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REVIEW

Dental health, sports, and quality of life: the impact of periodontal disease on athletic performance

Salud odontológica, deporte y calidad de vida: impacto de la enfermedad periodontal en el rendimiento deportivo

Ramiro Perez[1], Valeria Gambetta[2], Sofia Geraldine Genero de Oliveira Manarte[3], Maria Isabel Brusca[2,3] ✉, Virginia Jewtuchowicz[2,3,4], Maria Eugenia Castillo[2,3]

[1]Facultad de Motricidad Humana y Deportes, Universidad abierta Interamericana Argentina.
[2]Carrera de Especialización Periodoncia, Facultad de Medicina y Ciencias de la Salud, Universidad abierta Interamericana. Argentina.
[3]Carrera de Odontología, Facultad de Medicina y Ciencias de la Salud, Universidad abierta Interamericana. Argentina.
[4]Departamento Microbiología, Inmunología y Parasitología, Universidad de Buenos Aires. Argentina.

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Corresponding author: Maria Isabel Brusca ✉

ABSTRACT

Dysbiotic dental biofilm may increase the risk of periodontal damage and increase proinflammatory mediators such as IL-1ß, IL-6, IL-8, C-reactive protein, and TNF-α. Some of these biomarkers are linked to muscle fatigue, the risk of sports injuries, and persistent inflammation in high-intensity exercisers. Studies show that athletes with signs and symptoms of periodontal disease are more likely to suffer recurrent muscle injuries. Inflammatory mediators shared by PD and high-intensity exercise may be linked to an increased risk of fatigue, repeated muscle injuries, and a potential worsening of both PD and muscle function, which subsequently causes plasma creatine kinase (CK) leakage. Studies show that, in the presence of PD, salivary CK concentrations were increased in periodontitis. Other studies show that saliva can be used to detect muscle damage. Therefore, the objective of this work is to investigate the relationship between periodontal disease and sports performance, measurable by salivary biomarkers such as creatine kinase (CK). The increase in the concentration levels of CK present in saliva in periodontal patients.

Keywords: Proinflammatory Mediators; Periodontal Disease; Muscle Injury; Creatine Kinase; High-Intensity Exercise.

RESUMEN

La biopelícula dental disbiótica puede elevar el riesgo de daño periodontal y aumentar los mediadores proinflamatorios, como IL-1ß, IL-6, IL -8, proteína C reactiva y TNF-α. Algunos de estos biomarcadores están relacionados con la fatiga muscular, el riesgo de lesiones deportivas y el estado de inflamación persistente en practicantes de ejercicio de alta intensidad. Estudios evidencian que los atletas con signos y síntomas de enfermedad periodontal tiene mayor probabilidad de sufrir lesiones musculares recurrentes. Los mediadores inflamatorios compartidos por la EP y el ejercicio de alta intensidad podrían estar relacionados con un mayor riesgo de fatiga, lesiones musculares repetidas y un posible agravamiento tanto de la EP como de la función muscular, lo que en consecuencia causa una fuga plasmática de creatina quinasa (CK). Estudios revelan que, en presencia de EP, la CK salival, evidenció un incremento en su concentración en presencia de periodontitis. Otros estudios muestran que la saliva puede usarse para detectar el daño muscular. Por lo tanto, el objetivo del presente trabajo es Investigar la relación entre la enfermedad periodontal y el rendimiento deportivo,

medible mediante biomarcadores salivales como la creatina quinasa (CK). El aumento de los niveles de concentración de la CK presente en saliva en pacientes periodontales podría ser tenido en cuenta como coadyuvante en el diagnóstico clínico periodontal.

Palabras clave: Mediadores Proinflamatorios; Enfermedad Periodontal; Lesión Muscular; Creatina Quinasa; Ejercicio de Alta Intensidad.

INTRODUCTION

Numerous studies have reported a high prevalence of oral diseases in elite athletes, particularly dental caries (20-84 %), dental erosion (42-59 %), gingivitis (58-77 %), and periodontal disease (15-41 %). There are possible causes and associated factors for poor oral health in athletes: oxidative stress (an imbalance in the body between the production of free radicals and the body's ability to neutralize them with antioxidants, which can cause cell damage), sports diets (frequent consumption of electrolyte- and carbohydrate-based energy drinks to compensate for hypoglycemia and mineral salt loss, sugary beverages with a pH lower than 3), poor oral hygiene and lack of access to care, hyposalivation - dehydration (during exercise there is a reduction in salivary and crevicular fluid and secretory IgA, as well as salivary pH) and bruxism or overload.

In periodontal disease, dysbiotic dental biofilm triggers an immune response in the host and can be a potential cause of inflammation, leading to possible systemic alterations.[1,2,3] It is already known how periodontal disease can influence various systemic diseases and vice versa through microorganisms, shared risk factors, and the periodontium acting as a reservoir of inflammatory mediators.

Without supportive therapy or regular debridement, dysbiotic biofilm can increase the risk of periodontal damage and elevate proinflammatory mediators such as IL-1β, IL-6, IL-8, C-reactive protein, and TNF-α.[4] Studies reveal that some of these biomarkers are associated with muscle fatigue, the risk of sports injuries, and persistent inflammation in high-intensity exercisers.[5] Studies also show that athletes with signs and symptoms of periodontal disease are more likely to suffer recurrent muscle injuries.[6] Therefore, the question arises: could periodontal inflammation contribute to increased exercise-induced inflammation and the risk of muscle injury?

During intense exercise, neutrophils and M1 macrophages release mediators such as IL-1β, IL-6, IL-8, FNTα, and ROS (reactive oxygen species), which rise temporarily and intervene in an inflammatory response that initiates muscle repair and adaptation. But their excess, in overtraining or chronic inflammation, becomes harmful and causes muscle mass loss, muscle catabolism, fatigue, and delayed muscle fiber recovery.

The relationship between physical activity and periodontal disease has been studied, and moderate physical activity has been associated with a reduction in the prevalence of periodontal disease.[1] People who engage in moderate physical activity for 30 to 150 minutes per week have a lower risk of developing periodontal disease.[1] The possible causes of this link may be related to the regulation of inflammatory mediators and changes in proper oral hygiene. Elite athletes differ from the general population in that they engage in high-intensity training, so periodontal disease may play a different role in triggering deficits in athletic performance, with an increased risk of injury.[7]

Periodontal disease is a multifactorial inflammatory condition caused by the interaction of pathogenic microorganisms, host response, genetic factors, environmental factors, and personal health habits.[8] Multiple potential molecular processes involving cytokines such as IL-1b, IL-6, IL-8, and TNF-α occur. Increased levels of inflammatory mediators, such as IL-6 and IL-8, play a key role in the activation of matrix metalloproteinase 2 (MMP-2) by fibroblasts, leading to the degradation of gingival fibers and the periodontal ligament.[9,10,11] These cytokine functions are the result of the fight against periodontal pathogens, aimed at overcoming bacterial challenges.

Elevated levels of IL-6 and IL-8 were observed after intense exercise. IL-6 concentrations ranged from 1 to 4 times and 1,5 to 26,79 times in high-intensity exercise immediately after training, while IL-8 concentrations can range from 1,37 to 2,77 times after high-intensity exercise compared to baseline levels.[12] Chronically elevated levels of IL-6 and IL-8 are reported to be associated with fatigue,[13] which is a serious risk factor for muscle injury and creatine kinase (CK) leakage.[14]

Other important cytokines with similar functions in exercise and PE are IL-1β and TNF-α. Elevated levels of these cytokines were observed during intense exercise with predominantly eccentric movements, but not after moderate exercise.[12] IL-1β and TNF-α are potent proinflammatory cytokines that influence adhesion molecules and chemokines and are related to leukocyte migration and function, especially osteoclast bone resorption in PE.[15]

The results of a study in rats indicate that the association between physical exercise and EP was responsible for an increase in leukocyte concentration in the region of inflammation. EP generated an increase in neutrophils,

which could delay the healing process, and eosinophils, which can increase muscle fibrosis. PE influenced the modulation of the inflammatory process occurring in the area of muscle injury by increasing inflammatory markers, especially IL-6 and TNF-α. In addition, when PE was associated with exercise, the effects of muscle recovery after injury were affected. Macrophages were reduced with PE. These cells play a crucial role in muscle repair, as macrophages from different strains are responsible for promoting the differentiation and proliferation of satellite cells. This finding suggests that EP slows down the muscle repair process.[16] Furthermore, the association of EP with exercise showed an additive or cumulative effect, which could have been responsible for prolonging local inflammatory events.

Therefore, inflammatory mediators shared by PD and high-intensity exercise could be related to an increased risk of fatigue, repeated muscle injuries, and a possible worsening of both PD and muscle function, which consequently causes plasma creatine kinase (CK) leakage.[17,18,19,20] CK is an enzyme involved in muscle metabolism.[21] CK content is commonly used as an indicator of stress and is considered a semi-quantitative indicator of muscle fiber injury.[21] It is found in greater quantities in skeletal muscle, the heart, and the brain. Measuring its levels in the blood helps diagnose muscle, heart, or brain damage if levels are high.

General objective

- Investigate the relationship between periodontal disease and athletic performance, measurable by salivary biomarkers such as creatine kinase. (CK).

Specific objectives

- Study periodontal health in athletes
- Establish the prevalence of diseases in athletes Analyze indices of the need for periodontal treatment in athletes.
- Evaluate creatine kinase (CK) as a salivary biomarker for detecting periodontal disease and muscle injury
- Study CK levels or values in order to guide possible standardization.

METHOD

The research project is divided into two stages: The first stage will analyze oral health and the prevalence of oral diseases in high-performance athletes and will also take salivary CK samples as a biomarker for the diagnosis of periodontal disease.

The second stage will analyze salivary CK samples as a possible biomarker for muscle injury.

Sixty male athletes aged 18 to 35 from the San Lorenzo de Almagro and UAI Urquiza clubs were evaluated. Gingivoperiodontal indices and salivary CK were measured, and tears and cramps were recorded using a self-perceived survey. Patients who had received previous periodontal treatment and/or used antibiotics or any other medication during the six months prior to the consultation, and those with other chronic systemic diseases, were excluded from the sample.

After the clinical periodontal evaluation, the patients in the sample were divided into three groups.

Group 1: patients with a negative diagnosis of periodontal disease (healthy), group 2: patients diagnosed with gingivitis, and group 3: patients diagnosed with periodontitis.

Patients with muscle tears or injuries in each group were recorded using a self-perceived survey.

The saliva sampling procedure was performed as follows:

- BASELINE MEASUREMENT: 24-48 hours before training - Gingivoperiodontal diagnostic indices. Survey.
- FOLLOW-UP MEASUREMENT: Immediately after exercise at 24 hours and 48-72 hours.
- MEASUREMENT AT 4-8 weeks post-treatment. + indices (PI, GI, PPD, CAL).

All saliva samples were collected between 8:00 a.m. and 10:00 a.m. using the unstimulated saliva collection technique. Preparation: 60 minutes without eating, brushing teeth, or chewing gum. A sterile, disposable propylene container with a screw cap and a capacity of 150 ml was used. Samples were collected in one session per individual at a predetermined time. Approximately 2 ml was collected.

Samples were placed in a portable cooler with ice for transport and subsequent processing. Steps: 1) The patient was asked to accumulate saliva in their mouth for a period of 2 minutes; 2) They were instructed to deposit the accumulated saliva in the pre-established container. Approximately 2 ml of saliva was collected per patient.

The single reagent technique was used to determine the CK concentration.

This procedure was performed in a spectrophotometer located in the Scientific Research Laboratory of the UAI, CAECIHS. The information was entered into an Excel spreadsheet and then analyzed using statistical software. In order to analyze the overall behavior of the information, an exploratory analysis of the data was

performed, both graphically and analytically. The associations between variables and their significance (ϒ = 0,05) were studied using Pearson's correlation coefficient for quantitative variables.

RESULTS

Results of the first stage of the project

64,5 % of athletes had gingivitis, 31,5 % had periodontitis, and 4 % had healthy gums. 29,5 % had muscle tears and cramps, and of this group, 19 % of athletes had elevated CK levels and poor oral health.

DISCUSSION

In elite athletes with periodontal disease, persistently high salivary CK values may indicate insufficient muscle recovery or risk of injury due to an inflammatory synergy between PD and overtraining.

Over time, periodontal diagnosis has proven to be very useful in determining the type of pathology and its probable treatment. What it has not been able to determine so far is whether the disease is active or dormant. [22] For this reason, attempts have been made to establish different types of alternative or unconventional diagnoses that allow us to determine whether the disease is active.[22] Saliva as a diagnostic tool, together with its components, has emerged as an alternative due to the ease of sampling and also because it is a non-invasive method for the patient. Studies began to determine whether any of its components could be used to make an accurate early diagnosis of this disease and thus treat it quickly and prevent massive destruction of the periodontium.[22] One of the substances present in saliva is creatine kinase (CK), an enzyme that can serve as an important biochemical parameter of periodontal inflammation. Several research studies published in the international literature evaluated the use of these salivary creatines as a marker of PD, demonstrating their increase in the presence of this disease. The increase in CK concentration levels present in saliva in periodontal patients could be taken into account as an adjunct to clinical periodontal diagnosis.

Studies reveal that, in the presence of PD, salivary CK showed an increase in concentration in the presence of gingivitis. However, in periodontitis, there was an even higher concentration (412,8 U/L). This increase would be a consequence of pathological processes in periodontal tissues, where they are released and mixed with the surrounding saliva, originating from damaged periodontal cells. After conventional periodontal therapy, the activity of all salivary enzymes decreased significantly.

Other studies show that saliva can be used to detect muscle damage. Barranco Benacloch[23] demonstrated that CK can be used as a marker of muscle damage in human saliva. Marking a median increase of 256 U/L.

There are no standardized clinical ranges for CK in saliva as there are in blood. The reference values for CK in our body have a threshold of 190 U/L at a temperature of 37° (in blood), above which it is considered high. [24] Various experimental studies offer reference points: CK in saliva increases after intense exercise, in parallel, although to a lesser extent, with serum CK. At rest or in healthy controls, salivary CK values are usually in a low range between 5 and 40 U/L, and after strenuous exercise, values can rise to 100-200 U/L and in some cases to over 300 U/L.

CONCLUSION

Studies show that athletes with signs and symptoms of periodontal disease are more likely to suffer recurrent muscle injuries, establishing a possible bidirectional relationship between periodontal disease and athletic performance through shared inflammatory mediators. The presence of increased salivary CK in periodontal disease would represent a step forward in conducting further studies and deepening our knowledge so that it can be used in the future as a potential chemical marker for this disease, as well as for muscle injury and its interrelationship.

We emphasize the importance of preventive dental care, including the participation of athletes in behavioral changes related to oral health and the development of research projects and oral health promotion programs.

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AUTHOR CONTRIBUTION

Conceptualization: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Data curation: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Formal analysis: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Research: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Methodology: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel

Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Project management: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Resources: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Software: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Supervision: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Validation: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Visualization: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Writing – original draft: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

Writing – revision and editing: Ramiro Perez, Valeria Gambetta, Sofia Geraldine Genero de Oliveira Manarte, Maria Isabel Brusca, Virginia Jewtuchowicz, Maria Eugenia Castillo.

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