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Influence of mouthguards on the physical performance of soccer players

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Abstract – *Aim*: To evaluate the influence of different types of mouthguard (MG) on physical performance of female soccer players. *Material and methods*: The sample was composed of 25 female soccer players from 'Guarani Futebol Clube', age range 18–22 years. For data collection, two tests were performed: agility test (shuttle run) and aerobic capacity and VO_2 (Cooper test), in addition to application of a perception questionnaire after wearing mouthguards during the tests. *Results*: Data analysis showed that mouthguard type III presented better results in the VO2 and aerobic capacity tests ($P < 0.05$). In relation to difficulties experienced when wearing MGs, there were no reports of pain, discomfort, or nausea. However, 100% of athletes affirmed that it was not possible to speak with MG type I, 80% ($n = 20$) with type II, and no athlete found difficulty in speaking when wearing MG type III. Distractions were reported by 35% ($n = 6$) only when athletes wore MG types I and II. *Conclusions*: Among the three types evaluated, the customized MG (type III) presented better results in the athletes' physical performance evaluation, even taking into account physical tests performed without the use of mouthguards.

The search for perfection has raised the level of competitiveness in sports, and consequently, there are increasingly greater demands on athletes' technical and physical performance, which could increase the risk of traumatic lesions in contact sports (1).

From this aspect, the use of mouthguards allows the absorption and distribution impacts on the oral cavity, thus preventing contusions or mandibular fractures, dislocations and traumas affecting the temporomandibular joint (1–8).

When considering athletes, this type of result is an extremely worrying condition because it can be associated with difficulty in respiration and consequently the drop of physical performance. An athlete who uses mouth breathing may present 21% lower physical performance, suggesting that the use of an inadequate mouthguard may interfere in his/her performance (2,9).

Some characteristics make the mouthguard suitable for sporting practice, and these protectors must be made of a strong but comfortable material, not hamper verbal communication or respiration, and cover all the teeth up to the second molar, in addition to being used preferably in the maxilla. In addition, that must have good retention and minimal occlusal interference, not cause pain, and be of adequate thickness (10–12). In the literature, there are few reports on the effect of the use of different types of mouthguards on the physical performance of football players, and not one is considered a sample of participants in an age range that characterizes a single profile of expected performance; thus, the aim of this study was to evaluate the influence of different mouthguard uses in the physical performance of female soccer players.

Material and methods

This study was conducted in accordance with the regulations determined by Resolution 196/96 of the National Health Council of the Ministry of Health and approved by the Research Ethics Committee (Protocol 2009/0163). The 25 players were members of the women's football team of 'Guarani Futebol Clube' Campinas – São Paulo in the year 2010.

To evaluate the athletes' performance, the following three mouthguards were used, in random sequence, by all the volunteers:

1 Type I: Universal Protector, a mouthguard bought in sporting goods stores (Protector Fight® - Dogma Indústria e Comercio de Plásticos LTDA, São Paulo, São Paulo, Brazil). It is of standard size and is retained in the oral cavity when the arches are in occlusion.
2 Type II: Thermoplastic mouthguard made of EVA or PVC, which must be molded in the athlete's oral cavity after immersion in hot water (Protector Fight® – Dogma Indústria e Comercio de Plásticos LTDA, São Paulo, São Paulo, Brazil).
3 Type III (custom-made): Fabricated from an impression taken of the athletes maxillary arch, under vacuum in a forming machine.

To fabricate the type III mouthguard, impressions of the athletes' maxillary arches were taken with alginate (Algagel® Technew, Rio de Janeiro, Rio de Janeiro, Brazil), and the molds were poured with stone plaster (Asfer® Industria Química LTDA., São Caetano do Sul, São Paulo, Brazil). The impressions were taken by the researcher on previously scheduled days, using sterilized material. The casts were poured immediately, to prevent distortion of the molds.

The mouthguard colors were standardized according to types, with the object of facilitating communication with the athletes, yet maintaining secrecy with regard to the type of protector and its characteristics. Type I protectors were in red color; type II, yellow; and type III, transparent.

Physical tests

The 12-min Cooper (13) test and shuttle run with a ball (14) by all volunteers who participated in the study, without the use of mouthguard and with the use of each mouthguard (types I, II, and III), in randomized sequence.

The shuttle run with a ball is a test specifically to evaluate the agility of football players. The athletes must move the balls forward, using either of their legs, along a predetermined run on the training field in the shortest possible time. The run consisted of two parallel lines at a distance of 9.4 m from one another. Two balls were placed at 10 cm from the external part of one of the lines, with a distance of 30 cm between them.

The athlete took up her position behind the starting line, with legs apart in the anteroposterior direction, with the leg in the anterior position placed as closely as possible to the starting line. After the examiner gave the command 'ready', she started the test with the command 'Go', simultaneously activating the stopwatch (Oxer stopwatch 1/100 sec.)

The athlete started running from the starting line to the other line to get the first ball with her feet and move it as closely as possible, without kicking it, up to the starting line, where the ball was left in a determined place in the external part of the line. After doing this, she ran back in the direction of the second line to get ball 2 and perform the same sequence performed with the first ball. The time count was finalized when the athlete passed the starting line after leaving the second ball in the predetermined place.

The 12-min Cooper test (13) is used to evaluate aerobic power (VO_2 max) and physical fitness. The training field was marked with cones to determine the course the athletes should run by the end of 12 min. After each complete lap, 180 m were counted.

The athletes were informed that if they felt any difficulty or discomfort during the test, they should reduce their speed, without stopping, and continue running when they recovered their breath, covering the maximum distance possible in the 12 min.

All the test sessions were performed on the training field of 'Guarani Futebol Clube', Campinas-SP, Brazil.

The athletes were divided into two different groups to facilitate note-taking of the laps run by each of them. The test began from the time all the athletes had taken up their position on the starting line (starting cone) and the command 'Go' was given, and the stop watch activated.

The two physical tests with reference to each situation without the use of mouthguard and using each of the mouthguards were performed by the athletes, according to a draw, individualized for each athlete, on the same day, respecting an interval of 15-min rest between each of the phases, to allow the athletes to recover 14. The tests with the different protectors were performed on alternate days, always at the same time, with 1-week interval between each one.

Questionnaire application

On conclusion of the battery of the two tests, a questionnaire was applied to analyze perception with regard to the use of the different types of mouthguards and reports on discomfort, nausea, difficulty in breathing, difficulty in speaking, injury/pain, difficulty in removal, and distracting attention in the tests.

Method for analyzing the results

For the data with reference to the physical performance tests, exploratory data analysis was initially performed using PROC LAB of the statistical program SAS (SAS Institute Inc., Cary, NC, USA), and it was observed that the data met with the presuppositions of a parametric analysis. Thus, the analysis of variance (ANOVA) and Tukey's tests were performed with a level of significance of 5% for the shuttle run and Cooper tests. For analysis of perception with regard to the use of mouthguards, exploratory analysis was performed.

Results

After use of the mouthguards, none of the athletes reported having suffered injuries or pain. Nausea was reported by 44% ($n = 11$) of the athletes with the use of type I mouthguards and 52% ($n = 13$) when using types I and II mouthguards. None of the athletes reported having felt nausea with the use of the type III mouthguard.

Table 1 represents the results of the Cooper physical tests and VO_2 level. An improvement in the physical performance of athletes was noted with the use of the type III mouthguard.

Table 2 represents the results of the shuttle run agility test, and it may be perceived that there was no alteration in the result of the test in view of whether or not the mouthguards were used.

Difficulty in breathing was felt by 92% ($n = 23$) of the athletes, 36% ($n = 9$) felt greater difficulty in the use of type I mouthguard, 64% ($n = 16$) reported having difficulties with the use of types I and II mouthguards, and none of the athletes reported difficulty in the use of type III mouthguard.

Table 1. Results (mean and standard deviation – SD) of Cooper (meters), shuttle run (seconds), and VO_2 (ml kg^{-1} per min) tests without mouthguard and with types I, II, and III mouthguards

	Without protector		Type I		Type II		Type III	
Test	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cooper	2243.2 B	344.4	2325.2 B	380.5	2340.8 B	369.4	2612.7 A	369.8
VO_2	38.6 B	7.7	40.4 B	8.5	40.8 B	8.2	46.8 A	8.2

Means followed by different letters in the horizontal differ between them by the ANOVA test ($P < 0.05$).

Table 2. Results (mean and standard deviation – SD) of shuttle run test (seconds) without mouthguard and with types I, II, and III mouthguards

	Without protector		Type I		Type II		Type III	
Test	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Shuttle run	11.4 A	0.7	11.7 A	0.8	11.8 A	0.8	11.4 A	0.8

Means followed by different letters in the horizontal differ between them by the ANOVA test ($P < 0.05$).

With regard to distracting attention during the tests, 35% ($n = 6$) of the athletes reported that this occurred only with the use of type I mouthguard, and 65% ($n = 11$), with types I and II mouthguards.

Table 3 represents the difficulty found in each type of mouthguard with regard to speech.

Discussion

The occurrence of orofacial lesions and traumas in contact sports is highly prevalent and may be exemplified by the rate of 49.6% of occurrence in athletes who participated in the Pan American Games in Rio de Janeiro in 2007 (15). The use of mouthguards has become the only form of oral protection during sporting practice, which allows impacts to be absorbed and distributed, preventing mandibular contusions or fractures, as well as dislocations and traumas of the temporomandibular joint (1,2,4,8,16).

In Brazil, up to now, there are no scientific studies that propose to analyze the occurrence of mouth traumas in football only. This is a curious fact, as football is the most practiced sporting modality in Brazil where, according to the Brazilian football confederation ('Confederação Brasileira de Futebol – CBF'), around 30 million persons play the game, among whom 400 thousand are women (17).

Samulski (18) points out that attention and concentration are of fundamental importance in any sporting modality and are considered to be the ability to focus on relevant stimuli of the environment and be able to maintain this focus throughout the sporting practice (19). In the present study, the distraction of the athletes' attention related to the use of mouthguards was reported only when they used the type I (35%) or types I and II (65%). This shows the importance of the use of an adequate and individualized mouthguard type III which, because it fits adequately into the oral cavity, diminishes the discomfort of its presence and does not cause distraction of the athlete's attention, which may have the repercussion of a drop in his/her physical performance.

Barberini et al. (20) and Boffano et al. (21) observed that athletes reported difficulty in speaking, difficulty in breathing in addition to nauseas with the use of mouthguards, which were similar to the results found in the present study for mouthguards types I and II. Considering mouthguard type III, there was no report about difficulty in breathing, difficulty in speaking, or presence of nausea, once again emphasizing the importance of using individualized mouthguards.

The athletes' agility with the different types of mouthguards was evaluated by means of the agility test 'shuttle run with a ball', appropriate for football players (22). In the present study, no significant difference was found for the shuttle run with a ball test, when considering the use of the different types of mouthguards, or not, which may be justified by the rapidness of the test that does not last long enough to distract attention.

Alterations in the players' physical performance with the use of mouthguards were evaluated by means of the Cooper test, which has acceptable validity for verifying maximum aerobic power (relative VO_2 max) and

Table 3. Degree of difficulty reported as regards speech with each type of mouthguard

	Degree of difficulty						Able to speak			
	Low		Medium		High		Yes		No	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Mouthguard type I	0	0.0	2	9.0	20	91.0	0	0.0	25	100.0
Mouthguard type II	8	32.0	9	36.0	8	32.0	5	20.0	20	80.0
Mouthguard type III	18	72.0	0	0.0	0	0.0	25	100.0	0	0.0

physical fitness of athletes playing football (23–25), provided that the degree of motivation of those being evaluated is controlled, to prevent alterations in the results (26). When the athletes in the present study performed the test, they were motivated by the evaluator and the technical commission with words of encouragement to continue running at a maintained rhythm during all the phases of the test.

The physical performance of athletes with the use of mouthguards was evaluated by Barberini (27), who studied a sample of 14 athletes, within the age range of 17–41 years, of both genders. As the present study design considered a lower amplitude in the athletes' age range, it permitted control of the variable physical performance as a function of age. Teixeira and Pereira (28) pointed out that there is a trend toward a reduction in physical performance with the increase in age, which may cause changes in the results found in tests.

The mouthguards used in the study of Barberini (27) were those of types I and II, and an ergometric treadmill was used to analyze oxygen consumption and respiratory equivalent. The results found in the present study are similar to those of the above-mentioned study for types I and II mouthguards. With regard to type III, this study proved that its use guarantees better performance in oxygen consumption when compared with the use of types I and II mouthguards. The results found in physical performance and oxygen consumption of athletes with types I, II, and III mouthguards in this study were higher than those found when athletes performed the test without mouthguards, in comparison with the results of Barberini (27) in which athletes who used type II had a lower performance, with a drop in physical performance. It is therefore suggested that the use of mouthguards by the volunteers may have resulted in an increase in their confidence and sense of security when performing sporting activities, resulting in an increase in physical performance.

It is worth pointing out that in athletes who have suffered traumas, post-traumatic stress control is extremely important to physical performance, because after trauma, fear, insecurity, and intimidations are present and may compromise performance during sporting practice (29).

The importance of the present study design in considering each volunteer as its own control and not considering study groups formed by different persons may be the reason for the difference found in comparison with the data of other researchers.

After discussion of the results obtained, the use of mouthguards for the practice of football can be indicated, due to the high prevalence of orofacial traumas and because the physical performance of athletes did not undergo alterations. This emphasizes the importance of using individualized mouthguards (type III), which presented the best results, because of their better adaptation to the oral cavity, in addition to not causing nausea or difficulty in speaking. Awareness about the use of mouthguards is of extreme importance for the prevention of orofacial traumas, and in this sense, points out the need for the presence, in sports teams, of dental surgeons with involvement in sporting activities.

Conclusion

Among the three types of mouthguards evaluated, the individualized (type III) was the one that presented the best results in the evaluation of athletes' physical performance, also when considering the physical tests performed without the use of mouthguards. Use of the customized mouthguard was considered comfortable, and there were no reports of distraction of attention, presence of nausea, or difficulty in speaking. There was no report of pain or injury during the use of any of the three types of mouthguards.

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