Non-surgical treatment of sports-related temporomandibular joint disorders in basketball players

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Abstract - In this study, 18 basketball players (11 female, seven male; age range 14-32 years) with temporomandibular joint (TMJ) problems who had a history of sport injuries related to head or jaw region were evaluated and the results of the treatment were presented. A standardized functional examination of the masticatory system was performed including measurement of maximal jaw movements, recording of joint sounds, pain on movement of the jaw as well as tenderness to palpation of the both TMJ or masticatory muscles. Patients were also evaluated periodontally. Diagnosis was made according the criteria, described by Okeson, and appropriate treatment was applied using different kind of splints. At the end of treatment only one patient continued with right TMJ reduction with slight pain. Except for that patient, none of the patients had pain after treatment. The maximum opening of the jaws and the maximal jaw movements were statistically increased after treatment. Patients with TMJ problems also showed periodontal problems, most likely due to inadequate oral hygiene because of the limited jaw movements and pain. Periodontal parameters including probing depth (PD), Plaque index (PI), and Sulcus Bleeding Index (SBI) improved after treatment. Sports-related TMJ injuries may result in complex problems such as pain, TMJ sounds, limitation in maximal jaw movements and maximum opening of the mouth, difficulty in chewing. With the appropriate diagnosis this could be treated nonsurgically in 6-8 months. This study also showed that the TMI disorders may cause periodontal problems, which may affect all teeth and also the general health of the athlete.

Dental and facial traumas are common sportsrelated injuries. In several studies it is shown that 13-39% of all dental injuries were sports-related, and 11-18% of all sports-related injuries were maxillofacial injuries (1, 2). According to statistics published in the Journal of the American Dental Association (ADA) in 1990, 44-99% of temporomandibular joint (TMJ) problems are caused by trauma (3). Trauma here means an injury as

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obvious as a blow to the jaw with a fist or something as subtle as a whiplash injury with direct trauma to the head or jaw (3).

The risk of injury in contact sports is greater than in non-contact sports (4). Basketball is the sport that has an extremely high injury potential (5). In a study by Olvera, it was reported that female basketball players have 7.5% oral injury rate, which was 15 times greater than the injuries reported for men's football (6). In another study, wrestling and basketball have the highest incidence of orofacial injury for men and basketball and field hockey for women. It was reported that none of these athletes were wearing mouthguards (4). It was concluded by the authors that there is almost a sevenfold increased risk of orofacial injury in athletes competing in basketball without a mouthguard (7). Mouthguards offer protection to the dental and periodontal structures during contact sport practice. They also decrease both the number and the severity of injuries caused by blows or falls to the oral region (8-10). Chapman has considered that there is a significant reduction in the risk of injury, especially in concussion, following an impact to the mandible if a mouthguard is worn (11).

The extent of dental and maxillofacial injuries may not be apparent immediately. Some traumas or injuries may be discovered later or may result in permanent deformities if not diagnosed at that time or treated properly (12). Usually sports-related TMJ injuries are not apparent immediately, they may present as complex problems with time such as pain, TMJ sounds, limitation in maximal jaw movements and maximum opening of the mouth, difficulty in chewing etc. Most blows to the mandible do not result in fractures. This significant force that is transmitted to the temporomandibular disc and supporting structures may result in severe and usually permanent injuries. In both severe and mild trauma, the condyle can be forced posteriorly compressing the retrodiscal tissues. In some cases trauma to TMJ may cause intracapsular bleeding, which is even worse, that can lead to ankylosis of the joint (13).

In this study, 18 basketball players with TMJ problems who had a history of sport injuries related to head or jaw region were evaluated and the results of the treatment are presented.

Materials and methods

This study comprises 18 basketball players referred to our clinic at the Faculty of Dentistry of Hacettepe University, aged between 14 and 32 years (mean age: 22.8 years), suffering from TMJ pain and/or sounds.

The inclusion criteria for this study group were: 1 Subjects must have had a history of sport injuries

- related to head or jaw region.
- 2 Complete dentition with Class I molar relationship.

Subjects who had the following were not accepted into the study:

- **1** Previous orthodontic treatment.
- 2 TMJ disease symptoms or treatment before the injury.

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Complete medical and dental histories were taken from the patients and a standardized functional examination of the masticatory system was performed including measurement of maximal jaw movements, recording of joint sounds, pain on movement of the jaw as well as tenderness to palpation of the both TMJ or masticatory muscles (m. temporalis, m. massater, m. sternocleidomastoideus, m. pterygoideus lateralis). From these recordings a diagnosis was made according the criteria, which was described by Okeson (14), and appropriate treatment was undertaken. The diagnosis was also supported radiographically by magnetic resonance imaging findings.

The patients, who were diagnosed as masticatory muscle disorder received full arch maxillary stabilization splints. Splints were fabricated from acrylic resin and adjusted to have flat occlusal contacts for all opposing teeth, and uniform anterior and canine guidance was established. The patients were instructed to wear the stabilization splints at all times, except during meals and oral hygiene. For the patients, who were diagnosed as internal derangement of TMJ with reduction, received an anterior repositioning splint. These splints were fabricated at a forward position, which eliminates the TMJ sounds during opening and closing. A lingual retrusive guidance ramp was fabricated at these splints, which establishes this forward position. The patients were instructed to wear these splints at all times, even while eating. For the patients who were diagnosed as internal derangement of TMJ without reduction, received also stabilization splints and performed. manipulation was All manual interocclusal appliances were fabricated and adjusted by the same dentist.

Patients' periodontal statuses were also evaluated before and after the treatment. Periodontal examination consisted of probing depth (PD), plaque index (PI) (15) and Sulcus Bleeding Index (SBI) (16). PD was measured at six sites per tooth using a University of Michigan 'O' probe. PI and SBI were assessed at four different sites per tooth.

Standardized clinical examination was performed on monthly follow-up visits and corrections were made to the splints if necessary. Before and after treatment clinical examination recordings were compared and interpreted statistically. The results were analyzed using Wilcoxon signed rank test.

Results

18 basketball players (11 female, seven male), aged between 14 and 32 years (mean age: 22.8 years), suffering from TMJ pain and/or sounds were treated for 6–8 months. All patients were cooperative during the treatment and used the splints as instructed.

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None of the basketball players were using mouthguards. Only one in 18 (5.6%) was aware of the importance of using mouthguard during sports.

The diagnosis for TMJs and their positions after treatment are presented in Table 1. At the end of treatment only in one patient right TMJ continued with a slight pain who had bilateral reduction of TMJs before. Except for this patient none of the patients had pain after treatment (Table 1).

The maximum opening of the jaws was increased from 40.9 ± 7.4 to 47.1 ± 5.0 mm, an increase of 6.2 mm (P < 0.01). There were no difference in maximum jaw opening in patients who were diagnosed as internal derangement of TMJ with reduction. The increase in maximum jaw opening was observed in patients who were diagnosed as internal derangement of TMJ without reduction. The maximal jaw movement for the left side was increased from 8.2 ± 1.1 12.6 ± 0.5 to (P < 0.0001), from 8.3 ± 1.1 to 12.6 ± 0.6 (P < 0.0001) for the right side and the protrusive movement was increased from 4.7 \pm 0.6 to 7 \pm 0.7 (P < 0.0001) at the end of treatment (Table 2).

Figure 1 shows the difference of periodontal clinical measurements before and after the treatment of TMJ problems. Patients with TMJ problems also showed periodontal problems, which was most likely because of inadequate oral hygiene procedures because of the limited jaw movements and pain. PD, PI and SBI improved significantly compared with baseline. PD was reduced from 3.61 ± 0.5 to 1.83 ± 0.38 (P < 0.0001). PI was reduced from 1.55 ± 0.17 to 0.45 ± 0.07 (P < 0.0001),and SBI was reduced from

Table 1. The diagnosis for TMJs and their positions after treatment

 1.8 ± 0.15 to 0.16 ± 0.02 (P < 0.0001). After the measurements patients received scaling or scaling and root planning if needed.

Discussion

Several studies indicate a high level of trauma in athletes. Sport accidents were responsible for six times as many facial injuries compared with work accidents and accounted for three times more injuries than violence or traffic accidents (17, 18). Sports with high speed and high impact resulted in more facial bone fractures, whereas sports with low speed and low impact ended in more dental injuries (17).

Direct bodily contact during activities such as basketball, handball, and rugby is the most common cause of sports-related injuries (8). The lowest incidence of dental trauma was found in American football (1.4%) because of the mandatory dental and facial protection in this sport (6). Dental trauma in sports differs from other dental traumas as it is possible to easily prevent these injuries by using mouthguards and face protections (19). According to ADA mouthguards prevent over 200 000 oral injuries per year. A properly made mouthguard not only prevents serious injury to the teeth but also reduces the chance of concussion from blow to the jaw (20). The damage caused by a traumatic impact to the dento-alveolar structures, can also result in facial bone fracture and more seriously neck or brain injury resulting from increased cranial pressure and deformation. The most common cause of concussion in sport is a blow to the mandible (21).

Patient No.	Sex	Age	TMJ (before Tx)		TMJ (after Tx)		Ty paried	Pain (before Tx)		Pain (after Tx)	
			Left	Right	Left	Right	(month)	Left	Right	Left	Right
1	F	26	w/Red	w/Red	N	N	6	+	+	_	
2	F	28	w/Red	w/Red	N	Ň	6	+	_		
3	F	23	w/Red	w/Red	N	N	7	+	+	_	_
4	F	16	w/Red	w/Red	Ň	N	6	+		_	_
5	F	32	w/Red	w/Red	N	Ň	ő	+	+	-	-
6	M	20	w/Red	w/Red	N	w/Red	6	+		-	
7	F	25	w/Red	w/Red	N	N	7	+	_	_	- -
8	F	20	w/Red	w/Red	Ň	N	6	+	_	_	_
9	F	26	w/Red	w/out Red	.N	N	8		-	-	
10	М	22	w/Red	N	N	N	6	, ,	-	_	
11	М	19	w/Red	N	Ň	Ň	6		_		_
12	F	19	w/Red	N	Ň	N	6	- -	_	-	_
13	М	14	w/Red	N	N	N	8	÷	_	-	_
14	М	24	w/out Red	w/Red	N	N	6			_	_
15	М	25	w/out Red	w/Red	Ň	N	6		+ +	_	
16	F	25	N	w/out Red	Ň	N	7	_	т Т	_	_
17	F	32	N	w/out Red	N	N	6	_	+	_	_
18	м	16	Ν	w/Red	N	N	8	-	+	_	_

TMJ, temporomandibular joint; Tx, treatment.

Table 2. Maximum jaw movements

					Maximal jaw movements (mm)					
	TMJ (before Tx)		Max opening (mm)		Before Tx			After Tx		
Patient No.	Left	Right	Before Tx	After Tx	Left	Right	Protrusive	Left	Right	Protrusive
1	w/Red	w/Red	41	41	8	8	4	13	13	8
2	w/Red	w/Red	44	44	8	8	5	12	12	6
3	w/Red	w/Red	40	40	9	7	5	12	11	7
4	w/Red	w/Red	42	42	8	8	5	13	13	7
5	w/Red	w/Red	50	53	8	8	4	12	12	6
6	w/Red	w/Red	45	48	7	9	6	13	13	8
7	w/Red	w/Red	41	46	8	7	5	12	12	8
8	w/Red	w/Red	50	59	8	8	4	13	13	8
9	w/Red	w/out Red	35	46	11	6	5	13	13	7
10	w/Red	N	26	45	7	10	5	13	12	7
11	w/Red	N	49	50	8	10	5	12	12	7
12	w/Red	N	45	56	7	9	5	13	13	7
13	w/Red	N	49	49	7	9	4	12	13	6
14	w/out Red	w/Red	26	45	9	7	5	13	13	7
15	w/out Red	w/Red	30	45	9	8	5	12	12	7
16	N	w/out Red	30	43	8	10	4	13	13	7
17	N	w/out Red	33	48	7	9	4	13	13	6
18	N	w/Red	40	45	10	8	5	13	13	7

TMJ, temporomandibular joint; Tx, treatment.



Fig. 1. Difference in periodontal parameters before and after treatment. *P < 0.0001. Tx, treatment.

Chapman has considered that there is a significant reduction in the risk of injury, especially in concussion, following an impact to the mandible if a mouthguard is worn. The mouthguard reduces the force that is transferred across both the mandibular plane and TMJ and this also reduces the violent forces, which the brain is subjected (11). It was also shown on cadavers that mouthguards reduce the intracranial pressure and hence the force of impact to the brain which results from a blow to the jaws (22). There is an interesting case report presented by Murthy et al. reporting an incident of a cricket ball impact to the chin, which resulted in posterior dislocation of both TMJs and bilateral deafness (23).

Injuries to the TMJ can range from contusion to complex displaced fractures. Major factors in the treatment of any injury are the patient's age and the stage in development of the TMJ and surrounding structures. A failure of diagnosis or the lack of proper treatment may lead to deformities (24). All patients in this study have been treated non-surgically. Non-surgical treatment methods of TMJ disorders have a number of advantages over surgical treatment methods. These treatment modalities can be prescribed for both muscular disorders and internal derangement of TMJ. Surgical treatment methods have a number of disadvantages including surgical complications whereas non-surgical methods are easy to perform even for an inexperienced dentist. Although there are clinical studies that report success rates between 70 and 85% (25-27) for surgical treatment methods, the success criteria of these studies were quite variable and they were relatively short-term reports. Randomized clinical studies regarding the effectiveness of non-surgical treatment methods

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agree that conservative, non-surgical treatment methods should be attempted before surgery is considered. Additionally, non-surgical treatment methods are cost-effective and reversible in nature when compared with surgical methods. In this study non-surgical treatments were completed successfully except in one patient. They were all free of pain and discomfort and there were no limitations in jaw movements and mouth opening at the end of the study.

Patients in this study had periodontal problems, which was probably because of the pain, discomfort during functions and the limitation of maximum opening of the mouth. Oral hygiene instructions were given and demonstrated to the athletes and the importance of oral hygiene was explained by the periodontist. Beside these, no periodontal treatment was performed during the treatment of TMJ problems because of the pain and limited mouth opening. At the end of the treatment there were no periodontal problems. This could be because of either the oral hygiene instructions or being free of pain, discomfort and the limitation of mouth opening. The important point here was the reality that the TMJ disorders may cause periodontal problems, which may affect all teeth and also the general health of the athlete. In order to prove this periodontal status of an increased number of individuals having TMJ problems can be evaluated in further studies.

Couches, club doctors, dentists and parents should inform the athletes about the importance of mouthguard use. For the sports where mouth protection is more usual, players should be encouraged to wear mouthguard. Studies showed that the coaches have the highest impact on players about wearing mouthguard (28). The best way to reach more number of athletes can be to inform the coaches. Mandatory sports seminars may help to achieve this. In this study only one athlete in 18 was aware of the importance of using mouthguard and they have never been told about the necessity of using mouthguard during contact sports. Interestingly this dental visit was not their first dental visit. The general dentists must be also trained about sport injuries and how to fabricate mouthguard in order to be involved in community service activities in sports dentistry (29).

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