C. A., Browner, C. M. & Sonntag, V. K. H. Acute axis fractures: a review of 229 cases. *J. Neurosurg.* **71,** 642–647 (1989).

4. Anderson, L. D. & D'Alonzo, R. T. Fractures of the odontoid process of the axis. *J. Bone Joint Surg. Am.* **56,** 1663–1674 (1974).

5. Pointillart, V., Orta, A. L., Freitas, J., Vital, J. M. & Senegas, J. Odontoid fractures. Review of 150 cases and practical application for treatment. *Eur. Spine J. Off. Publ. Eur. Spine Soc. Eur. Spinal Deform. Soc. Eur. Sect. Cerv. Spine Res. Soc.* **3,** 282–285 (1994).

6. Schweigel, J. F. Management of the fractured odontoid with halo-thoracic bracing. *Spine* **12,** 838–839 (1987).

7. Müller, E. J., Wick, M., Russe, O. & Muhr, G. Management of odontoid fractures in the elderly. *Eur. Spine J. Off. Publ. Eur. Spine Soc. Eur. Spinal Deform. Soc. Eur. Sect. Cerv. Spine Res. Soc.* **8,** 360–365 (1999).

8. Patel, A. *et al.* Odontoid Fractures With Neurologic Deficit Have Higher Mortality and Morbidity. *Clin. Orthop. Relat. Res.* **470,** 1614–1620 (2011).

9. Ryken, T. C. *et al.* Management of isolated fractures of the axis in adults. *Neurosurgery* **72 Suppl 2,** 132–150 (2013).

10. White, A. P., Hashimoto, R., Norvell, D. C. & Vaccaro, A. R. Morbidity and mortality related to odontoid fracture surgery in the elderly population. *Spine* **35,** S146–57 (2010).

11. Majercik, S., Tashjian, R. Z., Biffl, W. L., Harrington, D. T. & Cioffi, W. G. Halo vest immobilization in the elderly: a death sentence? *J. Trauma Inj. Infect. Crit. Care* **59,** 350–6; discussion 356–8 (2005).

12. Tashjian, R. Z. *et al.* Halo-Vest Immobilization Increases Early Morbidity and Mortality in Elderly Odontoid Fractures. *J. Trauma Inj. Infect. Crit. Care* **60,** 199–203 (2006).

13. Smith, H. E. *et al.* Trends in Epidemiology and Management of Type II Odontoid Fractures. *J. Spinal Disord. Amp Tech.* **23,** 501–505 (2010).

14. Chapman, J. *et al.* The AOSpine North America Geriatric Odontoid Fracture Mortality Study. *Spine* 1 (2013). doi:10.1097/BRS.0b013e318286f0cf