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## The Impact of Oral Health on Athletic Performance: Narrative Review

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## **Abstract**

**Background:** Oral health is a key element of overall health. It both influences the whole organism and reflects the condition of the entire body. Surprisingly, it is often neglected in elite Athletes. Despite their high physical efficacy, they exhibit a surprisingly high prevalence of oral diseases.

**Aim:** The aim is to review current evidence on oral health in athletes. It aims to analyze the mechanisms by which oral health influences sports performance and how highly active patients differ from the average.

**Material and Methods:** A literature search was conducted using electronic databases, including PubMed. The search incorporated the following keywords: “Oral health”, “Athletes”, “Sports Dentistry”, and “Physical Efficacy”. Randomized controlled trials, systematic reviews, and meta-analyses published from 2004 to the present were included.

**Results:** Research shows a high prevalence of caries (15-89%), periodontal diseases (up to 77%), and enamel erosion (36-85%) in athletes. Up to 32% of them notice that oral diseases have a negative impact on training and sports performance. It is primarily due to pain and inflammation. The oral diseases impair physical performance, including reduced VO<sub>2</sub>max.

**Conclusion:** Poor oral health is common among athletes. It is an often overlooked barrier to achieving optimal athletic performance. Integrating oral healthcare into sports medicine is essential to improve both oral health and overall athletic performance.

**Keywords:** Oral Health, Sports Dentistry, Tooth Decay, Periodontitis, Physical Efficacy.

## **1. Introduction**

Oral health, defined as an absence of pain and diseases that limit physical and social functioning, is an integral component of overall health. (1,2) In professional sport, where differences between the contestants are minimal, each factor is important. (3) Even health issues perceived as insignificant may have a decisive impact on performance outcomes. (4) Although athletes are often viewed as exemplars of health, their oral health is often neglected. (2,5) At the 2012 London Olympic Games, dental problems represented approximately 30% of all medical consultations, making them the second most common reason for medical care after musculoskeletal injuries. (6,7) Reports from other major sporting events, including the Beijing and Rio de Janeiro Olympic Games, have confirmed the growing demand for dental care among athletes. (1,8)

Poor oral health may lead to discomfort, difficulties with food intake, and lowered self-confidence. (3,9) Moreover, oral infections may trigger a systemic inflammatory response. (10,11) The inflammatory mediators can impair muscle recovery and increase susceptibility to injuries. (12,13) Despite the evidence, oral health is one of the most neglected aspects of sports medicine. (14,15) Dental professionals are usually not included in the teams responsible for athlete care. (8) Sports dentistry focuses mostly on the prevention and management of orofacial injuries. (1,16) However, current evidence indicates a much broader spectrum of oral health challenges among athletes. (6) Conditions such as untreated dental caries, advanced periodontal disease, and dental erosion are prevalent in this population. (5,17) Most of these can be prevented; adequate measures should be a standard in professional and amateur sport. (10,12)

## **2. Oral health among athletes**

Current evidence shows that athletes suffer from numerous oral diseases. (6) The state of oral health is similar to that of the disadvantaged population. (2) Additionally, most of them can be prevented. (1,5)

Caries affects from 15 to up to 89% of athletes. (17) A study conducted among Slovak football players revealed that 86,3% of them presented moderate or high DMF status, with a mean of 3.8 decayed teeth. (12) When the contestants of the 2012 London Olympics were examined, 55% of them were diagnosed with tooth decay. (6,7)

Gingivitis is diagnosed in 58-77% of athletes, periodontitis in 15-41% of cases. (2,4) Among young elite athletes in Germany, deep periodontal pockets (>4 mm) were identified in 40% of

participants. (4,17) When the test was performed on their non-athletic peers, only 12% of them had similar results. (4,17)

Enamel erosion is especially prevalent in athletes. (2,18) The risk of pathological tissue loss is two times higher than in non-active patients. 36-85% of athletes show signs of erosion. (19)

Orofacial trauma is common (14-57%) in contact sports. (5)

Complicated eruption of third molars is prevalent in athletes, especially in peak performance age. Pericoronitis affects 5-39% of young active patients. (2,16,17)

### **3. Biological Mechanisms Linking Oral and Systemic Health**

The relationship between oral health and systemic health is bidirectional. (11,20) It is mediated through several biological pathways that can impact overall well-being and physical performance. The main mechanisms underlying this interaction are described below. (11,15,17)

#### **3.1. Systemic Inflammation**

The most widely researched link is the systemic inflammatory response caused by chronic oral infections. (10) Periodontitis is associated with the release of pro-inflammatory cytokines. These include interleukin-1 (IL-1), IL-6, IL-8, and tumor necrosis factor-alpha (TNF- $\alpha$ ), as well as C-reactive protein (CRP), into the general circulation. (11,12) Elevated cytokine levels can impair muscle physiology, repair, and endurance. (12,21) They also disrupt mitochondrial function. (17) Chronic low-grade inflammation is associated with reduced muscle mass and a decline in overall physical performance. (11,13) These affect all patients, but they are particularly noticeable in older adults. (13,20) Systemic inflammation from oral sources can also impair glycemic control, which can cause diabetes. (3)

#### **3.2. Bacterial Translocation**

Oral pathogens can enter the bloodstream through ulcerated gingival tissues and affect distant organs. (12,21) Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans have been linked to systemic conditions such as atherosclerosis, cardiovascular disease, Alzheimer's disease, and certain cancers. (12,18) These bacteria are strongly associated with periodontitis. (4,17) The relationship between oral pathogens and systemic diseases is influenced not only by the direct impact of bacteria but also by genetic predisposition. (12,17) For example, the HLA-DRB1\*04 allele has been associated with an increased risk of both aggressive periodontitis and autoimmune disorders, including rheumatoid arthritis. (12)

### 3.3 Nitric Oxide Homeostasis

The enterosalivary nitrate–nitrite–nitric oxide (NO) pathway is especially important for athletes. (18,22) Facultative anaerobic bacteria on the tongue reduce dietary nitrate to nitrites. When nitrite enters the bloodstream, it is then converted to NO, which is crucial for vasodilation, muscle contraction, and mitochondrial respiration. (17,22,23)

Factors such as antiseptic mouthwash use and ketogenic or high-fat diets can alter the oral microbiome. It can reduce the number of nitrate-reducing bacteria. This can lead to a loss of exercise economy, which means higher oxygen cost for the same workload. A lower level of NO in the blood can also cause increased blood pressure. (17,22)

**Tab.1** Mechanisms Linking Oral Health and Athletic Performance (6,11–13,24–26)

| Mechanism                          | Key Processes                                                                                                                                    | Potential Impact on Athletic Performance                                                                     |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Systemic inflammation              | Release of IL-1, IL-6, IL-8, TNF- $\alpha$ and CRP; chronic low-grade inflammation.                                                              | Impaired muscle repair, increased fatigability, mitochondrial dysfunction, reduced muscle mass and recovery. |
| Bacterial translocation            | Dissemination of oral pathogens (e.g., <i>P. gingivalis</i> , <i>A. actinomycetemcomitans</i> ) into bloodstream; systemic disease associations. | Systemic inflammatory burden and impaired overall health affecting performance.                              |
| Nitric oxide pathway               | Oral nitrate-reducing bacteria generate NO essential for vasodilation and mitochondrial respiration; dysbiosis reduces NO.                       | Reduced exercise economy, higher oxygen cost for a given workload, possible increase in blood pressure.      |
| Sensorimotor & functional pathways | Malocclusion, bruxism, oral frailty, chronic pain, impaired nutrition.                                                                           | Altered balance, increased injury risk, reduced recovery, impaired concentration and decision-making.        |

## **4. The Role of Oral Health in Sports Performance**

### **4.1.Effects of Specific Oral Diseases on Sports Performance**

Oral diseases can affect athletic performance in various ways. They can have direct physical consequences, such as pain and trauma. (10) Most involve more subtle biological mechanisms, such as systemic inflammation and biomechanical alterations. (10,11)

Dental caries is the most often reported oral health problem in elite athletes. When untreated, it can cause toothache, pulp infection, and abscess formation. (4,7) It is estimated that dental problems impair performance in 18% of athletes. (6,27) Pain and discomfort reduce concentration and sleep quality. (3) Sleep deprivation limits body regeneration abilities. (8) Severe tooth decay can also impair food intake, which can affect correct nutrition. (11,27) Moreover, carious teeth are sources of systemic inflammation, which was discussed in the previous section. (2,5)

Periodontal diseases, such as gingivitis or periodontitis, have been proven to have a negative effect on objective measures of physical performance. (11,26) Research involving elite German athletes showed that patients with signs of periodontitis had a 5.7% lower mean  $\dot{V}O_2$  max compared to athletes with a healthy periodontium. (11,17) Athletes with higher levels of periodontal inflammation achieved lower maximal power on cycling ergometer tests. Compromised patients generated 4.4 W/kg versus 5.0 W/kg in their healthier counterparts. (11)

Enamel erosion affects 36-85% of athletes. (5,18) It can cause severe hypersensitivity to hot and cold temperatures, as well as air stimuli. (8,10) This can be problematic during exercise because heavy breathing can cause pain. (12) Hydration during training can also be affected by hypersensitivity. (8,12) Tooth erosion is often the first noticeable sign of eating disorders, such as anorexia or bulimia. (3,6) These are more common among athletes in aesthetic and weight-class sports. (2,4) They have a huge impact on overall health and athletic performance. (28)

Orofacial Trauma is especially common in contact sports. (5,7) Injuries, such as crown fractures, tooth luxation, or soft tissue trauma, can cause immediate interruption of training and competition participation. (3,7) 33% of the respondents report insecurity and the fear of a subsequent injury. Athletes describe these as performance-reducing factors. (3,7,10)

Pericoronitis and other eruption pathologies are prevalent in athletes. (16) This is caused by the coincidence of the age of wisdom tooth eruption with peak physical performance. (27,2) Symptoms such as edema, trismus, and severe pain can completely exclude an athlete from any physical activity. (10,27)

## **4.2. Sport-related Risk Factors for Oral Diseases**

An athletic lifestyle is often associated with perfect health, but this is not always true when it comes to oral health. (2,5) A sports diet involves frequent consumption of simple carbohydrates, which are necessary to meet the high energy demands associated with intensive training. (29) During exercise, athletes also often consume acidic isotonic drinks. Both of them promote hard tooth tissue demineralization and an increase in cariogenic pathogens. (19,30) Moreover, intense physical activity can cause dehydration and xerostomia. (5) This reduces the protective properties of saliva. (12) Demanding training causes transient immunosuppression. (10) It lowers the level of S-IgA and increases cortisol levels, which makes the gingiva more susceptible to infection. (19,31) Additionally, frequent traveling and the failure to prioritize oral health in sports clubs' medical programs limit preventive care. (1,5)

## **5. Preventive Strategies in Sports Dentistry**

Effective prophylaxis in elite athletes requires a multidisciplinary approach. It involves not only the competitors themselves, but also their medical staff. Highly active patients lead demanding lifestyles, making it difficult to maintain regular preventive care.

Screening should be a key element of the pre-participation health evaluations (PHEs) to enable the early detection of infectious foci. This allows for the management of identified oral diseases before major competitions. Screening at training venues or camps increases participation in said competitions.

Strictly following daily fluoride-based preventive measures and a consistent oral hygiene regimen is particularly important for athletes. Because they are exposed to unique oral health risk factors, athletes should pay special attention to daily preventive habits. For everyday tooth brushing, 1450 ppm fluoride paste is usually recommended. For high-risk individuals, it should be replaced with a 2800 or even 5,000 ppm formulation. It is especially important not to rinse the paste after the wash, to enable its full preventive potential.

To reduce the dietary risk, athletes should make several changes in their daily routines. The double-bottle strategy is particularly valued in active patients. After using energy gels, isotonic drinks, or any carbohydrate supplement, they should rinse their mouth with clear water. This helps neutralize the oral pH. Sugary beverages should be avoided outside of training.

As many athletes are prone to injuries, mechanical protection is essential. Mouthguards are the most effective way to prevent or reduce the severity of sports-related dental injuries. Research shows that patients who suffered orofacial injury in the past are more likely to use mouthguards

in the future. This highlights the need for continuous education for players and their coaches to minimize the risk of trauma as much as possible.

A systemic change in the perception of oral health as a negligible issue is crucial. Oral health status has a meaningful impact on overall health. Its consequences can affect the athletic performance of professional athletes.

## **6. Summary and Conclusions**

Oral health is an integral part of general health. (6,14) Among elite athletes, it is often overlooked. (15,16) Research shows alarming levels of diseases such as tooth decay, gum problems, or enamel erosion. (6,14,17) Active patients are affected by specific sport-related risk factors, which makes them particularly prone to these pathologies. (4,14) Surprisingly, elite athletes present similar caries and periodontitis prevalence to socioeconomically disadvantaged populations. (3,7) Some of the sport-related risk factors are: frequent intake of simple carbohydrates and isotonic drinks, dehydration, and transient immunosuppression caused by intense training. (10,32)

It is important to remember that poor oral health has an actual effect on sports performance. (18,26) Pain can impair proper nutrition, concentration, sleep, and training. (6,12) Moreover, local infection causes a systemic inflammatory response. (2,5) This can hinder muscle regeneration and decrease objective performance indicators. (11,21) Participants report that dental problems realistically impair their quality of life and performance. (15,31) Sleep deprivation disables proper regeneration, and aesthetic imperfections affect the athlete's self-confidence. (30,31)

Most of the oral conditions the athletes suffer from are avoidable. Because of this, proper prophylaxis should be provided. (1,19) It is essential to perform systematic oral health screening as part of routine Pre-Participation Health Evaluations (PHE). (3,12) Effective prevention requires an interdisciplinary approach involving the entire medical team and the patients themselves. (11,15) Individual preventive measures include the use of high-fluoride toothpaste, custom-made mouthguards, and the “two-bottle strategy.” (11,17,24) In conclusion, a shift in the perception of oral health as a key determinant of athletic performance is essential to provide athletes with optimal conditions. (4,11) This is important for their sport career, while safeguarding their long-term health and well-being, including after retirement from professional sport. (10,24)

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