Original Article

The incidence of odontoid fractures following trauma in a major trauma center, a retrospective study

ABSTRACT

Background: Cervical spine injury is the most common vertebral injury after major trauma, 20% of all cervical fractures happen to be odontoid fractures. In young adults, odontoid fracture usually happens as a result of high-energy trauma after a motor vehicle accident (MVA). MVA in Riyadh represents 38.4% of all trauma cases, in which the head-and-neck are the most injured body parts. This research aims to provide information about the incidence of odontoid process fracture post-MVA in Riyadh, Saudi Arabia.

Methods: The design of this study was retrospective. A single level one trauma center database (trauma registry) was used to identify odontoid fractures post-MVA. All trauma cases from 2008 to the most recent were included, a total of 17,047 patients, to identify cervical spine fractures and further identify odontoid fracture incidence. The patients' radiographs were reviewed retrospectively, and odontoid fractures were classified by a board-certified spine surgeon. A descriptive analysis was carried out to report basic data distribution. Pearson's correlation was carried out to assess associations.

Results: A total number of cervical spine fracture was 1195 patients (6.6% of the total sample). The incidence of odontoid fractures during the entire study period from 2008 to 2018 was 42 of 480 patients with C2 cervical trauma, constituting 8.75% C2 fractures, and 3.5% of cervical spine fractures. The mean age was 41.75 ± 18 years. There were three patients (onemale, two females) with type I odontoid fracture, 26 (all males) with type II, and 13 (11 males, 2 females) with type III. Most patients were managed conservatively (83.33%), whereas 16.67% underwent surgical management.

Conclusion: The incidence of posttraumatic odontoid fractures is low, given the younger population of this study. This does not predict future incidence rates with the continued improvement of road traffic laws and awareness in the population.

Keywords: Cervical, fractures, motor vehicle accident, odontoid, spine, trauma

INTRODUCTION

The odontoid process is a bony protrusion of the axis, which is the second cervical vertebrae. Atlas, the first cervical vertebrae, surrounds the odontoid process allowing lateral rotation of the head.[1] Cervical spine fractures are the most common vertebral injury after major trauma; 20% of all cervical fractures happen to be odontoid fractures.[2] Anderson and D'Alonzo classified the odontoid fractures according to the site and the morphology into three types, which are type I, type II, or type III fractures.[3]

In young adults, odontoid fracture usually happens as a result of high-energy trauma after a motor vehicle accident (MVA).

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Hyperextension of the cervical spine is the most common mechanism of injury, although odontoid fracture can occur with hyperflexion of the cervical spine. As the atlantoaxial complex allows maximum range of motion than any other level in the cervical spine, the odontoid fracture is inherently unstable.[1,3] Due to the instability of the fracture, a serious spinal cord injury can occur.[3] Different options for managing these fractures ranging from immobilization with a semirigid orthosis in case of stable fracture to surgical arthrodesis.[4]

Motor vehicle (MVA) is a serious hazard that affects public health worldwide and is the main cause of all trauma admissions.[5] According to the World Health Organization approximately 50 million were injured, and 1.4 million died on the scene due to MVA.[6] In Saudi Arabia, motor vehicles are the main, and in many areas the only method of transport.[7] A study by Al Turki *et al*. conducted in the region showed that one person loses their life, and four are injured every hour due to MVAs.[8] Moreover, MVA in Riyadh represents 38.4% of all trauma cases in which the head –and neck are the most injured body parts.[9] This article aims to provide insight into the incidence of traumatic odontoid fractures in Riyadh, Saudi Arabia.

METHODS

This is a retrospective study conducted in a single level one trauma center. The trauma registry was used to identify traumatic odontoid fractures. All trauma cases between January 2008 and January 2016 were included, a total of 17,897 patients, of which 1195 had a cervical spine fracture and were included in the study to further identify odontoid fracture incidence. Cases presented between 2016 and 2018 were not accessible from the trauma registry as of writing, and the team attempted a manual database search for this period for C2 fractures (ICD 10 code: S12.100). Data were filtered to include cases that required a trauma team activation only. The following demographical data were collected; age, gender, weight, height, type of fracture, complications, and discharge status. Comorbidities such as diabetes mellitus, hypertension, osteoporosis, arthritis, previous head-and-neck injury, smoking, and history of using steroids or other medications were collected as well. Patients' computed tomography radiographs were reviewed retrospectively, and odontoid fractures were classified by a board-certified spine surgeon. Anderson and D'Alonzo's classification of the fractures was used as follows: Type I, type II, and type III. The management of each patient, conservative or surgical, was reviewed as well. Descriptive analysis was carried out to report basic data distribution using SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp). Pearson's correlation was carried out to assess the comorbidity effect on the incidence with $P \leq 0.05$ was considered statistically significant.

RESULTS

A total number of cervical spine fractures was 1195 patients (6.6% of the total sample). The incidence of odontoid fractures during the entire study period from 2008 to 2018 was 42 of 480 patients with C2 cervical trauma, constituting 8.75% C2 fractures, and 3.5% of cervical spine fractures. Male-to-female ratio was 9:1, with only four females identified in the sample. The mean age was 41.75 ± 18 years. There were three patients (one male, two females) with type I odontoid fracture, 26 (all males) with type II, and 13 (11 males, 2 females) with type III. Fracture types by age and management are shown in Table 1. Most patients were managed conservatively (90.48%) with a halo-vest cervical orthosis immobilization while those who were unstable (9.52%) underwent posterior fusion with screws surgical technique [Figure 1]. Thirty-eight patients were discharged, three deceased in a hospital due to cardiopulmonary arrest, and one patient was transferred to another center. Year by year analysis showed no statistically significant differences in incidence rates [Figure 2]. The further analysis noted no significant correlation with any of the collected variables and the incidence of odontoid fractures.

DISCUSSION

This study reviewed data from a level one trauma center assessing the incidence of traumatic odontoid fractures. There are multiple different reports describing cervical spine fracture rates in traumatic settings and many reported the odontoid process involvement rates.[10-16] However, most of the literature on odontoid fractures are pertaining to the geriatric population, which is expected due to its increased incidence rate in this age group and its associated morbidity and mortality.[2,3,17-20]

Cervical spine fractures constituted 6.6% of the available sample, out of which only 3.5% were odontoid fractures. This is lower than the reported results by Mower *et al*., where their team reported an 11% incidence of odontoid fracture out of total spinal fractures.[11] Tadros *et al*. reported the incidence of C2 fractures in their trauma registry. Their database returned 139 patients with cervical fractures, which constituted 0.74% of the total sample. Odontoid fractures comprised 84% of said fractures, in contrast to the 8.75% reported in this paper.[15] The differences in reported numbers continue throughout the literature. Which might suggest a population-based difference or a time influence on the incidence rates of traumatic odontoid

Table 1: Fractures type by age and management

Age	Number of patients	Odontoid fracture classification			Management	
		Type I	Type II	Type III	Conservative	Surgery
30 and below	20	0	15	6	17	3
Between 30 and 70	17	3	6	7	16	1
70 and above	5	0	5	0	5	0

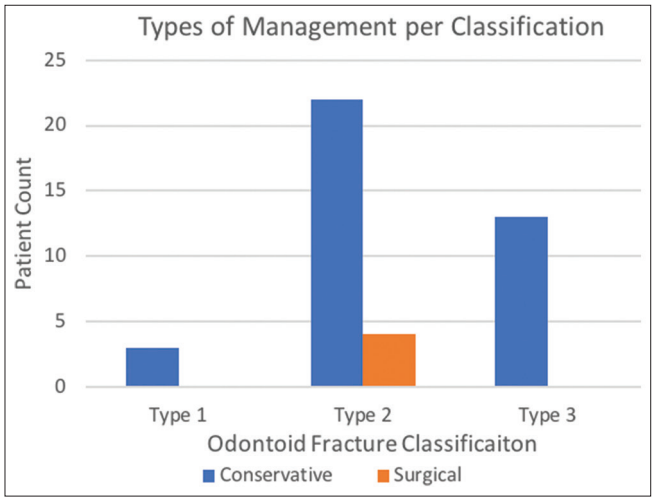

Figure 1: Most patients were managed conservatively (90.48%) with Halo vest cervical orthosis immobilization while those who were unstable (9.52%) underwent posterior fusion with screws

fractures. As stated, the mechanism of odontoid fractures is a hyperflexion, or more commonly, a hyperextension injury to the atlantoaxial joint. Yoganandan and Pintar noted that most of the odontoid fractures were associated with frontal impact MVA.[16] Such accidents, when combined with seat belt use, can simulate a sever hyperextension/flexion motion on the atlantoaxial joint. A study by AlEissa *et al*. on the same database used in this study noted that only 16% of patients used seat belts.[10] Moreover, their team noted that 85.1% of the patients presented due to an MVA, which might have skewed the data toward different injury patterns.[10]

The literature also notes an interesting observation absent from this study; the incidence of odontoid fractures increased with time. Passias *et al*. included 488,262 patients in their study and noted a steady increase of traumatic cervical spine fracture rates.[12] Tadros *et al*. and Robinson *et al*. noted the same trend with year-over-year increase in their studies.[13,15] The authors of this study attribute the lack of such observation to the aforementioned sparse use of seat belts among our population. Although the current data cannot support the future prediction of incidence, the authors hypothesize an increase in the upcoming years in the incidence rates of odontoid fractures due to the continued improvement of road traffic law implementation in the kingdom.

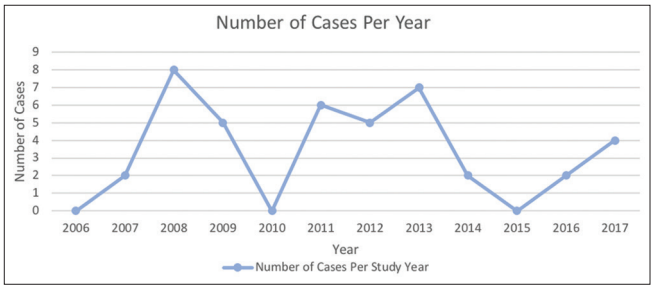

Figure 2: Year by year incidence showed no statistically significant trends in incidence rates

Mansuri *et al*. reviewed 29 articles on the topic of MVAs in Saudi Arabia and reported a change in the pattern of injuries postenactment of seat belt laws.[9]

Treatment algorithms for odontoid fractures are described in the literature over multiple studies but mostly concentrate on the geriatric population.[18,20] The current evidence regarding this population is level III, which is comprised case series and literature reviews. Treatment of type II fractures remains controversial, with most algorithms favoring posterior fusion if surgery was indicated.[2] Fracture management in the younger population, however, is still based on case reports and surgeon assessment at the time, with no clear recommendations to what would be the best management option. The fracture is usually accompanied by multiple injuries, and surgery may not be feasible at presentation.[10] This may explain the low number of surgical interventions noted in this study.

CONCLUSION

The incidence of traumatic odontoid fractures is low, given the younger population of this study. This does not predict future incidence rates with the continued improvement of road traffic laws and awareness in the population. A national trauma registry would provide significant insight into the trends of injuries to further guide appropriate treatment trends.

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Conflicts of interest
There are no conflicts of interest.

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