Orthodontist precautions in caring for periodontally affected patients

Precauciones del ortodoncista en la atención de pacientes con afecciones periodontales

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Abstract

Severe periodontal disease is one of the most common oral diseases, as well as malocclusions, which are very frequent anomalies. It has been widely discussed if orthodontic treatment is injurious for periodontal tissues, due to an increase in dental plaque and a change in oral microflora. Factors that allow the evaluation of a patient's susceptibility have been suggested, along with some preventive measures that need to be considered during orthodontic treatment in periodontal patients. It is critical for orthodontists to take into consideration the patients' susceptibility to suffer periodontal disease, taking the necessary measures during the orthodontic treatment to minimize dental plaque retention.

Palabras clave: enfermedades periodontales; tratamiento ortodóncico; prevención

Resumen

La enfermedad periodontal avanzada es de las enfermedades orales más comunes, así como las maloclusiones, que son anomalías muy frecuentes. Se ha discutido ampliamente si el tratamiento de ortodoncia es perjudicial para los tejidos periodontales, debido a un aumento en la retención de placa bacteriana y un cambio en la microflora oral. Se han sugerido factores que permiten evaluar la susceptibilidad del paciente y algunas precauciones que se debe tener durante el tratamiento de ortodoncia. Es de vital importancia que el ortodoncista tome en consideración la susceptibilidad que tiene el paciente de padecer enfermedad periodontal y que durante el tratamiento tome las medidas necesarias para minimizar la retención de placa bacteriana.

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INTRODUCTION

Malocclusion is one of the most common oral-maxillofacial abnormalities, with negative effects on facial appearance, oral function, and health. Orthodontic treatment is the preferred and most common method as it solves these kinds of problems, but over the years it has been widely discussed whether such treatment is harmful to periodontal tissues.[1] This is supposed to happen due to the accumulation of plaque and gingival inflammation induced by the change of oral environment following the use of braces,[2] which results in a change in the composition of the oral microflora[3] and in the physiology of the host.[4-5]

Epidemiological studies suggest that the global prevalence of gingival inflammation is high, and that advanced periodontal disease affects up to 30% of the population. Periodontitis is an infectious disease caused by dental bacterial plaque and its pathological manifestation is related to the host's response. There are other etiological factors associated with systemic diseases and local dentition factors. The progression of periodontal disease leads to the formation of periodontal pockets, and therefore the loss of insertion of connective and bone tissue.[4,6]

Periodontal disease is a multifactorial disease with interacting factors such as genetic susceptibility, systemic diseases, and habits like cigarette smoking or poor plaque control. The gram-negative anaerobic bacteria called *Porphyromonas Gingivalis* produces virulence factors and extracellular proteins, resulting in the destruction of periodontal tissues. Various studies suggest that some *P. Gingivalis* bacteria strains are more virulent than others, which is determined by the genetic expression of a locus called RAG.[1,7-10] With regard to periodontitis microbiology, there is controversy as to whether changes in the microflora due to orthodontic treatment are normalized afterwards or if they are irreversible.[5-11]

It is extremely important to select a predictable treatment sequence for the ortho-periodontal patient to solve gingival inflammation while minimizing treatment time and optimizing oral health and hygiene. Some factors should be carefully evaluated prior to orthodontic treatment, including the patient's general health and periodontal susceptibility, periodontal diagnosis, malocclusion classification, alveolar resorption pattern, periodontal biotype, and oral hygiene level. Each factor will have a special influence on treatment development and prognosis.[15] In addition, there is evidence regarding the actions that may affect the outcome of orthodontic treatment and should be taken care of, specifically related to the appliances used and the biomechanics applied during treatment. This is directly related to increased plaque retention, favoring some common elements in orthodontic practice.[16]

The available literature provides guidelines for orthodontic treatment in periodontal patients. These are intended to be used as a protocol and indicate the evaluation and treatment to be followed before, during, and after orthodontic treatment. Following this protocol can help prevent complications and improve the prognosis of orthodontic treatment in periodontal patients.[17]

DEVELOPMENT

The most common form of periodontal disease is chronic periodontitis (CP), which can start as bacterial plaque-induced gingivitis. However, not all cases of untreated

gingivitis inevitably progress to periodontitis.[16] The amount of periodontal tissue destruction in CP patients correlates with oral hygiene and local and general predisposing factors. Progression is usually slow to moderate, with more severe forms present in about 10% of the population.[17] Aggressive periodontitis (AP) is a less common form of the disease, which begins in young patients and progresses rapidly. There is a clear family association of AP cases, characterized by no medical history contribution.[18] The number of microorganisms is inconsistent with the severity of periodontal tissue destruction.[19]

Microorganisms involved in the pathogenesis of gingival inflammation and subsequent periodontal destruction are *Porphyromonas Gingivalis, Prevotella Intermedia, Aggregatibacter Actinomycetemcomitans, Tannerella Forsythia, Treponema Denticola,* and *Fusobacterium*. *Porphyromonas Gingivalis, Fusobacterium Nucleatum,* and *Aggregatibacter Actinomycetemcomitans* have shown to significantly increase after the use of braces, and the increase in these pathogens is significantly connected to the development of gingivitis and other associated pathologies, like white spots.[1,18,20-22]

Porphyromonas Gingivalis is a gram-negative anaerobic bacterium considered the main etiological factor in periodontal disease through the production of virulence factors and extracellular proteins, such as lipopolysaccharides, capsule, and fimbriae, resulting in destruction of periodontal tissues.[7,9,23] The pathogenicity of *P. Gingivalis* has been studied in animals like rats, rabbits, and drosophila melanogaster, showing a complicated mechanism of *P. Gingivalis*-host interaction in the development of periodontal disease.[1,24] In 1999, Curtis et al discovered a new pathogenicity island, a DNA region that encodes virulence determinants, in a proportion of *P. Gingivalis* strains called the RAG locus which was more common in deep periodontal pockets of periodontal patients. Shi et al mutated the genes the RAG locus in *P. Gingivalis* using the replacement strategy of an allele, showing that inactivation of the RAG locus reduced the virulence of *P. Gingivalis* in a rat model.[1]

An increase in bacterial plaque accumulation and development of inflammation after installing fixed orthodontic appliances have been reported in periodontally healthy patients.[25] Liu et al studied the prevalence of *P. Gingivalis* with the RAG locus in patients who developed gingivitis during orthodontic treatment, periodontally healthy patients (control samples) and periodontal patients. *P. Gingivalis* was present in 61.40% of patients with gingivitis during orthodontics, 35% of control patients, and 92% of periodontal patients.[1] The authors observed a significantly higher prevalence of *P. Gingivalis* in periodontal patients, followed by patients with gingivitis during orthodontic treatment, and control patients. They claim that carrying braces worsens hygiene if no special attention is paid to teeth cleaning, resulting in plaque accumulation and gingival inflammation. This creates an anaerobic environment due to gingival inflammation, deeper gingival sulcus, and pseudo-periodontal pockets; on the other hand, the gingiva is more susceptible to bleeding and therefore anaerobic *P. Gingivalis* will be more likely to survive. *P. Gingivalis* may play a similar role in orthodontic gingivitis and periodontitis.[1] The prevalence of the RAG locus was higher in periodontal patients than in those with orthodontic gingivitis and in control samples. *P. Gingivalis* with no RAG locus was detected mainly in healthy controls and healthy patients with orthodontics, showing that it represents null to weak

virulence of that strain of *P. Gingivalis*. A clear positive correlation was observed between the gingival index and the RAG locus gene, implying that this locus may play a similar pathogenic role in the development of gingival inflammation during orthodontic treatment compared to periodontitis. The authors concluded that monitoring *P. Gingivalis* is highly recommended after the installation of orthodontic apparatus.[1]

Regarding the *Aggregatibacter Actinomycetemcomitans* bacterium, it was originally found in aggressive periodontitis, and later also in chronic periodontitis.[18, 26] In addition, different serotypes have been found, as in *P. Gingivalis*, some of which are in healthy periodontium. It has been suggested that the destruction of healthy periodontium induced by this bacterium is the cause of the interaction between the pathogen and the host's immune response.[26]

Gastel et al conducted a prospective longitudinal study at the University of Leuven, in which they measured the impact of orthodontic appliances on periodontal and microbial clinical parameters.[11] They measured the total number of aerobic and anaerobic colony forming units (CFU) at three different times: prior to installation, at the time of removal, and three months after removal; then they used this information to calculate the CFU ratio (aerobic CFU/anaerobic CFU). They observed that all parameters increased post-orthodontic treatment compared to pre-treatment conditions. The supragingival CFU ratio was normalized after 3 months of removal, possibly because these sites are more sensitive to changes in oral hygiene. On the other hand, the subgingival CFU ratio remained significantly lower after 3 months of removal (with anaerobic CFU in greater proportion) compared to treatment start, suggesting that the change induced by orthodontic appliances is partially irreversible. Periodontal values tend to normalize following removal, but most values remain high compared to initial values. This suggests that most periodontal changes in orthodontic treatment are reversible, but that there is a change in the proportion of anaerobic bacteria compared to the aerobic ones, with the former increasing and maintained 3 months after removal. There is no evidence regarding longer-term changes.[11]

Factors that affect the outcome of orthodontic-periodontal treatment

There are some factors that should be evaluated prior to orthodontic treatment and that may affect a patient's outcome and prognosis against orthodontic treatment.

General health conditions and periodontal susceptibility

It has been established that certain systemic conditions are risk factors for the progression of periodontal disease, including psychological stress, tobacco smoking, immune system deficiency, diabetes mellitus, osteoporosis, certain autoimmune disorders, and the presence of periodontal pathogens. In patients free of periodontal disease who have good oral hygiene, including patients with a reduced but healthy periodontium, adequate orthodontic treatment does not affect bone level or long-term periodontal insertion. On the contrary, in patients with clinical signs of active periodontal disease, orthodontic tooth movement can accelerate the disease, even in the presence of good oral hygiene. Boyer et al compared alveolar bone level in two groups of periodontitis patients, one undergoing periodontal treatment only and the other one undergoing periodontal treatment combined with orthodontics. There was no significant difference between the groups,

and the authors concluded that orthodontic treatment does not negatively influence the outcome of periodontal treatment and may even be beneficial in the long term.[27,28]

Severity of periodontal disease

The progress of periodontal disease varies highly among patients. Even in the absence of dental care, different patterns and bone loss speed are observed. In addition, some individual sites of teeth may be at higher risk given their anatomical conditions.[15]

Malocclusion

Depending on malocclusion diagnosis, different orthodontic strategies can be used to achieve optimal results. The removal of periodontally compromised teeth and tooth movements to treat malocclusion can lead to major improvements in oral hygiene. Crowding alone has been reported to increase the risk of gingivitis, regardless of bacterial plaque levels.[15] In many cases, patients consult because of pathological dental migration. Studies have found that this migration occurs mainly in patients with aggressive periodontitis compared to those with chronic periodontitis, suggesting that periodontal tissue destruction plays an important role in the development of pathological tooth migration.[19,29-31]

Alveolar resorption pattern

It has been shown that it is possible to achieve orthodontic movements in teeth with intraosseous defects if periodontal disease is inactive. In addition, extrusive movements can be used to achieve a more occlusal position of the connective insertion tissue and to minimize intraosseous defects of one or two sides. On the other hand, it has been shown that intrusion improves the periodontal condition of reduced but healthy periodontal tissues when oral hygiene is good and orthodontic forces are optimal.[32,33] Therefore, it is better to perform guided tissue regeneration and/or bone surgery in areas with vertical defects after orthodontic treatment, as these movements can alter the dimensions of defects. It may be performed only in cases where the patient is able to maintain such plaque-free defects during active orthodontic treatment.[15]

Periodontal biotype

In patients with a thin periodontal biotype, dental movements towards vestibular may result in bone dehiscence which, in the presence of plaque, can lead to gingival recession.[15] However, in patients with a thick periodontal biotype and/or dental movements towards lingual, gingival recessions are less likely and orthodontic treatment may even result in a regression of dehiscence and fenestration. Careful evaluation of the patient's biotype and the motion vectors needed for optimal results is crucial in determining whether a gingival surgical increase is necessary prior to orthodontic movement. In cases where a tooth has gingival recession and must move towards vestibular, movement could increase dehiscence and therefore recession; in this case, surgery to cover the root is recommended first. On the other hand, if the tooth must move in a lingual direction, it will be positioned centrally in the bone, so surgery can be performed after orthodontic movement.[34] In addition, it is critical to observe the attached gingival area that is defined as the amount of rooted gum from the apical point of the gingival margin to the mucogingival junction, minus the depth of the gingival sulcus. The amount of keratinized gingiva is particularly important in treatment planning.[33]

Oral hygiene levels

Oral hygiene levels should be optimal prior to orthodontic treatment, and maintenance and monitoring during treatment should be guaranteed. If periodontal pockets are too deep to avoid good patient hygiene, pre-orthodontic intervention should be performed to remove the pockets. Therefore, the elimination of plaque-induced lesions should precede orthodontic treatment. There are some exceptions, in which orthodontic treatment is first indicated, such as when the removal of pockets is difficult because of poor dental position.[15,36]

Actions that contribute to a successful treatment

There are some measures that should be taken during orthodontic treatment, specifically aimed at decreasing factors that promote bacterial plaque buildup.

First, the construction of orthodontic appliances should be considered. These appliances and adhesive remnants are known to significantly increase plaque buildup, which is an important risk factor in periodontitis patients. They are also responsible for the increase of supra and subgingival microflora and their change to more pathogenic species.[16] Appliances located on the apical third of the crown are a plaque retaining factor. Both qualitative and quantitative changes in microbial flora to a more pathogenic biofilm have been demonstrated six months after installation of orthodontic devices.[15] This is why the construction of fixed devices in periodontitis patients should be designed with respect to their plaque retention properties and they should be as simple as possible.[16]

Molar bands can produce increased plaque buildup, pocket depth, and bacterial colonization. Studies indicate that the installation of orthodontic bands results in an increase in the percentage of spirochetes, filaments, and fusiforms. Little, but significant, insertion loss was reported in teeth with bands after orthodontic treatment compared to control samples, even in patients with good oral hygiene during treatment.[16] Atack et al conducted a review on the microbiological changes associated with orthodontic appliances, concluding that, after the cementation of bands, the subgingival microflora immediately changes to a periodontal pathogenic flora with an increase in anaerobic bacteria, especially *Prevotella* and bacteroid species, fusiform bacteria, and spirochetes. In most patients, this change appeared clinically as gingival inflammation, regardless of oral hygiene, as well as gingival enlargement.[37]

Using tubes in molars should be considered whenever possible, because they allow better control of plaque accumulation in the gingival area of orthodontic devices. However, recent studies in microbiology and periodontal changes following the installation of orthodontic devices after one year did not report significant differences between sites with bands and tubes.[38] On the other hand, the metal ligatures used to attach teeth to arches significantly reduce plaque buildup and the number of microorganisms compared to elastomeric ligatures, and they are definitely recommended in periodontal patients.[16]

Regarding adhesive material, a study on the colonization of bacteria associated with fixed orthodontic devices using a scanning electron microscope reported the presence of mature plaque after 2 to 3 weeks in the excess adhesive, as well as a step around the edge of both cementing composite and tooth, which had a consistent association

with bacterial accumulation.[15] The researchers concluded that excess adhesive material is critical for plaque accumulation in fixed orthodontic devices. Therefore, careful removal of excess adhesive material around orthodontic brackets is essential in adult periodontitis patients.[15]

It is important to consider that biomechanics varies in periodontal patients. The loss of alveolar bone during periodontitis moves the center of resistance closer to the root apex, and this must be incorporated into the biomechanical design of orthodontic devices. It is recommended to reduce the forces, and it might be necessary to add a greater moment, produced by a couple applied to the tooth, to overcome tipping time and produce a movement in body, avoiding tooth inclination.[15, 16]

Finally, retention must be considered. Reduced alveolar height may be insufficient support compared to the pressure exerted by the lip and cheeks, especially in teeth with severe bone loss. In these cases, containment is an extension of orthodontic treatment.[16] It is important for the fixed retainer to match the tooth's morphology and it must be cemented with caution, avoiding excess composite that could act as a plaque retention site. The retainer should be checked periodically, at least once a year, to detect signs of plaque buildup or possible detachment.[16] Compliant patients during periodontal maintenance and orthodontic containment treatment show less recurrence of periodontitis and less tooth loss than non-compliant patients.[39] The compliance pattern is very important in the long-term maintenance of good periodontal health, and risk factors, especially diabetes and smoking, should be considered when determining individual risk profile.[40]

Periodontal assessment guidelines

Before treatment, the orthodontist must ensure that the patient is able to take the necessary measures for adequate oral hygiene. In patients who do not meet hygiene requirements, orthodontic treatment should be postponed until proper plaque control is achieved. The patient should be informed that non-adherence to the oral hygiene protocol will result in suspension of orthodontic treatment.[17] Prior to orthodontic treatment, a clinical and x-ray evaluation should be routinely performed. The clinical evaluation should include a full periodontal examination of mouth, dental mobility, and gingival recession. The radiographic evaluation should include bitewing x-rays for the posterior sectors combined with periapical x-ray for both maxillary and mandible incisors. Patients with pathological periodontal pockets or where alveolar bone loss is detected on the x-ray should be referred to periodontal evaluation for corrective or interceptive treatment as needed.[17]

Hygiene and motivation instruction should be carried out during orthodontic treatment, following installation of the appliances. At each visit, it is important to ensure that there is adequate plaque control by the patient. As previously mentioned, orthodontic devices generally have a negative effect on oral hygiene; it is therefore necessary to make the required adjustments continuously. Non-adherence to hygiene protocols requires at least a pause in orthodontic treatment until significant improvement is evident. Periodontal evaluations are recommended every three months during the period of active orthodontic treatment. This control should be carried out on a visit dedicated especially to this.[41] Radiographic

evaluations should be performed at least once a year during orthodontic treatment. It should include bitewing x-rays for molars and premolars and periapical x-rays for the anterior sector. In addition, these x-rays serve to detect cavities and to evaluate root resorptions during treatment.[17]

Once orthodontic treatment is complete, a series of appointments should be scheduled to detect any early indication of periodontal disease. A quick clinical evaluation is advised as part of the check-up, supplemented with x-rays once a year. It should be borne in mind that both fixed and removable retainers are potential plaque retainers, as well as risk factors for recurrence of periodontal disease.[17]

Applications of orthodontics to periodontal treatment

Removal of pockets caused by dental crowding: it is common to find an adjacent bone defect in teeth crowded with soft plaque interproximal buildup. This can be improved by correcting the position of the teeth, thus avoiding periodontal surgery. This is the concept of forced eruption to treat two-walled bone defects. In some cases, vertical bone defects can be corrected by repositioning the tooth orthodontically.[42]

Correction of biological space invasion: in cases where the biological thickness has been invaded by means of a restoration and a defect has been created at the level of the gingival margin, it is possible to perform an orthodontic extrusion so that the dental part affected by the edge of the restoration becomes supragingival. This can be done instead of clinical crown enlargement surgery.[42]

Improvement of implant receptor sites: in a tooth where an implant will be performed, an adequate receptor site can be achieved by means of orthodontic extrusion, increasing the alveolus' local dimensions. In addition, it has been shown that a dental body movement within an edentulous region with a reduced transversal area results in a therapeutic bone remodelling.[42]

CONCLUSIONS

Early diagnosis and treatment are essential for the long-term success of orthodontic treatments in periodontal patients. The role of the orthodontist in the diagnosis and referral of a patient with periodontal disease is crucial, especially in young patients with aggressive periodontitis who frequently consult for orthodontic treatment.[17] From the beginning and throughout treatment, the orthodontist should take into account predisposing factors to periodontal disease, such as systemic diseases, bad habits like cigarette smoking, malocclusion type, periodontal biotype, and the patient's level of oral hygiene. In short, assess the patient's susceptibility to periodontal disease.[15]

It is important to take the necessary measures during treatment, specifically regarding the construction of appliances; these should be designed taking into account mainly their plaque retention properties and they should be as simple as possible. In addition, it is essential to analyze biomechanical considerations.

Many patients think that regular visits to the orthodontist are sufficient to monitor their dental and periodontal needs. However,

it is critical to educate patients about the importance of follow-ups with the periodontist, so that they can understand what periodontal disease is and how to prevent it. Strict adherence to guidelines such as routine evaluation protocols before, during and after orthodontic treatment can dramatically decrease severity and improve the prognosis of periodontal orthodontic patients. Finally, this protocol can help orthodontists avoid ethical and legal problems related to the early detection and treatment of periodontal pathologies.

CONFLICTS OF INTEREST

The authors state that they have no conflict of interest.

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