Nobel Med 2023; 19(3): 180-186

DO DEFENSIVE SPORTS CAUSE TEMPOROMANDIBULAR DISORDER?

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ABSTRACT

Objective: *In athletes who perform defensive sports, the maxillofacial region is more at risk of trauma than those involved in other sports. Repeated trauma to the mandible can lead to inflammatory responses in the masticatory muscles, laxity of the ligaments, and internal disorders. In this study, we aimed to examine the incidence of temporomandibular disorders (TMD) in athletes who perform defensive sports and the symptoms that may occur. We also aimed to compare the data we obtained with individuals who did not do sports.*

Material and Method: *Male individuals between the ages of 18-31 who applied to our clinic and were engaged in defense sports such as boxing, kickboxing, and karate for at least 5 years were included in the study group. (n=30) The control group was chosen among healthy individuals in the same age group who had never been involved in sports. (n=30) Participants were asked to complete a questionnaire consisting of demographic information, anamnesis information, and TMD symptoms. Clinical examinations were performed intraorally and extraorally. In addition, clinical examination of the temporomandibular joint (TMJ) was performed following the Axis I assessment and examination instructions reported in the research diagnostic criteria for temporomandibular disorders (RDC/TMD), and those with TMD symptoms were recorded.*

Results: *In the athletes participating in our study, symptoms such as deviation during mouth opening, pain in the TMJ capsule and masticatory muscles, and hypermobility; were higher than the participants in the control group. TMD was diagnosed in 60% of the athletes and 23.3% of the control group.*

Conclusion: *In order to prevent TMJ complications in athletes who perform defensive sports and to detect clinical signs of TMJ micro-macro trauma, athletes should be routinely examined, personalized mouthguards should be recommended, and awareness should be raised in terms of protecting TMJ health.*

Keywords: *Athletes, trauma, temporomandibular joint, temporomandibular joint disorders.*

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DELIVERING DATE: 15 / 12 / 2022 • **ACCEPTED DATE:** 24 / 03 / 2023

SAVUNMA SPORLARI TEMPOROMANDIBULAR BOZUKLUĞA SEBEP OLUR MU?

ÖZET

Amaç: Savunma sporcularında; maksillofasiyal bölge, travmaya maruz kalması açısından diğer sporlarla uğraşanlara göre daha fazla risk altındadır. Mandibulada tekrarlanan travma çiğneme kaslarında inflamatuvar yanıtlara, bağların gevşekliğine ve internal bozukluklara yol açabilir. Bu çalışmada savunma sporcularında temporomandibular bozukluk (TMB) görülme sıklığını ve oluşabilecek semptomları inceleyip, elde ettiğimiz verileri spor yapmamış bireylerle kıyaslamayı amaçladık.

Materyal ve Metot: Çalışma grubuna kliniğimize başvuran, en az 5 yıldır lisanslı olarak boks, kickboks, karate gibi savunma sporlarıyla uğraşan 18-31 yaşları arasındaki 30 erkek bireyler dahil edildi. Kontrol grubu, hayatının hiçbir döneminde sporla uğraşmamış olan aynı yaş grubundaki sağlıklı bireyler arasından seçildi. Katılımcılara demografik bilgiler, anamnez bilgileri ve TMB semptomlarından oluşan anketi doldurmaları istendi. İntraoral ve ekstraoral olarak klinik muayeneleri yapıldı. Temporomandibular eklemin (TME) klinik muayenesi, temporomandibular düzensizlikler için araştırma amaçlı tanı ölçütlerinde (RDC/TMB) bildirilen, Eksen I değerlendirme ve muayene talimatlarına uyularak yapıldı ve TMB semptomu olanlar kaydedildi.

Bulgular: Çalışmamıza katılan sporcularda; ağız açma sırasında deviasyon, klik sesi, TME kapsülünde ve çiğneme kaslarında ağrı, hipermobilite gibi semptomlar; kontrol grubundaki katılımcılara göre daha fazla görülmüştür. Sporcuların %60'ına, kontrol grubunun ise %23,3'üne TMB teşhisi konmuştur.

Sonuç: Savunma sporcularında TME komplikasyonlarını önlemek ve TME mikro-makro travmasının klinik belirtilerinin erken teşhisi için sporcular rutin olarak muayene edilmeli, kişiye özel ağız koruyucuları önerilmeli, TME sağlığının korunması açısından bilinçlendirilmelidir.

Anahtar kelimeler: Sporcular, travma, temporomandibular eklem, temporomandibular bozukluk.

INTRODUCTION

Increasing interest in sports around the world; has also increased sports injuries. Especially in athletes who perform defensive sports, the maxillofacial region is at higher risk than other athletes in terms of exposure to trauma.[1] Maxillofacial injuries and temporomandibular disorder (TMD) are an expected outcome of various sports activities such as football, skiing, basketball, cycling, hockey, snowboarding, boxing, and other contact defensive sports.[2,3]

Defensive sports may cause approximately 19% of maxillofacial injuries and 33% of dental injuries.[4] Injuries in the maxillofacial region resulting from defensive sports; the aggressive offensive and defensive nature of these sports requires hitting various parts of the body and face with full-force techniques and defending with a minimum amount of protective equipment. Therefore, the risk of exposure to serious injuries on the face is high.[3,5-7]

According to a study by Clegg, stomatognathic system injuries account for 33% to 56% of all injuries during an athlete's career. Most of these orofacial injuries heal without subjective symptoms, but the results often persist.[8] As reported by Jerolimov, all orofacial injuries in athletes are soft tissue injuries (50%), dental injuries (40%), jaw fractures and temporomandibular joint injuries. (10%). Among these, injuries of temporomandibular joint (TMJ) and adjacent anatomical structures constitute approximately 2-6% of cases, but there is no reliable data.[9]

The types of injuries in defensive sports depend on the trauma areas in the maxillofacial region and the transmission mechanism of the incoming force. Besides the magnitude and vector of the force, absorption mechanisms and transmission patterns must also be considered. The surrounding muscle, joint and extra-articular ligaments, articular disc, and teeth can absorb the traumatic effect of force.[9]

As explained recently, there are two main mechanisms in forming TMJ injuries and disorders in sports. It can be seen as macrotraumas or external factors (acute, strong, direct blows) and microtraumas or internal factors (repetitive, chronic overstrain, and overload).[10,11]

Temporomandibular injuries and disorders in sports; It can occur either as a result of direct blows to the temporomandibular region or as a result of indirect transfer of blows to the jaws. At the same time, the pathogenic effect of force can be distributed and modified by the surrounding muscles, joint and extra-articular ligaments, articular disc, capsule, and teeth. Macrotraumas can cause jaw, condyle, dislocations, skull

base fractures, concussion, joint disc and displacements, intracapsular hemorrhages, and edema changes. Microtraumas; can cause tendinitis, synovitis, capsulitis, osseous or fibrous ankylosis, articular disc displacement, subluxation, and condyle dislocation.[10,12,13]

Repeated trauma in the mandible may lead to inflammatory responses in the masticatory muscles, looseness of the ligaments, and internal disorders.[14] In TMJ disorders, symptoms such as limitation in mouth opening, sliding of the lower jaw towards the damaged side when opening the mouth, malocclusion, noise from the joint, pain in the joint, muscles, and surrounding tissues, bilateral or contralateral condyle fracture, and bilateral and ipsilateral articular luxation may occur.[15]

In this study, we aimed to examine the incidence of TMD in athletes who perform defensive sports and the symptoms that may occur and to compare the data we obtained with individuals who did not do sports.

Table 1. Demographic data of the athlete and control groups.

	Athletes		Control	
	n	(%)	n	(%)
Age				
18-24	23	76.7	23	76.7
25-32	7	23.3	7	23.3
Education				
Primary School	2	6.7	0	0
High School	3	10.0	6	20.0
'Bachelors Degree	22	73.3	23	76.7
Master's Degree	3	10.0	1	3.3
Marital Status				
Married	2	6.7	6	20
Single	28	93.3	24	80
Cigarette				
Yes	3	10	2	6.7
No	27	90	28	93.3

Table 2. The sports branches and duration of the athletes.

	n	%
Sport Branch		
Boxing	12	40.0
Kickboxing	8	26.7
Karate	10	33.3
Sports Year		
5-10 Years	14	46.6
10 Years And More	16	53.4

MATERIAL AND METHOD

Study Design

This study is a case-control study. The study group included slicensed male athletes aged 18-31 years who applied to our clinic and were engaged in defensive sports such as boxing, kickboxing, and karate for at least five years. The control group was selected from healthy individuals in the same age group who had never been involved in sports. Before data collection, all participants provided informed consent. Compliance of this study with scientific, ethical rules was approved by Atatürk University Faculty of Dentistry Ethics Committee (decision no: 23.03.2022/40).

Clinical Examination

To the participants, a questionnaire consisting of demographic information, anamnesis, and TMD symptoms was designed. After the patients filled out the questionnaire, intraoral and extraoral clinical examinations were performed. Oral hygiene, teeth, and supporting tissues were examined in the intraoral examination. The clinic and radiologic examination was supervised by a lecturer certified as an expert in oral and maxillofacial radiology; an oral and maxillofacial radiology assistant performed it. Clinical examination of the TMJ was performed in accordance with the Axis I evaluation and examination instructions reported in the research diagnostic criteria for temporomandibular disorders (RDC/TMD).[16] Axis I of RDC/TMD is a physical examination used to diagnose TMD. The areas where the patient felt pain in the face and head were asked and marked on the examination form. In addition, maximum mouth opening, deviation, presence of deflection, and joint sounds were evaluated and recorded.

When measuring jaw movements, the patient was first told to open his mouth as wide as he could, and the distance between the incisal edges of the maxillary and mandibular incisors was measured with the help of a caliper. The patient then wanted to shift his chin to the right and left. The distance between the maxillary and mandibular midlines was measured with the help of a caliper. Then, the patient wanted to shift his jaw forward, and the distance between the palatal surface of the maxillary incisors and the vestibular surface of the mandibular incisors was measured with the help of a caliper. Finally, the TMJ capsule area, masseter, and temporal muscles were palpated, and the findings were recorded.

Radiological Examination

Panoramic and TMJ radiographs taken routinely from patients for radiological examination were evaluated. Digital panoramic images and TMJ images; shot with the same device in standard conditions (Planmeca Promax, kvp 70, ma 10, time 16 s, Finland),

In panoramic x-rays, teeth, surrounding hard tissues, and TMJ hard tissues (mandibular condyle, articular eminence, mandibular fossa) were examined. Missing and decayed teeth, and degenerative changes in TMJ hard tissues were noted. In addition, hypermobility and hypomobility conditions were noted by evaluating the condyle position in the mouth, open and closed positions on TMJ radiographs. Existing panoramic radiographs of the control group were evaluated. Therefore, TMJ graphs were not taken additionally for the control group.

Statistical Analysis

Statistical analysis were done with the IBM SPSS Statistics 20 package program (Armonk, NY: IBM Corp.). The normal distribution of data was confirmed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The chi-square test was used for non-parametric comparisons between the athletes and the control group, and the independent t-test was used to compare the amount of jaw movement. It was considered significant when $p<0.05$.

RESULTS

Thirty athletes and 30 control groups were included in our study. All of the athletes were male, and their ages ranged from 18 to 31. All athletes were using mouthguards. The control group consisted of individuals of the same age and gender. None of the participants had a systemic disease. Table 1 shows the descriptive statistical results showing the distribution of age, education status, marital status, and smoking of the athlete and control groups.

Athletes involved in the study; have been dealing with boxing, kickboxing, and karate sports for at least 5 years under a license. This athlete's license distribution is shown in Table 2.

The TMJ examination findings of the athletes and the control group who applied to our clinic are shown in Table 3. When examining whether there is a deviation from the midline while opening their mouths, it was observed that 4 of the athletes had deviation and 9 had deflection. In the control group, the deviation

Table 3. The athlete and control group's research diagnoctic criteria for temporomandibular disorders (RDC/TMD) examination findings.

Parameters	Athletes [n (%)]		Control [n (%)]		*p*
	Yes	No	Yes	No	
Pain When Opening					
Capsule					
Right	9 (%30)	21 (%70)	2 (%0.06)	28 (%93.3)	0.020*
Left	6 (%20)	24 (%80)	0 (%0)	30 (%100)	0.010*
Masseter					
Right	4 (%13.3)	26 (%86.6)	1 (%0.03)	29 (%96.6)	0.161
Left	3 (%10)	27 (%90)	0 (%0)	30 (%100)	0.076
Temporal					
Right	1 (%03.3)	29 (%96.6)	0 (%0)	30 (%100)	0.313
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Pain in Right Lateral Movement					
Capsule					
Right	4 (%13.3)	26 (%86.6)	0 (%0)	30 (%100)	0.038*
Left	5 (%16.6)	25 (%83.3)	0 (%0)	30 (%100)	0.020*
Masseter					
Right	1 (%0.03)	29 (%96.6)	0 (%0)	30 (%100)	0.313
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Temporal					
Right	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Pain in Left Lateral Movement					
Capsule					
Right	7 (%23.3)	23 (%76.6)	1 (%0.03)	29 (%96.6)	0.023*
Left	1 (%0.03)	29 (%96.6)	0 (%0)	30 (%100)	0.313
Masseter					
Right	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Temporal					
Right	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Pain in Protrusion					
Capsule					
Right	8 (%26.6)	22 (%73.3)	0 (%0)	30 (%100)	0.002*
Left	3 (%10)	27 (%90)	1 (%0.03)	29 (%96.6)	0.301
Masseter					
Right	3 (10)	27 (%10)	0 (%0)	30 (%100)	0.076
Left	1 (%0.03)	29 (%96.6)	0 (%0)	30 (%100)	0.313
Temporal					
Right	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Left	0 (%0)	30 (%100)	0 (%0)	30 (%100)	
Click on Opening					
Right	12 (%40)	18 (%60)	6 (%20)	24 (%80)	0.091
Left	7 (%23.3	23 (%76.6)	4 (%13.3)	26 (%86.6)	0.317
Click on Lateral/Protrusion					
Right	9 (%30)	21 (%70)	4 (%13.3)	26 (%86.6)	0.117
Left	2 (%0.06)	28 (%93.3)	4 (%13.3)	26 (%86.6)	0.389
Pain in Palpation					
Capsule					
Right	10 (%33.3)	20 (%66.6)	1 (%0.03)	29 (%96.6)	0.003**
Left	5 (%16.6)	25 (%83.3)	5 (%16.6)	25 (%83.3)	1.00
Masseter					
Right	6 (%20)	24 (%80)	2 (%0.06)	28 (%93.3)	0.129
Left	3 (%10)	27 (%10)	3 (%10)	27 (%10)	1.00
Temporal					
Right	5 (%16.6)	25 (%83.3)	2 (%0.06)	28 (%93.3)	0.228
Left	2 (%0.06)	28 (%93.3)	3 (%10)	27 (%10)	0.640
Opening Type					
Straight	17 (%57.6)		28 5(%93.3)		0.004**
Deviation	4 (%13.3)		1 (%03.3)		
Deflection	9 (%30)		1 (%03.3)		

*: $p<0.05$, **: $p<0.005$

Table 4. Measurement values of jaw movements of the athlete and control groups: Investigation of parametric values.

Parameters	Athletes		Control		*p*	t
	n	Mean(mm)±SD	n	Mean(mm)±SD		
Right Lateral Movement	30	10,13±1,77	30	9,13±1,97	0.044*	-2.060
Left Lateral Movement	30	10,23±1,90	30	9,26±2,08	0.066	-1.875
Protrusion	30	9,80±1,90	30	8,13±1,61	0.001**	-3.661
Max Mouth Opening	30	47,20±3,05	30	44,50±2,77	0.001**	-3.582

SD: Standart deviation, ***:** $p<0.05$, ****:** $p<0.005$

was observed in 1 person, and deflection was observed in 1 person. It was observed that the athletes had more mandibular deviation and deflection than the control group. (p=0.004). The Clicking sound during mouth opening was heard in 12 people, 6 people in the control group in the right joint. (p=0.091), 7 people in the athletes, and 4 in the control group in the left joint (p=0.317). The clicking sound heard when opening the mouth in athletes was detected in more people than in the control group, but it did not give a statistically significant result. When the bilateral capsule, masseter, and temporal muscle region were palpated, it was observed that the pain in the right capsule (p=0.003), right masseter muscle (p=0.129), and right temporal muscle (p=0.228) and left temporal muscle region (p=0.640) was more in athletes. Pain during palpation, especially on the right side, was more common in athletes.

The measurement values of the jaw movements of the participants during the clinical examination are shown in Table 4. The athletes' maximum mouth openings (p=0.001) and protrusion (p=0.001) amounts were statistically significantly higher than the control group.

TME films taken from the athletes were examined, and it was observed that 12 of the athletes had bilateral hypermobility, 3 had left hypermobility, and 2 had right hypermobility. Figure 1 shows the TMJ radiograph of one of the athletes with bilateral hypermobility. The joint movements of other athletes are observed as normal.

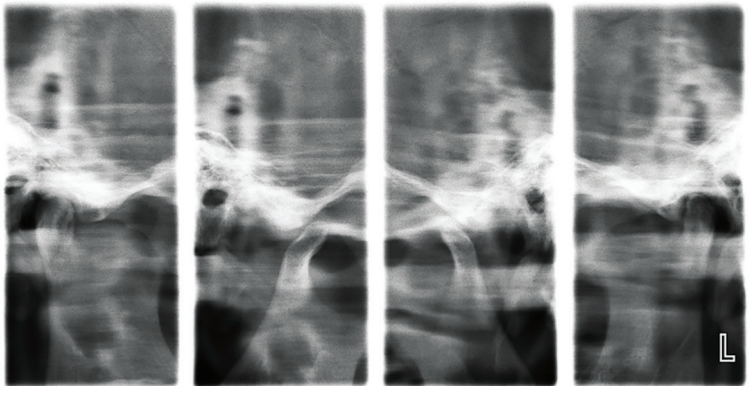

Figure 1. Temporomandibular joint (TMJ) Radiograph: Bilateral Hypermobility

DISCUSSION

Trauma is very common in athletes. athletic events; it is reported that the cause of injury is six times more than occupational accidents and three times more than traffic accidents and acts of violence.[17,18]

Because facial trauma can be associated with TMD symptoms, high-performance athletes who perform defensive sports have more traumatic lesions than non-athletes.[19] Bakland *et al*. examined TMD patients in their study in 1998 and reported that the symptoms started with trauma in 42% of the cases, and 5% of them were caused by sports.[20]

Temporomandibular injuries and disorders in sports may occur either as a result of direct blows to the temporomandibular region or indirectly as a result of the transfer of blows to the jaws.[10,12,13] The traumatic effect of force can be absorbed by the surrounding muscle, joint and extra-articular ligaments, articular disc, and teeth.[9] TMJ in disorders; limitation in mouth opening, sliding of the lower jaw towards the damaged side when opening the mouth, malocclusion, noise from the joint, pain in the joint, muscles, and surrounding tissues, subluxation, and bilateral or contralateral condyle fracture may occur.[15]

In this study, the incidence of TMD and the symptoms that may occur in high-performance athletes who perform defensive sports were investigated, and their findings were compared with the control group who did not do sports.

According to the studies conducted in the literature, a limited number of studies examined the prevalence of TMD in athletes who perform defensive sports. There was no consistent methodological approach in these studies. Most studies used their evaluation questionnaires, although documented examination results using the Helkimo index or RDC/TMD.[21-26] In our study, examination was done following the instructions in Axis I of RDC/TMD.[16] RDC/ TMD assesses the frequency of TMD signs and symptoms and determines the number of people diagnosed with TMD. It also allows the chronic pain condition associated with TMD and the diagnostic classification established based on the different subtypes of TMD.

In the clinical and radiological examination of the athletes and the control group, deviation, clicking sound during mouth opening, pain especially in the right side joint capsule, masseter and temporal muscles on palpation, pain in the TMJ capsule region at maximum

mouth opening, lateral, protrusive movements and during palpation; were observed more in athletes than in the control group.

When the participants were examined whether there was a deviation in the jaw during mouth opening, it was seen that 30% of the athletes had deflection and 13.3% had deviation. The deviation was detected in 03.3% of the control group and deflection in 03.3%. It was observed that the athletes had more mandibular deviation and deflection than the control group. (*p*:0.004). In a study by Perrson *et al*. in 1994, in which they looked at the prevalence of TMD, dental damage, and dental caries in wrestlers, they reported that the most common symptom was mandibular deviation.[23]

Athletes complained of pain in the TMJ capsule region more frequently than the control group at maximum mouth opening, lateral, protrusive movements, and during palpation. In the study of Jamalpour *et al*., they reported that anterior ear pain was the most frequently complained clinical symptom.[24] In the same study, they also stated that joint noise was the most common finding during the clinical examination.[26] In addition, Bonotto *et al*. reported that disc dislocation was the most common finding in their work on artists.[26] The click sound is the result of disc dislocation. In our study, although the clicking sound heard when opening the mouth in athletes was detected in more people than in the control group, it did not give a statistically significant result. (40% in Athletes, 20% in the Control Group), (*p*=0.091) Severe blows may cause damage to the ligaments of the disc. For this reason, displacement of the disc and associated joint noise is an expected situation in a population that is significantly exposed to the jaw and facial trauma.

Although the frequency of pain in the masseter and temporal muscle regions during maximum mouth opening, lateral, protrusive movements, and palpation was higher in athletes than in the control group, it did not give a statistically significant result. More meaningful results can be obtained when we increase the sample size. In the study of Weiler *et al*. with adolescent athletes in basketball and handball branches, they reported that masticatory muscle pain was the most common symptom in both the athletes and the control group. However, this is not statistically significant. The authors suggested that testosterone levels in adolescents had a protective effect in the absence of a large difference.[21] The absence of a validated and reproducible protocol makes it difficult to compare these findings with the results of our study. Adult athletes do not have as much pain as symptoms such as disc dislocation, deviation, and deflection; In these athletes who are constantly exposed to impact, it may suggest that the pain threshold is elevated or that the pain has become chronic.

Maximum mouth opening, right lateral movements, and protrusive movements of the athletes; were statistically significantly higher than those who did not do sports. Many studies have reported that trauma has an important role in the pathogenesis of TMJ hypermobility.[27-29]

In the literature, in the case-control study of Mendoza-Puente *et al*., published in 2014, in which boxers and handball players were compared, TMD was reported with a rate of 77.7% in boxers and 45% in handball players.[25] In addition, Jamalpour *et al*. reported the incidence of TMD as 28.1% in their study on boxers in 2015.[24] In a study published in 2016 by Bonotto *et al*. in order of their prevalence; 54.2%, 17.6%, 61.5%, 14.3% were reported.[26] In our study, 60% of the athletes and 23.3% of the control group were diagnosed with TMD.

In these studies trying to determine the presence of TMD, Bonotto *et al*. is the only study that uses tools that allow diagnosis in addition to describing symptoms. The use of RDC/TMD in our study also makes the prevalence of TMD more remarkable.

While the results are important, it is necessary to consider the small sample size. Therefore, further studies of TMD in larger groups of defensive athletes using the same methodological diagnostic criteria are needed. In addition, it may be useful to see the difference by adding participants from different contact sports branches.

CONCLUSION

As a result, in the athletes participating in the study, symptoms such as deviation during mouth opening, click, pain in the TMJ capsule and masticatory muscles, and hypermobility; were higher than the participants in the control group.

Therefore, athletes should be routinely examined to prevent TMJ complications in athletes who perform defensive sports and to detect clinical signs of TMJ micro-macro trauma early. In order to better protect the TMJ structures and dental arch, mouthguards made by dentists who are specialized in TMJ should be preferred. Athletes should be made aware of the protection of TMJ health.

*The authors declare that there are no conflicts of interest.

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