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Evaluation of Radiomorphological Changes on Panoramic Radiography in Defense Athletes

Savunma Sporcularında Panoromik Radyografide Radyomorfolojik Değişikliklerin Değerlendirilmesi

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ABSTRACT

Objective The alveolar prominence can change the morphology of the mandible by showing continuous remodeling. The chronic remodeling/resorption process of the jaw is influenced by gender, genetics, systemic conditions, sequence of tooth loss, duration of edentulism and other unknown factors. Our aim in this study is to investigate the effect of continuous trauma to the maxillofacial region on the morphology of the mandible in defense athletes.

Methods: In the study, the patients who applied to the Atatürk University of Dentistry, Department of Oral, Dental and Maxillofacial Radiology and routine panoramic radiographs of 26 athletes who have been involved in defense sports such as boxing, kickboxing, and karate for at least 5 years were used. Measurements were made using various parameters on the printouts of these graphs and the values of the right and left sides were compared.

Results: When the condyle height, ramus height, gonial angle and antegonial angle parameters are evaluated, there is a significant relationship between right and left values. Condyle index, Ramus index and Condylar ramus index values show no asymmetry in defense athletes.

Conclusion: In defense athletes were exposed to constant trauma; neither age, duration of sports, nor exposure to maxillofacial trauma did not cause significant changes in mandible morphology.

Keywords: Athletes, trauma, morphology, facial asymmetry

ÖZ

Amaç: Alveoler çıkıntı sürekli yeniden şekillenme göstererek mandibula morfolojisini değiştirebilir. Çenenin kronik yeniden şekillenme/rezorpsiyon süreci cinsiyet, genetik, sistemik koşullar, diş kaybının sırası, dişsizlik süresi ve diğer bilinmeyen faktörlerden etkilenir. Bu çalışmadaki amacımız, savunma sporcularında maksillofasiyal bölgeye gelen sürekli travmanın mandibula morfolojisi üzerindeki etkisini araştırmaktır.

Yöntem: Çalışmada Atatürk Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Radyolojisi Anabilim Dalı'na başvuran, en az 5 yıldır lisanslı olarak boks, kickboks ve karate gibi savunma sporlarıyla ilgilenen 26 sporcunun rutin olarak alınmış panoramik radyografileri kullanılmıştır. Bu radyografilerin çıktıları üzerinde çeşitli parametreler kullanılarak ölçümler yapılmış ve sağ ve sol taraftaki değerler kıyaslanmıştır.

Bulgular: Kondil yüksekliği, ramus yüksekliği, gonial açı ve antegonial açı parametleri değerlendirildiğinde sağ ve sol değerler arasında pozitif anlamda güçlü bir ilişki vardır. Kondil indeksi, ramus indeksi ve kondil ramus indeksi değerleri savunma sporcularında asimetrinin olmadığını göstermektedir.

Sonuç: Sürekli travmaya maruz kalan savunma sporcularında; ne yaşları, ne spor yaptıkları süre, ne maruz kaldıkları maksillofasiyal travma mandibula morfolojilerinde anlamlı değişikliklere sebep olmamıştır.

Anahtar Kelimeler: Sporcular, travma, morfoloji, yüz asimetrisi

INTRODUCTION

Facial trauma is a part of defensive sports. For this reason, mouth and jaw injuries are common in athletes engaged in these sports. Due to the increase in training for exercise and physical fitness in people, traumas caused by sports are increasing day by day.[1,2] Considering the increase in the tendency to violence and the increase in fights related to it, there is an increase in the direction of starting defensive sports, especially in the younger age groups. Injuries in the maxillofacial region resulting from defensive sports, the aggressive offensive, defensive nature of these sports, require hitting and defending various parts of the body and the face with techniques applied at full strength and with a minimal amount of protective equipment. Therefore the risk of exposure to severe injuries to the face is high.[3–6]

The protruding parts are at higher risk of injury, considering the face geometry. It has been reported that the nose is the most traumatized and fractured organ in maxillofacial traumas. This is followed by mandible, zygomatic bone, and maxilla fractures.[7]

The mandible is anatomically divided into 7 regions as: condyle, coronoid process, ramus, angulus, corpus, symphysis, and alveolar process. Condyle, angulus, and symphysis are the most sensitive regions to trauma. The symphysis is the region most exposed to external trauma.

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Long canine teeth and mental foromen in the region make it more sensitive. Condyle and angulus have thinner bone structures compared to other mandible parts. Therefore, the condyle and angulus region are also susceptible to trauma. Fractures of the mandible are most common in the condyle (36%), followed by the corpus (21%) and the angulus (20%), respectively.[8]

Types of contact sports injuries depend on impact regions on the maxillofacial region and the mechanism of transmitted force. The magnitude and vector of the force, as well as absorbing mechanisms and transmitting patterns, should be considered. The traumatic effect of the force can be absorbed by the surrounding musculature, articular disc, articular and extraarticular ligaments, and the teeth.[9] Repeated trauma to the jaw can lead to inflammatory responses in the masticatory muscles, internal disorders of the joint, and loosening of the ligaments.[10]

According to Clegg's research, injuries to the maxillofacial region in an athlete account for 33% to 56% of all injuries. Many of these orofacial injuries heal without subjective symptoms, but the consequences often persist.[11]

The alveolar process is subject to lifelong remodeling.[12] The continuous remodeling/resorption process of the jaw is affected by genetic sex, systemic condition, tooth loss, duration of edentulism, and other unknown factors.[13]

Changes in mandibular morphology can cause asymmetry. Mandibular asymmetry can be caused by abnormal growth rate, trauma, tumors, and morphological disorders such as condylar hyperplasia, coronoid hyperplasia, and hemimandibular hypertrophy. Also functional causes such as occlusal malformation, bruxism, temporomandibular joint dysfunction, and muscle dysfunctions can also cause mandibular asymmetry.[14]

Asymmetry is detected radiographically by panoramic radiography, posteroanterior radiography, lateral cephalometric radiography, submentovertex radiography, 45° oblique radiography of the mandible or computed tomography, cone-beam computed tomography and magnetic resonance imaging. The use of panoramic radiography for these metrics is controversial due to methodology-specific magnification and distortion; however, many studies support the use of panoramic radiography to detect mandibular asymmetry because of the advantages of being a standard, low-cost procedure that exposes the patient to relatively low radiation levels.[15]

In many studies, it has been reported that many factors such as age, gender, edentulism, malocclusion affect mandibular morphology. Still, no previous study has shown whether continuous trauma to the maxillofacial region causes changes in mandibular morphology. Our aim in this study is to investigate the effect of constant trauma to the maxillofacial region on the morphology of the mandible on panoramic radiography in defense athletes.

METHODS

Data collecting

Compliance of this study with scientific, ethical rules was approved by Atatürk University Faculty of Dentistry Ethics Committee (Date 23.03.2022, decision no: 41).

The sample consists of panoramic radiographs taken for examination purposes of 26 people aged 17-34 who applied to Atatürk University Faculty of Dentistry, Department of Oral, Dental and Maxillofacial Radiology between 2020-2022. Since the routine panoramic radiographs were studied retrospectively, the participants did not obtain the consent form. Based on the history taken from the patient, individuals with a history of any systemic disease affecting bone metabolism (renal osteodystrophy, hyperparathyroidism, hypoparathyroidism, paget's disease, osteogenesis imperfecta, osteomalacia), fractures involving the jaws and orthognathic surgery were not included in the study. Patients with any lesion in the mandible that may cause bone destruction (such as osteomyelitis, benign or malignant tumors, cysts) were also excluded from the study.

A single technician took all of the evaluated panoramic radiographs with a Planmeca Promax digital panoramic device at Atatürk University Faculty of Dentistry, Department of Oral, Dental and Maxillofacial Radiology. In order to ensure standardization in panoramic radiographs, the reference points determined by the manufacturer on the device were fully complied with. During the scanning, the patients were positioned appropriately, with the Frankfurt horizontal plane paralel to the floor and the sagittal plane perpendicular to the floor, to prevent the cervical vertebra from being superposed to the anterior body of the mandible. Radiographic image with no artifacts in the regions to be measured and traceable mandible borders were included in the analysis. Radiographs that did not meet these conditions were excluded from the study.

After the clinical examination of the patients, the printouts of the routine panoramic radiographs were taken. In order to make the neces -sary measurements, firstly, the outlines of the condyle and mandible were drawn on acetate paper. Essential measurement points were marked on tracing paper, and measurements were made (Figure 1-2)

Figure 1: Marked points and linear measurements on panoramic radiography

- Co: The highest point of the condyle
- O_1: The most lateral point of the condyle
- O_2: The most lateral point of the Ramus
- A line: Tangential to Ramus
- B Line: Vertikal line from C to A line
- CH: Condyle height (Distance between Co and O_1)
- RH: Ramus height (Distance between O_1 and O_2)
- CRH: Condil Ramus height (Distance between Co and O_2)

Figure 2: Angular measurements on panoramic radiography

- Gonial Angle (GA): The angle formed by the intersection of the tangent line drawn to the lower border of the mandible and the tangent line drawn to the posterior border of the Ramus on both sides.
- Antegonial Angle (AGA): Angle formed by tangents drawn from the deepest point of the antegonial notch to the cortical border on both sides.

The marked anatomical points and definition

- Co: The highest point of the condyle
- O_1: The most lateral point of the condyle
- O_2: The most lateral point of the Ramus
- A line: Tangential to Ramus
- B Line: Vertikal line from C to A line

Measurement made

- CH: Condyle height (Distance between Co and O_1)[16]
- RH: Ramus height (Distance between O_1 and O_2)[16]
- CRH: Condil Ramus height (Distance between Co and O_2)[16]
- Gonial Angle (GA): The angle formed by the intersection of the tangent line drawn to the lower border of the mandible and the tangent line drawn to the posterior border of the Ramus on both sides [17]
- Antegonial Angle (AGA): Angle formed by tangents drawn from the deepest point of the antegonial notch to the cortical border on both sides.[17]

Measurements were made on both the right and left sides. Asymmetry indices were determined using the formula developed by Habets et al. [16]

Asymmetry Index (AI) = [(Right - Left)/(Right + Left)] × 100

Statistical Analysis

Statistical analyses were performed with the IBM SPSS Statistics 20 package program (IBM SPSS Corp., Armonk, NY, USA). Descriptive statistics were used to see the age distribution of the athletes, the time they did sports, and the distribution of the parameters we measured. Spearman's correlation analysis was performed to see the relationship between the data. Those with a correlation significant value of less than 0.01 were considered significant

RESULTS

Twenty-six athletes licensed for at least 5 years in defense sports, such as boxing, kickboxing, and karate, were included in our study. All of the athletes are male, and the mean age is 23.38±4.02. The average time the participants spent doing sports was 10.27±4.104. All participants stated that they used mouth guards during their sports activities. None of the participants had a systemic disease. Distribution of age, sports year, CH, RH, GA, AGA, CI, RI, and CRI values of the athletes. It is shown in Table 1. The average values of the right gonial angle (GA) and antegonial angle (AGA) and left gonial angle and antegonial angle of the athletes are very close to each other. Similarly, the condyle (CH) and ramus heights (RH) on the right and left sides are almost the same. When the condyle (CI), ramus (RI) and condyle-ramus (CRI) asymmetry index are examined, it is seen that continuous trauma to the face does not cause asymmetry in the athletes.

The results of Spearman's correlation analysis, which we conducted to examine the relationships between the CH, RH, GA, and AGA values measured on panoramic radiographis of the athletes, are given in Table II and Table III. This analysis shows a strong positive correlation between left CH and right CH, left RH, and right RH (Table 2). There is a strong positive relationship between left GA and right GA, Left AGA, and right AGA (Table 3).

DISCUSSION

Many studies in the literature have reported that many factors such as age, gender, edentulism, and malocclusion affect the alveolar process and cause changes in mandible morphology,[13] but there is no previous study on whether continuous trauma to the maxillofacial region causes changes in mandible morphology. In this section, we plan to discuss the studies on other factors affecting morphology.

Mandible morphology can be examined radiographically by various imaging methods. In panoramic radiography, Mandibular morphological measurements are controversial due to methodology-specific magnification and distortion; however, many studies support the use of panoramic radiography to evaluate mandibular morphology because of its advantages such as being a standard, low-cost procedure for patients and relatively low radiation exposure.[15]

In addition to these advantages, panoramic radiography data were used in this study because of their easy accessibility for retrospective analyses. Also, evidence shows that vertical and angular measurements can be made accurately using panoramic radiography if the patient is positioned correctly.[18]

Kjellberg technique[19] and Habets technique[16] frequently examine CH, RH, and mandibular asymmetry with panoramic radiography. In 1987, Habets et al.[20] reported that a 1 cm change in head position on panoramic radiography causes a 6% vertical dimension difference. In 1988, while investigating the relationship between temporomandibular joint dysfunction and condylar asymmetry using panoramic radiography, they developed a formula to evaluate the mandibular condyle and Ramus.[16]

According to this formula, an index rate of 6% may result from 1 cm. A displacement difference in head position during panoramic radiography and >6% indicates the presence of asymmetry.[18,19]

In the literature, there are studies in which the Habets AI formula is used in different anatomical points and occlusion types to obtain AI.[15,18]

The effects of age, dental condition, and gender on CH and RH are unknown.[21-23] In their study examining condyle morphology with CBCT, Al-Koshab et al. stated that males generally exhibited a larger condyle volume and size than females.[24] Huumonen et al (2010) also reported that especially female and edentulous individuals have smaller CH and RH.[22] Joo et al (2013) reported that the ramus height was greater in men, while there was no significant difference in condyle height between genders.[23] In addition, Ökkesim et al.[25] reported that RH differs according to gender and can even be used to predict gender. There was a difference in the measurement of CH and RH in individuals with skeletal Class-1, Class-2, and Class-3 bites.[26] However, no study was found examining whether repeated exposure to trauma has an effect on CH and RH elevation.

In this study, in defense athletes who have sustained trauma to the maxillofacial region, Habet's technique was used in the evaluation of CH, RH. All of the athletes participating in this study were male. When the participants' right and left CH and RH were measured, a robust positive correlation was found between right and left values. Therefore, we can interpret that trauma to the maxillofacial region does not significantly affect the CH and RH values.

GA is a significant parameter in orthodontic analysis. The value of this angle significantly affects the mandibular structure and, therefore, the craniofacial structures. Studies have indicated that the direction of condylar growth is related to the change in GA.[27] Studies indicate that individuals with small GA have strong masticatory muscles[23] and thick mandibular cortical thickness.[28] According to the studies of Joo et al., women have larger GA than men, while men have larger cortical thickness. The same study reported that edentulous individuals have larger GA than dentate individuals.[23] Our research concluded that the participants right and left GA values significantly correlated. We can interpret that continuous trauma does not cause a significant change in GA.

In the literature, few studies evaluate AGA, one of the morphological structures.[29] It has been stated that AGA is affected by the size of the gonial angle and thus the differences in chewing forces.[31] It is also stated that it is affected by the number of teeth and gender.[29-30] However, being exposed to constant trauma did not cause a significant difference in the right and left AGA values of the participants.

Based on these data, we believe that the most important reason why continuous trauma to the maxillofacial region in defensive athletes does not cause a significant morphological change in the mandible is that the athletes constantly use mouth guards in addition to their professionalism.

It is generally accepted that the primary function of a mouth guard is to prevent injury to the teeth. Recently, many researchers have shown that using a mouth guard can significantly reduce the incidence of maxillofacial injuries.[31]

Mouth guards have been shown to reposition the mandible, moving the condyles away from their fossae.[32] As a result, the forces from a mandibular blow that would normally be transmitted directly from the condylar heads to the cranium will be attenuated by the increased space. It has also been suggested that a mouth guard may act by absorbing some of the impact force from a blow to the lower part of the mandible.[33] We also suggest that it may reduce the likelihood of causing morphological changes to the mandible.

CONCLUSION

Continuous trauma to the maxillofacial region in defense athletes did not cause a significant morphological change in the right or left mandibular regions of the athletes. Neither the age of the athletes nor the time they did sports did not affect this situation. Besides the magnitude and vector of the force, absorption mechanisms and transmission patterns must also be considered.

Force absorption mechanisms and the use of mouthguards have significantly prevented this. However, athletes should be made aware of using personal mouthguards by going through regular dental examinations.

Ethics Committee Approval: Compliance of this study with scientific ethical rules was approved by Atatürk University Faculty of Dentistry Ethics Committee (Date: 23.03.2022, decision no: 41).

Informed -Consent: Since the routine panoramic radiographs were studied r57etrospectively, consent form was not obtained from the participants..

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Hasta Onamı: Rutin panoramik radyografiler retrospektif olarak saklananlardan onam formülü alınmamıştır.

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