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Imaging of external auditory canal fractures associated with maxillofacial traumas by CBCT

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ABSTRACT

Imaging of external auditory canal fractures associated with maxillofacial traumas by CBCT

Background: The external auditory canal (EAC) is a frequently disregarded region in the assessment of maxillofacial traumas (MFT). The anterior and inferior walls of EAC occur from the tympanic portion of the temporal bone. Tympanic plate is in close proximity with temporomandibular joint. Posterior and anteromedial dislocation of the condyle can result with fracture in the tympanic plate when the condyle is forced against to EAC. The aim of this study to evaluate association with MFT and EAC fractures by using Cone Beam Computed Tomography (CBCT).

Methods: CBCT images of 65 patients undertaken between 2016 and 2019 were assessed by one observer to detect the probable EAC, maxilla, mandible and condyle fractures. Descriptive and detailed statistics were performed using SPSS version 20.0 (IBM, USA). Intra-observer reliability was calculated using Weighted Cohen's kappa coefficients.

Results: EAC fracture was determined in 40 % of the patients. Of the EAC fractures, 47.4 % and 41.7 % were associated with maxillary and mandibular fractures, respectively. Of the EAC fractures, 42.3 % were bilateral. Left and right condyle fractures were detected together with 41.7 % and 45.5 % of the related side EAC fractures, respectively. Chi-squared test was used to evaluate statistical significance between EAC and other fractures.

Conclusion: Tympanic plate of EAC can fracture depending on the force against to it in MFT. In the assessment of maxillofacial trauma patients, CBCT images should be carefully evaluated not to overlook EAC fractures.

KEYWORDS

Ear canal, Mandibular condyle, Multiple trauma

ÖZ

Maksillofasiyal travmalarla ilişkili dış kulak yolu kırıklarının KIBT ile görüntülenmesi

Amaç: Dış kulak yolu (DKY) maksillofasiyal travmaların (MFT) muayenesinde sıklıkla gözden kaçırılan bir bölgedir. DKY'nin anterior ve inferior duvarları, temporal kemiğin timpanik parçasından meydana gelir. Timpanik parça temporomandibular eklem ile yakın ilişkidedir. Kondil DKY'e doğru kuvvet uyguladığında, kondilin posterior ve anteromedial dislokasyonu timpanik parçada kırık ile sonuçlanabilir. Bu çalışmanın amacı, MFT ve DKY kırıklarının ilişkisinin Konik Işınlı Bilgisayarlı Tomografi (KIBT) kullanılarak değerlendirilmesidir.

Gereç ve Yöntemler: 2016-2019 yılları arasında alınan 65 hastanın KIBT görüntüleri; olası DKY, maksilla, mandibula ve kondil kırıklarını saptamak için bir araştırmacı tarafından değerlendirildi. Tanımlayıcı ve ayrıntılı istatistikler SPSS 20.0 sürümü (IBM, ABD) kullanılarak yapıldı. Gözlemci içi güvenilirlik Weighted Cohen's Kappa katsayısı kullanılarak hesaplandı.

Bulgular: DKY kırıkları, hastaların % 40'ında görüldü. DKY kırıklarının % 47.4 ve % 41.7'si sırasıyla maksiller ve mandibular kırıklarla ilişkiliydi. DKY kırıklarının % 42.3'ü bilateraldi. Sol ve sağ kondil kırıkları, sırasıyla % 41.7 ve % 45.5 oranında ilgili tarafın DKY kırığıyla birlikte görüldü. DKY ve diğer kırıklar arasındaki istatistiksel anlamlılığı değerlendirmek için Ki-kare testi kullanıldı.

Sonuç: DKY'nin timpanik parçası, maksillofasiyal travmalarda kendisine gelen kuvvete bağlı olarak kırılabilir. Maksillofasiyal travma hastalarının değerlendirilmesinde, DKY kırıklarını gözden kaçırmamak için KIBT görüntüleri dikkatle incelenmelidir.

ANAHTAR KELİMELER

Çoklu travma, Dış kulak yolu, Mandibular kondil

INTRODUCTION

The external auditory canal (EAC) is a passageway leading from the outside of the head to the tympanic membrane. The canal is lined with skin that extends to the tympanic membrane with an average length of 24 mm. EAC is splinted into two parts as cartilaginous and bony segments. The cartilaginous segment constitutes the outer one-third (8mm) of the canal while the bony segment constitutes the inner two-thirds (16 mm) of the EAC. The bony segment is a slightly curved S-shaped tube which is formed by the temporal bone. The superior wall of the EAC is formed by squamous portion of the temporal bone, and the posterior wall is represented by the mastoid portion of the temporal

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bone. The anterior and inferior walls of that bony tube are comprised of the tympanic portion of temporal bone which is in close proximity to the temporomandibular joint.[1,2]

In cases of maxillofacial trauma particularly involving the mandible, the condyle can dislocate into the EAC and rupture the tympanic plate.[3] The force and direction of trauma are important factors which determine the condylar dislocation. While no fracture or displacement was found in maxilla and/or mandible, it is supposed that a temporary posterior dislocation of condyle may have occurred. When the condyle is displaced against to the tympanic plate, as it is unsupported by bone, fracture of the plate can ensue.[4,8] Blood in the EAC, hearing loss, hemotympanum, and/or a laceration can be seen as a result of plate fracture.

The use of cone beam computed tomography (CBCT) in clinical practice offers a variety of advantages for imaging of the maxillofacial region. The advantages are rapid scan time, image accuracy and reduced patient radiation dose compared to Multislice Computed Tomography.[9,10] The aim of this study was to evaluate the EAC fractures associated with maxillofacial trauma by CBCT images.

MATERIAL AND METHODS

This is a retrospective study evaluating the possible EAC fractures in patients who were taken cone beam computed tomography by the suspect of maxillofacial trauma. This study had ethical approval from the Non-interventional Clinical Researches Ethics Board at Hacettepe University (GO 18/1122). CBCT images of 65 patients undertaken between 2016 and 2019 were selected from the digital archive of the Department of Dentomaxillofacial Radiology, Faculty of Dentistry, at the University of Hacettepe. CBCT images including condylar region had been taken with the suspect of fracture associated with maxillofacial trauma were included in the study. CBCT images with history of tumor or surgery in the EAC region and with inadequate diagnostic quality were excluded.

CBCT scans were taken using the i-CAT Next Generation CBCT scanner (Imaging Sciences International, Hatfield, PA, USA) with tube voltage of 120 kVp; tube current of 5 mA and exposure time of 7 seconds per pulsed radiation. Voxel size was 0.20 mm for 16 x 4-12 cm custom mode field of view. The reconstructed images were evaluated by a single observer in axial, sagittal, and coronal planes with i-CAT vision 1.9.3.14. After two weeks, 15 CBCT images were reevaluated to investigate intra-observer reliability by the same observer.

All data was transferred to an Excel sheet. Descriptive and detailed statistics were performed using SPSS version 20.0 (IBM, USA). Chi-squared test was used to evaluate the statistical significance between EAC fractures and maxillofacial fractures. Intra-observer reliability was assessed using Weighted Cohen's kappa statistics. Statistical significance was set at $p < 0.05$.

RESULTS

Of the 65 patients included in this study, 34 were males and 31 were females, with the age ranging from 5 to 78 years (mean 33.17 ± 19.4 years). Kappa scores were between 0.886 and 1 indicating high intra-observer reliability.

EAC fractures were detected in 9 of the 19 maxillary fractures, and the EAC fracture detection rate was 47.4 %. Of the mandibular fractures (excluding condyle fractures), 41.7 % were together with EAC fractures. Left EAC fractures were detected in 5 of the 12 left condyle fractures, similarly right EAC fractures were detected in 5 of the 11 right

condyle fractures. Detection rates of the EAC fracture together with condyle fracture were 41.7 % and 45.5 % in the left and right side, respectively.

EAC fractures were detected in 38.5 % of the patients. Among these, 9 and 8 patients were associated with mandibular and maxillary fractures, respectively. 1 patient with EAC fracture had coexisting maxillary and mandibular fracture. 5 patients had no fracture in mandible, condyle and maxilla. 2 patients had isolated condyle fractures, one of them was in the left side and the other one was in the right side.

Right EAC fractures were detected together with 58.8 % of the left EAC fractures (Figure 1). A significant association was observed on cross-tabulation of the right EAC fractures and the left EAC fractures using chi-square test (P = .001) (Table1).

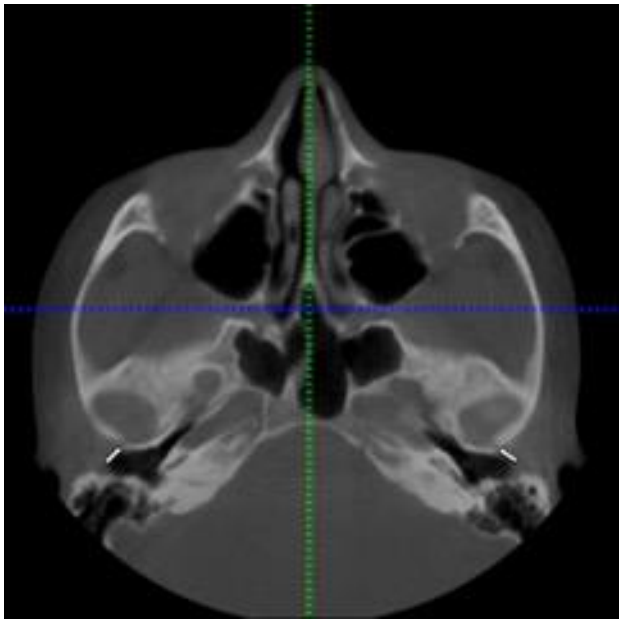

Figure 1. Axial CBCT image showing displaced fractures of EAC in right and left sides (white arrows)

Table 1. The Association Between The Right EAC Fractures And The Left EAC Fractures

		LEFT EAC FRACTURE	
		Absent n(%)	Present n(%)
RIGHT EAC FRACTURE	Absent n(%)	40 (83.3)	8 (16.7)
	Present n(%)	7 (41.2)	10 (58.8)

DISCUSSION

This study evaluated the association between maxillofacial traumas and EAC fractures which are considered as an uncommon and unnoticed complication of posterior dislocation of the mandibular condyle using CBCT images. There is a paucity of information in the literature regarding EAC fractures secondary to maxillofacial trauma as most

of the literature on EAC fractures consists isolated case reports.[11] Gomes et al. documented a case of tympanic plate fracture due to posterior dislocation of the mandibular condyle and presented a review of 13 articles in the literature which report 24 fractures of the tympanic plate following mandibular trauma in patients. In 11 cases, the tympanic plate fracture was present on the right side, nine cases were on the left side and four cases were bilateral.[12,13]

Wood et al. evaluated tympanic plate fracture in temporal bone trauma. They detected tympanic plate fracture in 27 (58.7 %) of the 39 patients.[14] In this study, the rate of EAC fracture was 38.5 % which is lower than aforementioned study, however it is a high percentage clinically. The difference between the EAC fracture detection rates may depend on the area which force is directed.

Burchhardt et al.[15] examined all multi-trauma patterns such as assaults, motor vehicle accidents and falls associated with EAC fractures. Temporal bone and mandible were evaluated by using computed tomography. They found that 3.3% of mandibular fracture included an EAC fracture. In the present study, EAC fractures associated with mandibular fractures was found as 41.7 % being substantially higher than mentioned before. The individuals who had trauma directly to the maxillofacial region were included in our study. Therefore, it could be the reason of differences in the EAC fracture rates.

EAC fracture detection rate was 47.4 % in maxillary fractures and 41.7 % in mandibular fractures (excluding condyle fractures). 45.5 % and 41.7 % of the condyle fractures were detected with EAC fracture in the right and left side, respectively. On the other side in this study, 58.8 % of the left EAC fractures co-existed with right EAC fractures. These findings of the present study suggest that the detailed CBCT interpretation of EAC should be performed in maxillofacial trauma patients in order to avoid overlooking of the EAC fractures.

Basic limitation of the present study is the lack of knowledge of the time course between trauma and CBCT imaging of the patients. Fractures starts to heal with time after trauma, detection of fractures become obscure. But still, this study ensures the importance and utility of CBCT in determining overlooked EAC fractures in the maxillofacial region with decreased radiation exposure dose.

CONCLUSION

In dentistry, it is necessary to assess presence of EAC fractures while examining maxillofacial traumas using CBCT. EAC fractures may result in hearing loss and canal stenosis. Hence, EAC should be included in the field of view of CBCT scan for all patients with maxillofacial trauma in order to make a careful assessment of EAC fracture.

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