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LITERATURE REVIEW

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Considerations about the relation between occlusal trauma and periodontal/peri-implant disease

Considerações sobre a relação entre trauma oclusal e doença periodontal/peri-implantar

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ABSTRACT

The occlusal trauma is an injury to the insertion apparatus as a result of excessive occlusal force, and its interaction with periodontal/peri-implant disease remains controversial topic in the literature. The aim of this study was to review the literature about the relationship between occlusal trauma and periodontal/peri-implant disease, through an analysis of experimental studies in humans and animals, as well as systematic reviews that discussed the role of occlusal factor as etiological or aggravating periodontal/periplant disease. It was concluded that, although not considered a cause for the development of periodontitis and peri-implantitis, occlusal trauma may exacerbate bone loss around the teeth or implants. Moreover, the diversity of methodologies in studies on the subject might contribute to the conflicting results available, highlighting the importance of standardization and more detailed research criteria.

KEYWORDS

Dental Implants; Periodontal diseases; Peri-implantitis; Dental occlusion, Traumatic.

RESUMO

O trauma oclusal é uma injúria ao aparato de inserção como resultado de força oclusal excessiva, e sua interação com a doença periodontal/peri-implantar permanece um tema muito discutido na literatura. O objetivo neste artigo foi realizar uma revisão de literatura acerca da relação entre trauma oclusal e doença periodontal/peri-implantar, por meio de uma análise de estudos experimentais em humanos e animais, bem como de revisões sistemáticas que discutiram o papel do fator oclusal como etiológico ou agravante da doença periodontal/peri-implantar. Concluiu-se que apesar de não ser considerado fator etiológico para o desenvolvimento de periodontite e peri-implantite, o trauma oclusal pode agravar a perda óssea ao redor de dentes ou implantes. Além disso, a diversidade das metodologias nos estudos sobre o assunto pode contribuir para os resultados conflitantes disponíveis, destacando-se a importância da padronização e maior detalhamento dos critérios de pesquisa.

PALAVRAS-CHAVE

Implantes dentários; Doenças periodontais; Peri-Implantitis; Oclusão dentária traumática.

INTRODUCTION

In recent decades, the role of occlusion and the impact of their interaction in periodontal tissues has been the subject of extensive discussion in the literature, highlitghing the occlusal trauma. According to the American Academy of Periodontology [1] occlusal trauma is the injury that results in tissue changes within the insertion apparatus as a result of excessive occlusal forces. An occlusion that produces such

injury to tissues is called traumatic. When the occlusal load focuses on healthy tissue, there is a primary occlusal trauma. However, when the force reaches a compromised periodontium, it has the secondary occlusal trauma [2-7].

The injuries resulting from occlusal trauma, besides affecting the periodontal tissues (in the case of natural teeth), can affect the peri-implant region. Thus, it is already established that the obtainment and maintenance of balanced occlusal relationships is important both in natural dentition and in rehabilitation with osseointegrated implants [2,4,7-18]. Nevertheless, the actual role that the occlusal trauma plays in the installation and / or worsening of periodontal / peri-implant disease remains controversial.

The aim in this study was to conduct a literature review about the relationship between occlusal trauma and periodontal / peri-implant disease, through an analysis of experimental studies in humans and animals, as well as systematic reviews that discussed the role of occlusal fact as etiological or aggravating periodontal / peri-implant disease.

LITERATURE REVIEW

For the maintenance of healthy metabolism of periodontium, mechanical stimuli from occlusal forces of functional activity are necessary. Thus, when such functional stimulation is insufficient there is degeneration of periodontum. If occlusal forces exceed the adaptive capacity of the tissues, the result is tissue injury. This issue is still very controversial, however, it is known that a functional occlusion is crucial to the balance of the various components of the stomatognathic system in which the periodontal structures are included [2-5]. It was reported that the tissue damage associated with the occlusal trauma can be classified into two types: primary and secondary. The primary trauma occurs in a tooth with normal periodontal structure and the secondary is related to occlusal forces (normal or excessive) causing damage to a compromised periodontium [3-5].

The effects of occlusal adjustment adjunct to periodontal therapy in patients with periodontitis were evaluated by a literature review [17]. The authors aimed to identify and analyze all existing studies that have sought answers to this question, and concluded that although still need to prove the benefits of occlusal adjustment in relation to periodontal parameters, available evidence does not demonstrate any damages related to this therapy. The decision whether or not to perform occlusal adjustment remains focused on clinical assessment, professional experience and patient comfort. There is insufficient evidence to assume that occlusal adjustment is necessary to reduce the progression of periodontal disease.

In another systematic review study [18], the authors sought to clarify the biological effects of occlusal trauma in the stomatognathic system. It was selected seventy articles published between 1967 and 2012, which related the consequences of occlusal trauma in different structures, among them the periodontium. The studies were conducted in animal models and did not include implants and prostheses, only natural teeth. It was observed that the occlusal trauma may affect, in addition to the periodontium, the pulp tissue, the masticatory muscles, temporomandibular joint, and the central nervous system. The results showed a discrepancy of authors in real influence of occlusal trauma, highlighting the need to conduct more randomized trials.

Animal studies

Despite the great success of rehabilitative therapy with dental implants, excessive forces may compromise osseointegration during the healing period, or lead to loss of implants, even when the osseointegration is already established. Such forces can also lead to detorque and microleakage at the abutment-

implant interface. A group of researchers [19] developed an experimental animal model to verify, histologically, degenerative changes in dental implants with different intensities of occlusal trauma. The first and second molars on both sides of forty rats were extracted. Then, implants were installed and the rats were divided into experimental and control groups, according to the overload. It was observed that the induced trauma has generated bone loss and compromised osseointegration. The results emphasize the risk of occlusal trauma compromising peri-implant tissues even in the absence of infectious and inflammatory processes.

The effect of occlusal trauma on the peri-implant bone loss, in completely osseointegrated implants, is not much reported and provides little impartial evidence to support a relationship of cause and effect. In animal studies, the trauma induced by occlusal contacts on a non-inflamed peri-implant environment did not affect osseointegration. However, the association between the occlusal contacts, in the presence of inflammation, significantly increased bone resorption [22].

In a study of primates it was observed that five of eight implants have lost osseointegration due to excessive occlusal load, after 4.5 to 15.5 months [25]. Among the remaining three implants, one showed severe loss of bone ridge and the other two showed larger bone-implant contact. The results suggest that the load on the implants may have significantly affected the responses of the peri-implant bone. However, the loss of osseointegration may be due to excessive overloads applied in the study, such different from reality.

In another research with monkeys [26], clinical and radiographic loss of implant osseointegration caused by occlusal trauma was evaluated. It was observed that the presence of inflammation caused by plaque accumulation was an aggravating factor of effects of occlusal trauma on peri-implant bone loss. However, the implants which only suffered occlusal trauma lost their osseointegration, highlighting this factor as the main cause of loss of osseointegration.

A group of researchers [27-29] conducted experiments on monkeys to demonstrate the influence of occlusal trauma in the development of peri-implantitis. The authors divided the study into three articles to present their results. In the first article in the series it was found that there was no peri-implant bone loss when the occlusal trauma was induced by placing a supra occlusal structure (100 μm in height) in the absence of peri-implant inflammation. In the second article, peri-implant inflammation was induced, and occlusal trauma was also caused by a supra occlusal structure of 100 μm in height. In the course of time, it was observed the presence of peri-implant bone loss, suggesting that the association between peri-implant inflammation and occlusal trauma is a major etiological factor in bone loss. In the third study, it was evaluated the influence of different intensities of occlusal trauma (supra occlusal structure of different heights: 100 μm, 180 μm and 250 μm), in the absence of peri-implant inflammation, on the response of bone adjacent to the implant. The results showed that bone resorption tended to increase with occlusal trauma caused by a structure of 180 μm or more, suggesting that this height is the threshold for starting the peri-implant bone resorption, even in the absence of inflammation.

To evaluate the incidence of traumatic forces applied directly to the teeth, three dogs were subjected to orthodontic forces in the lower incisors [30,31]. The teeth on the left side were moved to the buccal surface for five months. Over the next five months, they were resumed to the original position, and the same movement was induced on the right side. Three teeth of other dogs, in which no forces were applied, served as controls. The animals were subjected to rigorous plaque control during the experiment, and after 15 months they were sacrificed. It was obtained bucco-lingual histologic sections from their jaws. The results showed that dehiscence can be produced in the

alveolar bone with the buccal inclination of the teeth, which is corrected when the teeth return to their original position. In addition, teeth movements are not necessarily accompanied by loss of connective tissue attachment.

Similar research was carried out in the teeth of monkeys [32] that were submitted to alternating forces with orthodontic elastics for five months. After this period, when dehiscences were produced on the buccal surface, the elastics were removed. Then, with the repositioning of teeth, a split flap was raised. In one side of the jaw, the soft tissue within bone dehiscences was removed, and was maintained on the opposite side. After six months, the monkeys were sacrificed and it was prepared tissue blocks for microscopic analysis. It was observed that the buccal alveolar bone (reduced in height by applying alternating forces) regenerated after the discontinuation of forces. When the soft tissue was surgically removed from the inside of the buccal dehiscence produced by such forces, the bone regeneration was reduced. The traumatic force, alone, produced an aseptic inflammatory process, demineralizing bone matrix - reversible injury. Inflammation occurred with the destruction of bone matrix by inflammatory products - irreversible injury. Along with the inflammation, occurred the destruction of bone matrix by inflammatory products - irreversible injury.

Human studies

In natural teeth, the periodontal ligament has neurophysiological receptor function, which transmits information from nerve endings to the central nervous system. The presence or absence of periodontal ligament function determines a great difference in the phase of detection of occlusal force. While, in teeth, the excessive force can be caught early, in the case of implants, the absence of proprioception of the periodontal ligament can lead to significant bone loss [20].

The peri-implant bone loss has two major etiological factors: inflammation caused by micro-organisms and occlusal overload. The first is already well established in the literature as a causal factor. The second, however, is controversial. A study was conducted in order to verify the correlation between occlusal trauma and peri-implant bone loss that compromised osseointegration. The authors concluded that there is not sufficient evidence to confirm the correlation between occlusal overload and peri-implant bone loss [21].

Assessing the occlusal ability to detect occlusal interferences, it was found that the perception of interference on natural teeth and implants with antagonists was approximately 20 and 48 μm respectively [23]. In another study [24] it was detected values of tactile perception for implants 8.75 times higher (100.6 g) than for natural teeth (11.5 g). These results demonstrate that dental implants, without the receivers of the periodontal ligament, may be more susceptible to occlusal overload, which is justified by its low adaptive capacity and of distribution of forces.

DISCUSSION

It can be observed that the share of occlusal trauma as an etiological factor of periodontal / peri-implant disease is not confirmed, but many authors claim that this could lead to its worsening [2-5,8,14-15,21-22,25,30].

Excessive force can be a detrimental factor, especially in rehabilitation with dental implants [14-15,22,25,30]. It is difficult to establish when certain force becomes excessive for teeth or implants, but it should be considered that as important as the strength of the force is the frequency with it focuses on the system. For implants, excessive occlusal force leads to marginal bone resorption and may lead to loss of osseointegration and detorque in the connections. In addition, oblique loads can generate micro movements, which may favor the microleakage in implant-abutment interface, possibly causing peri-implant bone resorption [17,18]. While the teeth have periodontal ligament, which cushions the force transmitted to the alveolar bone, the implants are in close

contact with bone tissue and, in the absence of periodontal ligament, misguided or excessive forces in intensity may accumulate next to the first turns of the implants, causing marginal bone loss.

The loss of osseointegration and excessive loss of marginal bone loss due to occlusal trauma has been demonstrated in several studies in animals [27-29]. On the other hand, some studies reported contradictory results showing that the overload has not increased bone loss. The difference between studies may be attributed to the magnitude and duration of the forces applied in the essays. Furthermore, it should be noted that the application, in humans, of the results obtained in animals requires caution.

Animal models and clinical studies were conducted to clarify the histological changes that occur in the periodontium affected by occlusal trauma, concluding that traumatic occlusal forces do not lead to the development of gingivitis, periodontal pockets, gingival recession or loss of connective tissue attachment [2,8,30-32]. The clinical signs of occlusal trauma are increased tooth mobility and root fractures.

Radiographic signs are increased periodontal ligament space or alveolar bone resorption, even with adequate control of biofilm. In the absence of inflammation, bone changes may be reversible with the removal of excessive occlusal forces. Traumatic forces can cause bone resorption, but this is reversible and does not lead to the loss of insertion and to the apical migration of the junctional epithelium [30-32].

Traumatic occlusal forces have been considered one of the local factors that accelerate the inflammatory bone resorption when periodontitis is present. Some authors found evidence that occlusal changes do not lead to the start of periodontal disease, but play an important role in its progression [2-6,21]. Regardless of the presence or absence of periodontitis, it is observed that periodontal changes that occur in the occlusal trauma vary according to the size, direction and location of the force applied, as well as the pattern of immune response of the host.

Bone loss resulting from periodontal occlusal trauma can be a co-destructive irreversible effect. Some authors identified changes in bone formation and resorption after application of experimental traumatic occlusion with systemic disorders such as diabetes mellitus. The bone resorptive activity produced by occlusal trauma was also increased when associated to nicotine in animal models [18].

The clinical decision to perform or not the occlusal adjustment should be tied to an assessment of factors, ranging from relieving symptoms till the re-establishment of patient function. The occlusal adjustment should be conducted with caution and understood as one of the steps of an integral treatment.

CONCLUSION

Although the occlusal trauma is not be considered as an etiological factor in the development of periodontitis and peri-implantitis, its presence may exacerbate the loss of bone around teeth or implants. Thus, when premature contacts or interferences are detected, the occlusal adjustment, either in teeth or in prosthesis on implants has been recommended.

The diversity of methodologies involving studies of occlusal trauma and periodontal / peri-implant disease may be one of the contributing factors for the conflicting results available in the literature. Therefore, we emphasize the importance of standardization and more detailed search criteria.

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