ORIGINAL ARTICLE

TRENDS in
Sport Sciences
2020; 27(**2**): 49-55
ISSN 2299-9590
DOI: 10.23829/TSS.2020.27.2-1

Oral health in young elite swimmers

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Abstract

Introduction. Evidence of a lack in oral healthcare in sport has emerged since reports from Olympic Games indicated a higher risk for problems of the oral cavity. Oral diseases could affect well-being and the quality of life, with anecdotal reports that athletes are concerned about their oral conditions and potential impairment of performance. Aim of Study. Our purpose was to observe, through a clinical perspective, the orofacial development, dental relationships and oral health of young elite swimmers. Material and Methods. A cohort of 17 young elite swimmers were evaluated for skeletal and occlusion development or problems arising from gums and teeth. Results. Several conditions (e.g. pattern II, class III and crossbite) differed from the normal skeletal and dental development but most of the swimmers evaluated had a proper position of bone bases and teeth. Dental caries (n = 5) and gum-inflammatory states (n = 3) were also detected. Conclusions. Oral health status was not completely monitored in our group of elite swimmers. Strategies to prevent oral diseases and promote oral health within sport need to be developed. Good oral health practices should be a priority for athletes, clubs and sports federations.

KEYWORDS: oral hygiene, occlusion, swimming, performance.

Received: 23 March 2020
Accepted: 20 April 2020

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Introduction

Protecting athletes health and wellbeing is an important consideration, given the high standards of performance required on elite sports competitions. Oral health is an important part of overall health and a key factor for wellbeing and quality of life [17]. Links between oral health and sports performance have been studied primarily through studies of the Olympic Games focusing on the higher risk of poor oral health conditions in elite athletes across a wide range of sports [12, 19]. Elite sport practitioners are being very concerned about their own oral conditions since oral health is an important part of overall health and well-being, and deficits could impair training and performance. Dietary patterns, high nutritional requirements, exercise-induced immunosuppression and a lack of oral health literacy, awareness and preventive support are possible risks to oral health [2, 5, 18].

Swimming is an individual and cyclic sport, where performance is dependent on several determinants including genetic, physiological, biomechanical, psychological and contextual [10]. Oral health has been consistently reported as poor across elite athletes from a range of sports, such as the presence of dental caries

(15-75%), dental erosion (36-85%), moderate-to-severe periodontitis (up to 15%) and pericoronitis (5-39%) [2, 18, 19]. Beyond pain, systemic inflammatory illness, eating and sleeping instabilities, oral diseases can impair self-confidence and social interaction [2, 12]. In the view of these well-recognised effects it is likely that oral-related conditions might affect sport performance determinants and, hence, good oral health should be promoted to maintain a good exercise and sporting performance.

Many athletes do not have dental monitoring and do not receive dental care (even those preparing to compete in the Olympic Games), suggesting a lack of prioritisation of oral health in sport [19]. Therefore, oral health promotion and prevention strategies should be integrated within sports medicine aiming to change oral health-related behaviours, including awareness of risks of oral diseases, regular dental assessment and level of knowledge and beliefs related to oral conditions. Despite poor oral conditions are reported across several sport practitioners, in contradiction to the common perception that athletes are completely healthy, the nexus between oral diseases and sports performance is not well understood and warrants further and detailed research. Nevertheless, and since studies about swimming and oral health are particularly scarce, is important to consider all the information available in a cohort of young elite promising athletes in order to avoid any potential hinder to their development.

Aim of Study

To quantify, through a clinical perspective, the orofacial development, dental relationships and oral health of young elite swimmers.

Material and Methods

A cohort of 17 young elite Portuguese swimmers (five males and 12 females, 10 front craw specialists with unilateral breathing pattern, five backstrokers and two butterflyers, 15.9 ± 1.1 years of age, 61 ± 6 kg of body mass, 171 ± 6 cm of height and ≥14 h/week of training) voluntarily participated in this study. The experiments were conducted during a training control session for those swimmers who reached qualifying standards to participate in World and European championships as part of long-term preparations to the Paris 2024 Olympic Games. All swimmers gave their informed consent after a detailed description of the study aims and the potential risks and benefits from their participation. All participants had the opportunity to withdraw from the investigation at any time. The study protocol was approved by the local Ethics Committee and conducted in compliance with the ethical standards of the Declaration of Helsinki.

Participants were evaluated by a dentist to guarantee a standardised examination of skeletal and dental occlusion-related development or problems arising from gums and teeth. The visual dental health inspection was performed for the purpose of making a gross assessment of the swimmers oral status. The process was limited to recognising abnormal conditions and encouraging the athletes to visit a dentist (preferably with additional training in sports dentistry) to provide an exactly diagnosis, planning and treatment. All procedures were minimally invasive, painless and designed to minimise its impact on training schedules, evaluation staff and swimmers performance tests. During data collection, all swimmers were instructed to control and maintain good oral behaviours. Swimmers were also warned of possible negative impacts on their performance resulting from oral health problems.

Facial pattern and asymmetry were evaluated through subjective facial analysis [22, 25] after an extraoral standardised photographic (Sony Cyber-Shot™ DSCHX300, Tokyo, Japan) protocol (frontal and right profile views) with the subjects standing, in an oriented natural head position, with teeth occluding on maximal intercuspal position and lips relaxed. Facial pattern analysis was performed on the profile view allowing for any sagittal skeletal discrepancies between maxilla and mandible. Facial pattern assessment followed this classification: (i) pattern I, when harmonious facial growth and relationships between upper and lower dental arches were presented; (ii) pattern II, when a convex profile was presented resulting from maxillary excess, mandibular deficiency or a combination of both; (iii) pattern III, when a flat or concave profile was presented resulting from maxillary deficiency, mandibular excess or a combination of both [22, 25]. Facial asymmetry was evaluated on the frontal view analysing the presence of visible laterognathism [25].

Without involving the use of dental instruments or specialised equipment, intraoral dental examination was cursorily conducted using gloves, tongue depressors and intraoral artificial lightening, to assess the occlusion relationships, dental and periodontal health. An intraoral photographic (Sony Cyber-Shot™ DSC-HX300, Tokyo, Japan) set were also taken (frontal, right and left-side views) with teeth occluding on maximal intercuspal position. Dental occlusion was assessed by the first molar relationships in agreement with Angle classification [1] and by intraoral observation of dental malocclusions features. Dental and periodontal health

were evaluated to identify the presence of dental caries and gums-related states (e.g. supragingival plaque and visible gingivitis clinical signs), respectively. Healthy teeth were considered when free from plaque or decay, and healthy gums when free from redness and bleeding. Without previous tooth brushing, swimmers oral status was generically and qualitatively evaluated using a three criteria scale (good, sufficient and poor) including both dental and periodontal conditions. Other situations as dental stains, missed teeth and orthodontic treatment (finished or unfinished) were also recorded through clinical intraoral inspection. The photographs were processed and filed by subject in a digital file (Microsoft® PowerPoint®, version 2010, Microsoft Corporation, Washington, USA) creating a single extraoral and intraoral visible screen for each swimmer. All frequencies were obtained using the Statistical Package for the Social Sciences (SPSS, version 25.0 for Windows).

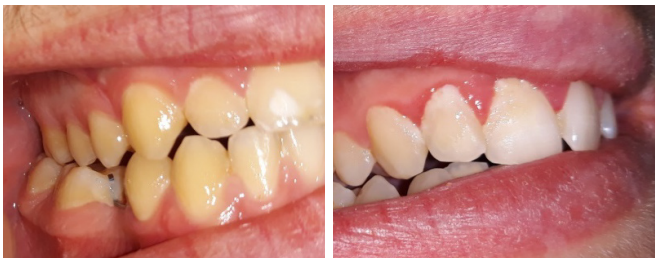
Results

Swimmers skeletal and facial development, occlusion, dental and periodontal health, and oral status are presented in Table 1. In the extraoral analysis, most of the subjects presented a proper sagittal skeletal development (pattern I). In contrast, facial asymmetry was observed in the frontal view in most swimmers (11 out of 17) and particularly for front crawl specialists. Similar to skeletal development, a proper molar relationship (Angle class I) was also identified in 10 subjects. However, malocclusions were present in form of unilateral (Figure 1a) or bilateral crossbite and edge-to-edge bite. Good dental and periodontal health were observed, as the worst findings were present in five and three swimmers affected by dental caries and gingivitis (Figure 1b), respectively. Participants were generally classified with good oral hygiene (n = 11), being also identified sufficient (n = 4) and poor (n = 2) oral

Table 1. Description of the skeletal and facial development, occlusion relationships, dental and periodontal health and oral status for all swimmers observed (n = 17)

		Front crawlers (n = 10)		Backstrokers (n = 5)		Butterflyers (n = 2)	n = 17
		Male (n = 4)	Female (n = 6)	Male (n = 1)	Female (n = 4)	Female (n = 2)	Total
Skeletal pattern	Pattern I	3	4	1	3	2	13
	Pattern II	1	2	–	1	–	4
Facial asymmetry		4	4	1	–	2	11
Angle classification	Class I	3	3	–	2	2	10
	Class II	–	–	–	1	–	1
	Class III	1	3	1	1	–	6
Malocclusions	Crossbite	3	1	–	–	–	4
	Edge-to-edge bite	1	1	–	–	–	2
Dental caries		2	1	1	1	–	5
Periodontal health	Supragingival plaque	3	2	–	1	1	7
	Gingivitis	1	–	–	1	1	3
Oral status	Good	1	5	1	3	1	11
	Sufficient	2	1	–	–	1	4
	Poor	1	–	–	1	–	2
Other observations	Dental stains	1	–	–	1	–	2
	Missed teeth	–	–	1	–	–	1
	Past orthodontics	1	2	–	–	–	3
	Current orthodontics	1	–	–	2	–	3

conditions. Other conditions including extrinsic dental stains, missing teeth and current or past orthodontic treatment, were also reported.



a) b)

Figure 1. Example of a unilateral posterior crossbite, supragingival plaque and gingivitis (left and right panels, respectively) observed in our group of swimmers

Discussion

During childhood, occlusion development is exposed to many stimuli. Despite multifactorial aetiology, occlusion deviations from ideal aesthetic and functional conditions, so-called malocclusions, are largely dependent on environmental conditions such as a correct neuromuscular role, proper breathing and normal tongue position and function [20]. Malocclusions can occur anteroposteriorly, vertically and/or transversely in the form of skeletal and/or dental discrepancies. The oral cavity is positively affected by pressures exerted by surrounding oral tissues and muscles (e.g. tongue, lips and cheeks) during the growth phase and, since swimming includes orofacial rhythmic movements that are repeated many times, it can be important for a suitable skeletal and muscular growth, including the dental progress and the dentoalveolar arches tridimensional development [14, 26].

Swimming is recommended during childhood for water safety, learn-to-swim, recreation and enjoyment, as well as competitive sporting pursuits, all of which can promote full-body harmonic development. Specific effects of swimming in dentofacial morphology and orofacial muscle activity have been notated. Within the limits of different studies, swimmers appear to have more symmetrical and proper maxillary and dental relationships and less rate of malocclusions on different tridimensional planes (e.g. less cross and open bites), abnormal swallowing, oral breathing habits and incompetent lips than non-swimmers [26]. From our results, several conditions differed from the normal skeletal and dental development but most of the swimmers evaluated had a proper position of bone bases and teeth (pattern I and Angle class I, respectively).

When practiced from the earliest ages, swimming is a useful breathing exercise requiring entrained breathing methods [15, 26]. At a young age swimmers learn how to prioritise nasal breathing during expiration and oral breathing during inspirations, have frequent apnea periods and need to seal their lips avoiding swallowing water. It is well-known that any abnormal perioral muscular activity as well an incorrect tongue position can facilitate dentoalveolar changes. Only when there are balanced intraoral and extraoral muscle forces, i.e. the existence of a neutral zone, it is possible to establish the appropriate tooth eruption and dental arches growth [14, 26]. The inspiratory and expiratory cyclic movements, involving nose, mouth, tongue, lips and cheeks, when repeated correctly over extended bouts of swimming, should assist the correct development of the whole stomatognathic system [14, 26].

During swimming the pattern of breathing needs to be synchronised with body motion and swimmers must learn how to breathe in a way to ensure propulsive continuity and well-adjusted coordination [15, 23]. Postural and occlusal changes in swimmers possibly are linked with swimming technique, breathing pattern and the amount of training time and frequency [24, 26]. Since breathing habits can disturb swimming performance, an inadequate or irregular breathing process also could affect the orofacial development leading to specific malocclusions, postural unbalances, asymmetric muscle contractions and non-synchronised coordination [14, 16].

Asymmetric breathing habits increase asymmetric muscle activation and may influence the onset of crossbites [26]. While breaststrokers and butterflyers have been stated with less facial and occlusal discrepancies, the front crawl specialists have been increased in these asymmetries [14]. Our results seem to confirm the findings reported in the literature with the presence of crossbites being only observed in front crawl and reporting a higher frequency for male swimmers. The facial asymmetry was presented in backstrokers and butterflyers, however, in front crawl it was greater evident probably given the large number of these specialists breathing unilaterally in our group of swimmers.

Breath asymmetries presence in front crawl specialists should be a focus, however, it should also be paid close attention to the swimmers from techniques described as “more symmetrical”, since freestyle swimming still also very present in their training schedules. Complementarily, to maintain the face above the water line (e.g. backstrokers) or breathing too late

(e.g. butterflyers) might lead to head over-extension or flexion, respectively, and may encourage the jaw to adopt different anteroposterior positions. From our results, it is possible to observe skeletal and dental discrepancies (e.g. pattern II and Angle class II and III, respectively) in backstrokers despite without any rate of these problems in butterflyers. A low tongue position has also been adopted by competitive athletes, including swimmers as a functional movement to reduce the time required to breathe avoiding swallowing water. This position could explain different dental discrepancies and orthodontics needs and the large number of swimmers with several malocclusions, and undergoing or undergone orthodontic treatment [14]. From our results, orthodontics needs (past or current) were more presented in front crawl, which it seems to confirm higher asymmetries for these specialists rather than the other swimming techniques. However, at the time of our observation, two female backstrokers were also undergoing orthodontic treatment.

Elite swimmers are encouraged to train intensively and extensively to achieve their best performance. Athletes competing to the highest level can be subject to intense training loads and may have periodically experience transient immunosuppression leading to a decrease in host defenses. This pattern could have consequences on general health. Although the degree of immune suppression is dependent on the level of fitness, intensity and duration of exercise, it is possible that athletes have a higher potential infections risks as an increased incidence of upper respiratory tract infections [13, 21]. As a part of the first-line-of-host-defense against pathogens that invade the oral mucosal surface, salivary immunoglobulin A is one of the best indicators of mucosal immunity [7, 28]. Studies confirm a decrease in salivary immunoglobulin A levels of those who practice sports at a high-competitive level, especially elite swimmers [7, 8, 13].

Given that, salivary immunoglobulin A is a marker of oral mucosal defence and the prominent immunoglobulin in saliva. By preventing microbial adherence and neutralizing virulence enzymes and toxins, a decrease in salivary immunoglobulin A could facilitate a higher incidence of oral health problems, increasing susceptibility to gum and teeth-related diseases such as periodontal problems and caries development [7, 28]. Nevertheless, have been suggested lower values of active caries and a higher frequency of protective bacteria in competitive swimmers compared to non-competitive counterparts [7]. However, data should be interpreted carefully since tooth decay development is a multifactorial and dynamic disease dependent on many interacting factors such as microbial biofilm, host conditions, substrate and time [11]. Non-competitive swimmers might have poorer nutritional habits with a large intake of sugar, explaining a higher presence of cariogenic bacteria.

Nutritional (including sports drinks, supplements and a high carbohydrate intake) and physiological changes (as dehydration, local drying of the mouth and decreased salivary flow) are also major sport-related causes for oral problems, impairing the protective role of saliva against microbial activity and also a teeth remineralizing effect [6, 18]. Oral inflammatory and infectious diseases such as gingivitis and tooth decay lead to higher levels of pro-inflammatory cytokines in whole body, increasing the susceptibility to fatigue and muscle injuries and the tendency to reinjury in several sports [2, 18, 27]. From our results, gingivitis and dental caries were observed as well as supragingival plaque across different swimmers and, if these diseases were not managed, it can progress to a systemic inflammatory illness, could cause pain, inability to train or perform, high treatment need or even tooth loss [19, 29].

During day-to-day swimming activities, especially for who engage in elite competition and spend several hours in pool, the teeth are permanently in contact with large volumes of pool water. The repetitive and long-term exposure of the teeth surfaces could increase dental staining or even dental erosion [4, 9]. Even in properly maintained gas-chlorinated pools, dental stains develop from the interaction between saliva and chemicals used for pool water disinfection (when contact are >6 h/week) predominantly on the upper or lower incisors buccal or/and lingual surfaces [9]. In contrast, enamel erosion results from the pH uncontrolled monitoring as acidic swimming pool water [3, 4]. In the current study, two swimmers from different clubs presented dark-brown stains on the buccal surfaces of lower incisors. Although teeth stains often produce dental aesthetic changes with significant psychological and social effects, dental erosion is a painful and irreversible tooth wear condition. This can be minimised if swimmers are informed about the potential risks and if are supervised in regular dental attendance.

Our study requires acknowledgment of some limitations. First, the study was not conducted under a clinical environment or using dental tools. Therefore, our results need to be carefully interpreted given the likelihood that some diagnoses could be underestimated, overestimated or not fully diagnosed. However, the protocol adopted characterised by its simplicity with the added advantage that it required only minimal complexity, time and costs

has become widespread, and is frequently employed to provide dental data. Secondly, the subjective analysis has some limitations and swimmers with past orthodontic treatment may have reduced the number of occlusion asymmetries. An objective evaluation requires a highly detailed extraoral and intraoral inspection, using specific dental equipment as well, if necessary, using x-ray sources, to establish a reliable diagnosis.

Conclusions

The results reported that oral conditions appear to be poorly monitored in our group of elite swimmers and highlight oral healthcare needs in elite sport. To determine how oral health is important, epidemiological studies, regular oral screening and prevention programs need to be implemented. Strategies to prevent oral diseases and promote oral health need to be developed and evaluated. These strategies should be a high priority for athletes, clubs and national federations. Clinicians and researchers should pay close attention to orofacial development, occlusion discrepancies and dental-related problems, integrated with a sports dentistry team, to prevent, treat and monitoring oral health-related changes in swimmers and other athletes.

Acknowledgments

The authors gratefully acknowledge the cooperation of the swimmers, coaches and support staff who participated in this study.

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