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Optimizing treatment for odontoid fractures in the elderly: a balancing act with the patient at center stage

Huybregts, J.G.J.

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CHAPTER

7

SUMMARY



SUMMARY

This thesis addresses the complexities of treating odontoid fractures in elderly patients. These fractures affect the odontoid process of the second cervical vertebra (C2) and present unique treatment challenges. The optimal treatment approach remains controversial.

Chapter 1 provides a general introduction and outline of the thesis. Odontoid fractures are the most common cervical spine injuries among the elderly, who have an increased risk of complications and mortality. More than 70% of patients with odontoid fractures are older than 65 years, with many being over 80 years old. These fractures are largely caused by minor trauma, such as falls, and are often exacerbated by osteoporosis, a condition prevalent in the elderly. Odontoid fractures are classified into three types, with type II and type III being the most prevalent and clinically relevant. Treatment may be surgical or conservative, each with its own risks and benefits, particularly for elderly patients. The main objective of this thesis was to explore the clinical and radiological outcomes of both surgical and conservative treatment approaches, with the aim of optimizing care for this patient group.

Chapter 2 presents a systematic review and meta-analysis of the historical literature. This review aimed to compare outcomes of surgical and conservative treatments for type II and III odontoid fractures in patients aged 65 and older, focusing on clinical outcomes, fracture union, and fracture stability. A comprehensive search was conducted across seven databases, yielding 41 studies with a total of 2099 patients, most of which were retrospective case series. The review found no clinically relevant differences in Neck Disability Index (NDI) and Visual Analogue Scale (VAS) pain scores between treatment methods. Surgically treated patients had higher fracture union rates at last follow-up (72.7% vs. 40.2%), but stability rates were not significantly different from those of patients treated conservatively. Data were of limited quality and showed substantial heterogeneity, severely limiting the strength of conclusions, and studies were likely biased. Complications were common in both groups, with surgical complications related mainly to the operation itself, and conservative treatment leading to immobilization-related issues. This review suggested the need for well-designed studies to better understand the correlation between clinical and radiological outcomes and to adjust for differences in factors such as age and fracture characteristics.

Chapter 3 examines practice variation in the Netherlands regarding the treatment of odontoid fractures in elderly patients. This study retrospectively explored differences in treatment strategies across centers, rather than treatment modalities within centers. Some centers adopted a low-threshold-for-surgery approach, recommending surgery for relatively healthy patients with dislocated fractures. In contrast, another center employed an initially-conservative approach for all patients. Outcomes of these two treatment philosophies were compared in a natural experiment—or pseudo-randomized design—to reduce confounding. Fracture union (53% vs. 43%) and fracture stability (90% vs. 85%) at last follow-up did not differ between groups. Analyzing differences in clinical outcomes between the groups was infeasible due to data limitations. As expected, patients aged ≥ 80 years in both strategies exhibited less union (64% vs. 30%), less stability (97% vs. 77%), and higher mortality within 104 weeks (2% vs. 22%) compared to patients aged 55–80 years. When the fractures were reassessed blinded for the original scoring in the patient files, discrepancies were found in 26 cases (15%), indicating only substantial agreement ($\kappa=0.69$) between the new and original scores. Caution should therefore be exercised when using this classification to guide treatment decisions.

Chapter 4 presents the results of an international prospective comparative study—the largest available study on odontoid fractures in the elderly. Fifteen centers in eight European countries participated in comparing outcomes between surgical and conservative treatments. At 52 weeks, improvement (decrease) in NDI was largely similar between surgical and conservative treatments (–11 vs. –14), as were union (86% vs. 78%), and stability (99% vs. 98%). NDI improvement did not differ between patients with union and those with persistent non-union (–13 vs. –12), indicating that clinical outcomes and fracture union are not clearly associated. There were no differences in any of the secondary outcomes (including VAS neck pain, Likert patient-perceived recovery, and EuroQol-5D-3L) or among subgroups (including type II and displaced fractures). No cases of secondary neurological deficits were identified. As expected, secondary treatment was less common after surgical treatment than after initial conservative treatment (6% vs. 19%). Mortality within 52 weeks (8% vs. 11%) and 104 weeks (10% vs. 14%) did not differ between the treatment groups. It can therefore be concluded that treatment should prioritize favorable clinical outcomes over radiological findings.

Chapter 5 explores the usability of Hounsfield unit (HU) measurements as a predictor of fracture union in elderly patients with odontoid fractures. HUs are

a quantitative measure of bone mineral density (BMD) obtained from CT scans. Decreased BMD has been associated with poorer fracture healing in animal and some clinical studies, although it had not yet been studied in odontoid fractures in the elderly. This study examined whether baseline HU measurements in the bodies of C2 and C3 can predict fracture union at 52 weeks. Baseline HUs in C2 (HU 246 vs. 282) and C3 (HU 260 vs. 251) did not differ between patients with and without union. Compared to control patients in the literature, both patients with and without union exhibited lowered HUs, suggesting osteopenia (cervical HUs <300). It can be concluded that baseline HU measurements in C2 and C3 are not associated with fracture union at 52 weeks, and therefore fail to serve as predictors of union in elderly patients with odontoid fractures. Since both the union and non-union groups exhibited decreased BMD, all elderly patients with odontoid fractures should be referred for osteoporosis screening and appropriate treatment.

Chapter 6 presents a general discussion, also addressing the limitations, future perspectives, and direct clinical implications. The findings of this thesis support initial conservative treatment for odontoid fractures in elderly patients, with surgical intervention reserved for the relatively rare cases of persistent symptomatic non-union. Prioritizing clinical outcomes over radiological results is important, since clinical outcomes and fracture union are not clearly associated. Asymptomatic non-union can be viewed as an acceptable treatment outcome and should not automatically prompt secondary surgical treatment. Additionally, given the prevalence of decreased bone mineral density in this population, routine osteoporosis screening is recommended to enhance care for elderly patients with odontoid fractures. Historical fears regarding the dangers of undertreatment—such as secondary fracture displacement leading to spinal cord injury—are now considered unfounded, as none of the patients in this thesis experienced these complications. Although surgeons might interpret these results as a rationale for maintaining their usual treatment practices, they should recognize that similar outcomes can be achieved with treatments that impose a lower burden on the patient and may be less costly. Therefore, surgeons should prioritize minimizing this burden by avoiding overly aggressive treatments that do not improve outcomes and may introduce additional risks. The prescribed treatment regimen could ultimately harm the patient more than the fracture itself.