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Clinical and morphological evaluation of odontoid fractures of C2 vertebra

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Abstract

There have not been enough studies on cervical vertebra-2 (C2) odontoid fracture and their clinical and radiological evaluation. This study was designed to determine the proportions of the C2 odontoid fracture types and to determine the specific incidence of fracture types according to age and gender and to evaluate them clinically and with cervical spine computed tomography (CT) sections of each case. We retrospectively reviewed 32 cases of C2 odontoid fractures admitted to our clinic between January 2013 and March 2017. There were C2 odontoid fracture [15 (46.9%) male and 17 (53.1%) female] who were referred to the neurosurgical clinic. The mean age was 38.5 (2-87). The most frequent reasons for application were in-vehicle traffic accidents 18 (56.3%), fall 6 (18.8%), outside-vehicle traffic accidents 4 (12.5%), assault 3 (9.4%), breast Ca. 1 (3.1%) due to metastasis. In terms of odontoid fracture types; Type I 4 (12.5%), Type II 23 (71.9%), Type III was 5 (15.6%). 13 (40.6%) anterior, 7 (21.9%) posterior and 12 (37.5%) nondeplase were applied for odontoid fracture displacement in our cases. Pain and tenderness in the neck region of 29 patients (90.6%) were present in C2 odontoid fractured patients who applied to our clinic, while 3 (9.4%) patients presented with hemiparesia. The Frankel scale of these patients; 1 patient (3.1%) applied with B, 2 (6.3%) with D, 29 (90.6%) with E scale. Odontoid fractures do not always come to us with spinal cord damage, often the initial sign may be only neck pain. In such cases, odontoid fractures can be easily misdiagnosed and can result in morbidity and mortality, which is a major problem. The aim of our study is to draw attention to the importance of this issue by evaluating the existing data on odontoid fractures in many aspects, which are not enough studies in the literature.

Keywords: Computerized tomography, Odontoid fracture, Spinal cord injury

Introduction

Odontoid fractures often occur as a result of motor vehicle injuries, falling from height, pedestrian injuries and sports injuries. Odontoid fractures are a usual injury to the cervical spine. It constitutes between 10% and 16% of whole cervical spine fractures [1]. Odontoid fractures were divided into three types by Anderson and D'Alonzo in 1974 [2]. More recently, Grauer et al.[3] proposed a modified classification to better distinguish types II and III fractures. Odontoid fracture, which is the most usual C2 fracture, has two-phase age distribution and, most commonly occurs between the ages of 20-30 and 70-80 [4]. Odontoid fracture, especially in the elderly population, is an important cause of morbidity and mortality and may tend to remain symptomatic in some patients, while it may occur weeks or years later with signs of myelopathy in some patients [5]. In young patients, these fractures are usually caused by high-speed accidents, while in older patient trauma is caused by falls. Improved safety of motor vehicles and a seatbelt reduced spinal cord injuries in the young population [6]. However, odontoid fracture occurs in 75% of cervical spine injuries, which are children under 7 years of age [7]. In these cases, the fracture often passes through the synchondrosis and can be overlooked as it is difficult to distinguish the fracture [8]. It is suspected in children younger than 7 years presenting with neck pain or neurological deficit. Considering the high fusion rate achieved with conservative treatment, it is recommended for most synchondrosis fractures.

A long and continuous history of epileptic seizures may cause odontoid fractures in patients and may result in severe neurological deficits due to spinal cord compression [9]. Odontoid fractures have been reported to cause seizures [9].

The Frankel scale, which evaluates the sensory and motor functions of the patients, is of great importance during admission to the hospital [10].

Computed tomography helps us, that more precise determination of the morphology of the odontoid fracture, to evaluate in more detail, in making decisions about conservative and surgical. CT helps us in appropriate assessment of odontoid fracture and the direction and displacement of the odontoid [11,12].

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In this study, Odontoid fracture are a usual injury of the cervical spine, which should be considered first.Because most of the patients with odontoid fracture are admitted to hospital with pain and tenderness.We determined the incidence, types, morphology of the fracture, the reasons for admission to the clinic and accompanying neurological findings, Our aim is to draw attention to the importance of this issue since the available data on these fractures is scarce.

Materials and Methods

Thirty-two cases of C2 odontoid fractures admitted to our clinic between January 2013 and March 2017 were evaluated retrospectively.

Computed tomography images 64-detector-row Philips Brilliance CT scanner (Philips Medical Systems, Cleveland, OH; collimation 0.625 mm, pitch 1, 0.75 s / cycle scan rate, section thickness 2 mm, increment 0.45 mm, dose 250 mU and 120 kV) and 16-detector Toshiba Activion V3.00 CT scanner (Toshiba Medical Systems, Tokyo, Japan); collimation was obtained with 0.625 mm, pitch 1, 0.75 s / cycle scanning rate, cross-sectional thickness 2 mm, cross-sectional increment 0.45 mm, dose 200 mU and 120 kV). CT images of the cases were evaluated by radiology workstation (INFINITT; Infinitt Healthcare, Seoul, Korea) by neurosurgeons (H.O), (A.C) and a specialist neuroradiologist (S.H) who were experienced in CT. Ethics committee approval was received for this study.

Data were presented as mean (min-max). Age, gender, fracture displacement and type, neurological examination, Frankel scale [10], and cervical CT sections of each case were evaluated.

Results

Of the 32 C2 odontoid fractures admitted to the neurosurgery clinic [15(46.9%) were male, 17(53.1%) were female] and the mean age was 38.5(2-87). The most common reasons for admission were in-vehicle traffic accidents 18(56.3%), falls 6(18.8%), out-of-vehicle traffic accidents 4(12.5%), assault 3(9.4%), breast Ca 1(3.1%) due to metastasis (table 1). Sagittal, coronal and axial sections of the cases were evaluated on cervical vertebra tomography (Figure 1). In terms of odontoid fracture types, Type I 4(12.5%), Type II 23(71.9%) and Type III 5(15.6%) were determined. In terms of odontoid fracture displacement, anterior 13(40.6%), posterior 7(21.9%), nondeplaced 12(37.5) was determined. While 29 patients (90.6%) had pain and tenderness only in the neck region, 3(9.4%) patients presented with hemiparesis. Among the patients evaluated with Frankel scale, one (3.1%) patient was admitted to hospital with B, 2(6.3%) D, 29 (90.6%) E scale (table 2)

Tablo 1. Reasons for admission of patients

	N	%
In-vehicle traffic accident	18	56.3
Fall	6	18.8
Out-of-vehicle traffic accident	4	12.5
Assault	3	9.4
Metastasis	1	3.1

Discussion

Odontoid is the central structure of the craniovertebral junction. Imaging of this small structure remains a challenge even for radiologists due to complex bony and ligamentous anatomy. Radiological evaluation is important in terms of patient management and prognosis, since different lesions have markedly different clinical course. When the anatomical structure of odontoid is considered, the close proximity of this structure to the cervical spinal cord, brain stem, cerebellum, nerve roots, cranial nerves, cerebro-spinal fluid channels and vascular structures increases the importance of odontoid fractures [13]. Trauma to the cervical spine is the main cause of odontoid fractures. These fractures are often the result of high-energy trauma in young patients, motor vehicle accidents, falls from high height, assault. It occurs in the elderly population after lower energy effects such as falls [14, 15]. In our study, in-vehicle traffic accidents were the highest, similar to literature.

The most usual injury mechanism is hyperextension of the cervical spine. The head and C1 vertebra are pushed back during the accident, and as a result of this backward displacement the ligaments connected to the odontoid are stretched, leading to fracture of the odontoid.The odontoid fracture can also be seen in hyperflexion of the cervical spine. The lateral mass on both sides of C1 and the odontoid are interconnected by the transverse ligament.If the cervical spine becomes extremely flexed, the transverse ligament transmits excessive anterior forces to the odontoid process and causes odontoid fracture. Odontoid can be displaced in proportion to the severity of the fracture [1]. In our study, 40% of the patients had an anterior displacement and 22% posterior displacement table 2.

In cases of cervical spine trauma, odontoid fractures are a common injury. These fractures account for 20% of all cervical spine fractures [1]. Odontoid fractures were divided into three types by Anderson and D'Alonzo in 1974 [2]. Type II odontoid fracture is the most common type of odontoid fracture and accounts for more than 50% of all odontoid fractures. Type III odontoid fractures account for the majority of the remaining odontoid fractures. Type I odontoid fractures are rare [1].

Table 2. Clinical results of the study groups.

Odontoid Fracture Types		Displacement of Odontoid fracture		Frankel Scale		Neurological examination	
	N (%)		N (%)		N (%)		N (%)
Type 1	4 (12.5)	Anterior	13 (40.6)	B	1 (3.1)	Pain-Sensitivity	29 (90.6)
Type 2	23 (71.9)	Posterior	7 (21.9)	D	2 (6.3)	Hemiparesis	3 (9.4)
Type 3	5 (15.6)	Nondisplaced	12 (37.5)	E	29 (90.6)		

Frankel scale (14); B. Complete motor loss, sensory function preserved to some extent; D. Significant motor function, but have a weakness; E. Neurologically intact

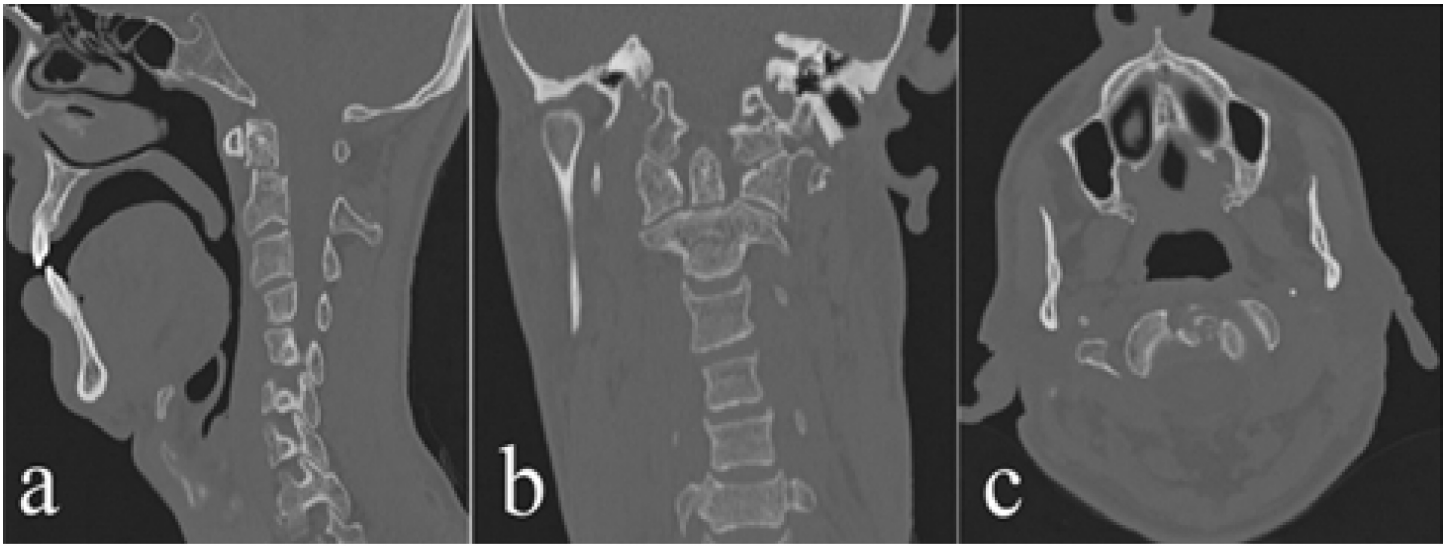

Figure 1. CT cross-sectional view of aC2 odontoid fracture case
44-year-old male patient who was brought to the emergency department because of an in-vehicle traffic accident had an anterior displacement type II odontoid fracture on sagittal (a), coronal (b) and axial (c) images of cervical spinal computed tomography.

In our study, type II odontoid fractures accounted for more than 70% of the total, table 2.

CT provides the best resolution of bone structures. The imaging method to be selected is cervical spine CT. It is the most valuable radiological device to identify and characterize the odontoid fracture [11,12] Figure 1.

Odontoid fracture has a biphasic age distribution and the highest age distribution is between 20-30 and 70-80 years [4]. In young patients, these fractures are usually caused by high-speed accidents, while in older patient trauma is caused by falls. In addition, improved motor vehicle safety and seat belt reduced the incidence of spinal cord injuries in the young population to some extent [6]. The upper cervical spine is more susceptible to high levels of trauma due to the decrease in bone density over time in the elderly due to the stiffer the lower cervical spine. The higher odontoid fracture rate in the elderly may be explained by the osteoporosis nature of the elderly [6]. Odontoid fracture occurs in 75% of cervical spine injuries in children under the age of 7 [7]. These fractures usually pass through synchondrosis, making the diagnosis difficult [8].

A long and continuous history of epileptic seizures may cause odontoid fractures in patients and cause serious neurological deficits due to spinal cord compression, whereas odontoid fractures have been reported to cause seizures [9]. Odontoid, which is associated with cerebellum, brain stem and spinal cord, and these fractures may cause seizures [16]. Odontoid dislocation is a potentially dangerous complication. There is always a risk of serious spinal cord injury [4]. Serial neurological examinations were analyzed according to the Frankel scale, which included detailed evaluation of motor and sensory functions [10]. In our study, 90.6% of the patients admitted to hospital with complaints of pain and tenderness, while only 9.4% presented with neurological damage table 2.

Conclusion

In conclusion, in the injury of the cervical spine, odontoid fractures should be considered first. Because most of the patients with odontoid fracture are admitted to hospital with pain and tenderness. Since the C2 odontoid fracture can be easily overlooked in patients admitted to the emergency department, it is vital to detect CT-guided odontoid fracture by considering the patients' complaints and clinics. In this respect, we aimed to contribute to the literature on odontoid fractures which there are not enough studies in the literature.

Conflict of interests
We declare that we have no conflict of interest.

Financial Disclosure
All authors declare no financial support.

Ethical approval
The study was approved by the local ethics committee.

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