

ORTHODONTIC TREATMENT & PERIODONTAL TISSUES

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ABSTRACT

The correlation between periodontal supportive tissues and orthodontic treatment is confirmed, as well as its positive or negative repercussions on the success of the treatment and its final results. This fact is due to many factors related to the structure of the periodontal tissues, type of malocclusion, treatment procedures, and others.

In this article, we tried to give a comprehensive review of all aspects related to this correlation with a focus on gingival recession and orthodontic treatment, at the end we concluded the article with a set of important recommendations to reach safe treatment outcomes at the periodontal tissues as possible.

KEYWORDS

Orthodontics, Orthodontic Treatment, Periodontal Tissues, Periodontal Disease, Gingival Recession.

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DISCUSSION

Orthodontic treatment results are reflected in the occlusal, functional, and esthetic levels, without neglecting the integrity of the periodontal tissues. So, attention must be paid to the periodontal tissues and the teeth placed in them. Recently, there has been an increased demand for both orthodontic treatment and post-orthodontic complications on the periodontal tissues among adult patients. Perhaps, the lack of satisfaction with the facial appearance accompanying following social media contributed to this.

Interconnection between orthodontic and periodontal treatments

Orthodontic and periodontal treatments support each other, through the contribution of orthodontics to the improvement of periodontal health, and in return, periodontal therapeutic procedures facilitate orthodontic movements, and thus the description of symbiosis can be launched on the interconnection between them, and it is also known that the malocclusion is associated with inflammations of the periodontal tissues, on the other hand, the results of the short and long-term of the orthodontic treatment are influenced by the status of the periodontal supporting tissues. Therefore, the joint work between orthodontists and periodontists is required to achieve harmony between the beautiful smile and gingival esthetics.

Orthodontic treatment & periodontal disease

Orthodontic treatment offers the following benefits for periodontal disease, which are as follows: making oral hygiene better, aligning the teeth within the alveolar envelope, elimination of occlusal trauma, utilizing hopeless teeth to enhance hard and/or soft tissues as a preparatory procedure for implants,[8] and also helping to correct the changes of gingival contour.

On the other hand, the loss of the periodontal will affect the dental orthodontics movement through the change in the ratio of the crown to the root and shifting of the resistance center, thus, change in the ratio of forces and moments, as well as the reduction of the dental root anchorage.

Gingival recession & orthodontic treatment

The term (GR) gingival recession refers to the movement of the free gingival margin apically, which exposes the area of the tooth root surface, which is caused by a Gingivitis (gingival inflammation) or as a result of mechanical stress factors such as malocclusion, traumatic occlusion and trauma like teeth cleaning (brushing or flossing) incorrectly.

In general, orthodontic dental movements are not classified as an elementary cause of the gingival recession, but it can't be denied that there are periodontal risks associated with orthodontic treatment in its various phases, which occur as a result of the participation of a group of factors distributed between the patient and specialists, the orthodontic treatment plan and orthodontic appliances themselves.

These risks manifest as complications during the treatment or within the two years later, in sort of tissue damage (recessions, dehiscence, and fenestration), which can be single or multiple.

When could orthodontic treatment cause GR?

Although, orthodontic treatment is not considered to cause gingival recession lonely except rarely, but this treatment without taking into account the periodontal supportive tissues becomes a predisposing factor to the recession, so depending on the severity and pattern of gingival damage, orthodontic therapy alone may be sufficient as a treatment or require concomitant periodontal treatment [1].

In the context of orthodontic treatment, both gingival tissue thickness, and the direction of the applied orthodontic movement may be considered as factors for the appearance and progression of gingival recession, this risk increases with decrease in gingival thickness to less than 2 mm.

The different orthodontic movement types have a kind of risk, in cases of the periodontal thin biotype tissues, which may be causing the occurrence of gingival recession and loss of Keratinized Tissue Width, and it has always been a mention of the direct relationship between proclination movements, and the increased loss of keratinized gingiva as much as the decreasing of gingival tissue thickness (more thin - more loss).

Periodontal biotype

Based on the thickness of gingiva, two patterns of periodontal biotype were suggested by Claffey and Shanley as following: thick biotype (thickness of gingiva ≥ 2 mm) and thin biotype (thickness of gingiva ≤ 1.5 mm).

Gingival biotypes (thin and thick) refer to the characteristic of the periodontium profile, which is supporting the tooth, among the factors that predispose to a certain biotype: anatomy and physiology, tooth shape determined by genetics, function, and nutrition, hormonal and metabolic disorders (Calcium and Phosphorous). According to Petrova, M.D., the average prevalence dehiscence of roots (with thin biotype) is 20%.

A group of studies indicated an association of gingival biotype with:

- Gender: thick biotype is more common in males, whilst in females, thin biotype was indicated with thinning of the alveolar bone.
- Age: thick biotype is more common in younger ages.
- tooth shape: thick biotype with square tooth shapes, thin biotype with triangular tooth shapes, or slender tooth shapes.
- Dental alignment: if mandibular and maxillary anterior teeth are well aligned, presented with a thick gingival biotype, but if they are proclined, then presented with a thin biotype.
- Facial phenotype: thin biotype linked to mesoprosopic facial phenotype.

Alveolar bone

The presence of restricting factors for orthodontic movements within the morphology of the alveolar bone must be taken into account when planning the treatment.

The thickness of the cortical bone varies according to:

- Gender: thicker in males than females, and also the density more.
- Age: thicker in adults than in younger.
- Jaw: thicker in the lower jaw than the upper.
- Site: in jaw: thicker in the posterior areas than the anterior
- thicker in the oral areas than the buccal
- Alveolar crest: both thickness and the density increase from the
- Crest to its base.

A proportionality between gingival and alveolar bone thicknesses was observed both in males and females, with a predominance of a lower alveolar bone thickness with a thinner biotype in females compared to males.

Incisors and canines are associated with a risk factor for a decreased thickness of the buccal dentoalveolar plate (especially lower incisors & upper canines). So, it was found that with orthodontic treatment, the lower incisors are more susceptible to cases of gingival recession, specifically the lower central incisors [2].

Excessive Forces

Applying high forces in the context of orthodontic treatment causes negative changes in the remodeling and resorption process of the alveolar bone, in which bone resorption dominates, causing gingival recession even with the presence of sufficient attached gingiva.

Tooth extraction

For tooth extraction, the response of the bone plates varies according to the periodontal biotype, so the pattern of bone remodeling differs, considering that thick biotype with thick bone plates, while thin biotype with thin bone plates with the prospect of dehiscence and fenestration occurrence.

In addition to the above, thin biotype is associated with a risk factor for fracture of the alveolar bone plates when high extraction forces are applied, hence, this is the importance of atraumatic extraction to preserve the thin plates [3].

On the other hand, the dental extraction accompanying the orthodontic treatment with the multiple dental movements toward the extraction site may cause: 1- Gingival recession. 2- Resorption of dental roots. 3- Gingival clefting. 4- Loss of the bone and attachment.

Gingival invaginations, which may appear with trial to close spaces after the extraction.

Nevertheless, strategic tooth extraction in the context of orthodontic treatment has its considerable pathological causes, which are many, including periodontal problems.

Cases of malocclusion with the most risk

Clinical malocclusion cases, in which orthodontic buccolingual movements of lower incisors present a risk factor:

- Surgical cases of Class III.
- Compensation in dental Class II.
- Camouflage treatments of Class III.
- Bimaxillary protrusion with hyperdivergent facial pattern.

Critical orthodontic movements types with periodontal complication

- orthodontic retraction movement of whether the mandibular incisors or maxillary incisors.
- skeletal maxillary expansion in cases of the permanent dentition, in both the rapidly (RME), or slowly (SME). These risks appear more in the upper first premolars than the first molars.
- expansion dental arch in the sagittal direction.
- some cases of rotational tooth movements, because of anatomical reasons connect with the alveolar bone and tooth dimensions.
- orthodontic mesiodistal movements of the upper molars in the direction of maxillary sinuses (in case of floor extensions).

Vestibular gingival recession

Studies about vestibular gingival recession indicate the following:

- During orthodontic treatment no considerable increasing the gingival recession of lower incisors was founded, but less than 10% of treated subjects had more than 2 mm of recession after treatment.
- After orthodontic treatment, the prevalence of the labial gingival recession of lower incisors (mostly detected on central incisors) was mild severity, where it was 10.3%, distributed in two types: Miller Class I (8.6%), and Miller Class II (1.7)%. There is a risk of development of severe GR associated with Class III malocclusion and reclined lower incisors.
- Perhaps, there is a possible risk for the development of the labial gingival recession in the orthodontic and retention phases, which occurred in treated patients with an odds ratio (4.48) than in the control group.
- There is no effect of the value of the lower incisors' proclination in dental root exposure or even gingival recession, whereas, the evaluation of the treatment results after 5 years revealed the existence of GR by an average of (12%).
- Vestibular GR is not caused by orthodontic movements, which make any alteration in the inclination of the mandibular incisors.
- Buccal orthodontic dental movement doesn't associate with the buccal gingival recession.
- Gingival recession after treatment (32 years later) with a fixed functional appliance (Herbst) was

inconsequential and not associated with incisors' proclination.

- Whilst, it was found that surgically or orthodontically proclination of mandibular incisors more than (10°) increases the possibility of a gingival recession on the lingual aspect.

Retention phase after orthodontic treatment

Studies in this phase showed the following:

- After orthodontic treatment by fixed appliances, improvement of Oral health is achieved with the different types of retainers (removable or fixed).
- While another mentioned, that the improvement only with removable (Essix) retainers.
- Using Lingual bonded retainers causes gingivitis and increased plaque build-up.
- Short / long-term use of fixed retention had a slight negative effect on periodontal health.

How does the likelihood of a gingival recession change?

- It is possible to decrease the probability of a gingival recession by increasing:

HKG (the height of keratinized gingival tissue).

ICW (the dimension of the dental arch between the tip of the cusp from left to right canines - intercanine width).

Symphyseal width of the lower jaw.

- On the other hand, GR could be increased in case of occurrence an increase of the dental arch depth, while it is indicated that conservative treatment without extraction of teeth in the context of orthodontic therapy, carries a higher risk of recession [4].

Treatment protocol

Orthodontic approach and treatment protocol for clinical cases of gingival recession with thin biotype was suggested as following:

- Avoiding more proclination of the incisors.
- Ideal oral health care.
- performing the necessary surgical procedures (free gingival graft) before planning dental movements in these cases:

Orthodontic treatment without teeth extraction.

Presurgical preparation (orthodontic decompensation).

pre-prosthetic mouth preparation.

- Checking the ideal oral health care once again.
- Aligning teeth roots within the dento-alveolar envelope with no more proclination.
- Reassessment of the necessity of the mucogingival Grafting Procedures post-orthodontic treatment.

Non-surgical treatment directions

In cases of periodontal tissue problems with contraindications for surgical treatment or that do not require surgical interventions, their treatment intends to improve or even maintaining the condition of exposed root surfaces and periodontal supportive tissues surrounding teeth.

Non-surgical treatment varies according to the severity of the case between traditional Non-surgical treatment varies according to the severity of the case between traditional procedures that include monitoring the periodontal status and prevention in simple cases, treating teeth sensitivity, restorative treatment that varies from dental composite materials to pink-composite or pink-ceramic and even the gum masks, whereas in severe cases with Orthodontic treatment, and in the complex cases with surgical treatment, or possibly a combined interdisciplinary treatment [5].

In general, with the movement of the tooth to a normal position towards the center of the alveolar bone, the treatment procedures for alveolar bone dehiscence and also gingival recession will be reduced and the surgical procedures will be more predictive of success if required. And among cases of gingival recession, which orthodontics may treat it without surgical procedures, is the local recession (V-shaped) caused by occlusal trauma.

Surgical treatment directions

Improving periodontal tissues is very necessary and important procedure pre-orthodontic treatment, as follow:

- Maximizing soft tissues volume, in case of thin gingival biotype, and Shallow vestibule accompanying with an inadequate width of attached gingiva.
- In cases of decreased Keratinized tissue width to lower than (2 mm), which need orthodontics treatment with teeth movements outside the alveolar envelope, it will be suggested periodontal plastic surgery (gingival grafting).
- Bone augmentation procedures should be confirmed in cases of the dentoalveolar bone defect (fenestration and dehiscence).

An advantage to thick biotype cases could be mention here, which is boosting the graft-revascularization, and success of the graft incorporation, by increased blood flow. So as a result of that, there is a greater possibility of root coverage completely.

- Surgical techniques of soft tissue grafting improve the periodontal biotype, such as:
- Grafting by subepithelial connective tissue, which is considered as the most effective, reliable and documented technique.
- Grafting by an acellular dermal matrix.
- Surgical modified roll technique.
- Using the platelet-rich fibrin (PRF) membrane.
- Using the fetal (amnion, chorion) membranes.

- Vestibular incision subperiosteal tunnel access (VISTA), which is used to cover the roots and treating the multiple gingival recessions, and also mentioned as a surgical procedure to facilitate the orthodontic therapy.

Prognosis

With a comprehensive discussion of gingival biotypes with the different classes of gingival recession (according to the Mahajan's classification), the prognosis for gingival recession can be determined as follows:

- Class I: with thick biotype (BEST), with thin biotype (GOOD).
- Class II: with thick biotype (BEST), with thin biotype (GOOD).
- Class III: with thick biotype (FAIR), with thin biotype (POOR).
- Class IV: with thin biotype (POOR).

Because of that, the collaboration of a multidisciplinary dental approach is recommended, and it will be reflected in the ultimate treatment outcomes and its long-term continuity.

Recommendations for safe orthodontic treatment as possible

The Synergy between periodontal and orthodontic treatment achieves the gum contours esthetic. So, it is recommended to record the level of gingival edges for diagnostic reasons in the treatment planning phase, then bond the orthodontic appliance accordingly. With continuous monitoring of periodontal status to ensure esthetic treatment results.

Orthodontics with fixed appliances is considered as harmful to periodontal tissues, because of that orthodontic treatment should be preceded and punctuated by a high level of oral hygiene and care, with continual evaluation and awareness of patients, due to the tendency of plaque to accumulate around the various elements of orthodontic appliances. Because the oral hygiene status with inflammation are considered as determining factors in the progression of gingival recession.

The identification and pre-evaluation of the biotype of the periodontal tissues will assist in various dental procedures, and will also provide a visualization for the orthodontist about the possible orthodontic movements according to the specificity of each case without negative treatment complications on the periodontal tissues, thus, conclude the final treatment result and the case prognosis.

Cone-beam computed tomography is recommended for diagnosis, because CBCT provides an accurate assessment of the morphology of the alveolar bone and the possibility of orthodontic movement, thus, the choice of accurate treatment methods.

During orthodontic treatment, it is necessary to early detect any negative complications on the periodontal

tissues, and correct them through typical oral health care and making adjustments in the applied system of forces and moments to achieve a suitable roots torque.

Suggested treatments for an apical or coronal shift of the gum contour are orthodontic treatment (by extrusion or intrusion of the teeth), crown lengthening surgically (by osseous or gingival resective surgery).

When clinical cases are with probability existence of bony fenestration or dehiscence, then a dental extraction or orthostripping should be a part of the treatment plan to avoid the excessive expansion of the dental arch, but when there is a need for expansion or dental movement outside the alveolar bone envelope, then this requires prior surgical procedures.

In combined orthodontic and periodontal cases, it is important to benefit from the skeletal anchorage (TADs) by using micro or mini-implants, which will be employed to boost the final treatment outcomes.

Cases of thin biotype with dental crowding in the lower anterior region, it is recommended to limit their labial movement by using a fixed appliance (self-ligating bracket system), Segmental arch technique, round arch wires, light Class III elastics, braces with individual torques, and orthostripping consciously and rationally.

CONCLUSION

The relationship between orthodontics and periodontal tissues is spiky, and in which many factors are involved, oral health (plaque, proper oral care, presence of an inflammation or periodontal diseases), the structure of the periodontal tissues (pattern of biotype, keratinized tissue, alveolar bone, and cortical plates), good planning of the orthodontic treatment in parallel with the assessment of the need for periodontal treatment

(before, during or after treatment), type of orthodontic appliance and the output orthodontic movements.

So, we strongly recommend the multidisciplinary dental approach and hope that the aforementioned recommendations for orthodontic treatment will lead to clinical outcomes, that fulfill esthetic with functional requirements and to be safe at the same time on both soft and hard periodontal tissues for short/long-term.

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