

Orthodontic Tooth Movements and its Effects on Periodontium

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ABSTRACT

Orthodontic treatment aims at providing an acceptable functional and aesthetic occlusion with appropriate tooth movements. These movements are strongly related to interactions of teeth with their supportive periodontal tissues. In recent years, because of the increased number of adult patients seeking orthodontic treatment, orthodontists frequently face patients with periodontal problems, hence there exist to know the effects of periodontium on Orthodontic tooth movements.

KEYWORDS: Orthodontics, Periodontium, Interdisciplinary Treatment

INTRODUCTION

Often orthodontists can be of considerable assistance in interdisciplinary treatment approach by preventing excessive periodontal surgery by establishing a physiologic alveolar crestal topography of a localized bony defect, up righting of mesial tipped molar, forced eruption of a fractured teeth avoiding extraction, leveling the gingival margins, correcting biological width violations, improving implant sites.

EFFECT OF ORTHODONTIC TREATMENT ON PERIODONTAL HEALTH

The primary cause for the inception and progression of gingival inflammation and periodontitis is bacterial plaque. Orthodontic treatment is sometimes considered a predisposing factor for periodontal disease, as orthodontic appliances may inhibit complete oral hygiene procedures resulting

in increased bacterial aggregations. The problem is not the aggregations, but there is a possibility of transition of the supra gingival plaque into sub gingival plaque during tipping or intrusion tooth movements that favors the conversion of gingivitis into periodontitis.¹ But these can be overcome by proper oral hygiene and periodontal surgical procedures done if needed before orthodontic treatment.

EFFECTS OF ORTHODONTIC TREATMENT ON PERIODONTIUM

As the tooth is moved that is extruded, intruded or up righted

1. The relation between the bone margin and the CEJ remains unchanged,
2. The free gingiva follows the tooth 90% of the distance,

How to cite this article:

Chaitanya ASK, Reddy YM, Sreekanth C, Reddy BV, Kumar BL, Raj GKP. Orthodontic Tooth Movements and its Effects on Periodontium. Int J Dent Med Res 2014;1(4):119-123.

3. The attached gingiva follows the tooth 80% of the distance,
4. While the mucogingival junction remains in the same position,
5. No attachment loss.

This means that the attachment apparatus, alveolar bone and gingiva follows the tooth during the extrusive movement due to force transmitted by the gingival fibers and periodontal fibers. However, inflammation always should be controlled to ensure that the supra-crestal connective tissue remains healthy and that the crestal alveolar bone height remains at its original level.² But orthodontics is used as an adjunctive therapy for correcting isolated bony defects, not generalized bony defects

Orthodontic Extrusion:

Experimental observations done animal^{3, 4} and human⁵ studies that have shown similar results on healthy periodontium during extrusion i.e. bone, free gingivae, attached gingivae follows the tooth.

Extrusion of an individual tooth is used specifically for correction of isolated periodontal osseous lesions and reported to reduce infra bony defects and decrease pocket depth. The extrusive tooth movement leads to a coronal positioning of intact connective tissue attachment, and the bony defect is shallowed out. But orthodontics is used as an adjunctive therapy for correcting isolated bony defects, not generalized bony defects.

Isolated bony defect corrected by osseous surgery, which lead bone removal of adjacent two or three teeth and corrected by orthodontically extruding the affected tooth .Because of the orthodontic extrusion, the tooth will be in supra occlusion. Hence, the crown of the tooth will need to be shortened, in some cases followed by endodontic treatment.

During orthodontic extrusion, the relationship between the Cemento-enamel junction and the bone crest is maintained. This means that the attachment apparatus (alveolar bone) and gingiva follows the tooth during the extrusive movement due to force transmitted by the gingival fibers and periodontal fibers.

However, inflammation always should be controlled

to ensure that the supra-crestal connective tissue remains healthy and that the crestal alveolar bone height remains at its original level.

Orthodontic extrusion is of two types:

- **Slow extrusion with periodontium:** During tooth extrusion bone and gingiva follows the tooth and erupted tooth root requires bone removal and gingivectomy for gingival esthetics. Such type of extrusion is also called forced eruption and used for treating isolated bone defects root fractures and root caries and vertical ridge augmentation procedures.
- **Rapid extrusion without periodontium:** Orthodontically extruding the tooth and thus moving the margin away from the bone. Bone and gingiva does not follow the tooth which is achieved by circumferential supracrestal fiberotomy to prevent bone and gingiva from following the root. So that during tooth extrusion bone and gingiva will not follow the tooth and used for correcting biological width violation of restorations.

Molar up Righting:

Mesial tipping of mandibular second molars occurs because of non-replacement of missing first molars are a very common clinical problem. Mesial tipping produces a gingival or pseudo-pocket on mesial surface if no periodontal attachment has been lost and also the cleansing activity is decreased in that area However, a pocket deeper than 3 mm formed produce micro ecosystems that promote growth of pathogens and subsequent attachment loss

When there is a definite osseous defect caused by periodontitis on the mesial surface of the inclined molar, up righting along with its extrusive component the tooth pulls the crestal alveolus coronally and thus reduces the vertical osseous defect. Orthodontic therapy thus eliminates unnecessary bone removal for pocket elimination and provides sufficient space for prosthetic replacement.⁶

Furcation involvement of up righted molar:

Furcation defects generally remain the same or get worse during the orthodontic treatment. If tipped

molars have furcation involvement before orthodontic up righting with simultaneous extrusion may with heavy forces increase the severity of the furcation defects, especially in the presence of inflammation

Furcation that increased in severity were associated with extrusion was due to heavy forces and possible periodontal inflammation. However, Molar up righting procedures can be carried out without further periodontal furcal breakdown in patients with light intrusive forces if applied in an inflammation-free environment.⁷

Orthodontic Intrusion:

Similar to extrusion, intrusion of teeth has been recommended

- For increasing the clinical crown length of single teeth.
- For teeth with horizontal bone loss or infrabony pockets

Orthodontic intrusion can change horizontal bony defect into a deep and narrow defect that is more favourable for regeneration of the periodontium through grafting procedures.⁸

Increasing the clinical crown length of single teeth:

Similar to the case with extrusion, metric and histologic studies intrusion of teeth showed gingiva also moved the distance when the teeth were intruded with a continuous force of 80–100 g.

Kokich recommended an interrupted, continuous force for levelling of gingival margins on supra erupted teeth. The key understanding why intrusion can be used to increase clinical crown length is related to the subsequent restorative treatment.

When orthodontic intrusion is used for leveling of the gingival margins to desired heights, such teeth must then be provided with porcelain laminate veneers or crowns or by composite restoration for incisal discrepancy.

Similar to extrusion, intrusion of teeth has been recommended as for correcting isolated horizontal bone loss defects. Orthodontic intrusion can change

a horizontal bony defect into a deep and narrow defect that is more favorable for regeneration of the periodontium through grafting procedures. Intrusion of teeth has been recommended as for correcting isolated horizontal bone loss defect, not for generalized horizontal bone defects.

Tooth movement through cortical bone:

During orthodontic tooth movement, tooth moved out of the alveolar housing or positioned more facially lead to alveolar bone dehiscence and conductive also for loss of gingival tissue. Gingival recession occur due displacement of soft tissue apical to CEJ with exposure of root surface.⁹

Tooth moved out of the alveolar housing or positioned more facially and again moved towards alveolar housing or lingually (original position) lead to complete regeneration of alveolar bone with intact junctional epithelium and normal gingival position. Evidently, the soft tissue facial to an orthodontically produced bone dehiscence may contain soft tissue components (vital osteogenic cells) with a capacity for forming bone following repositioning of the tooth into the alveolar process.¹⁰

In an orthodontic case showing a recession defect and a thin gingiva associated with a prominent, facially positioned tooth surgical treatment for root coverage should be postponed until orthodontic therapy is completed.

Similarly in a case requiring orthodontics for showing a recession defect and a thin gingiva associated with a prominent, facially positioned tooth surgical treatment for root coverage should be postponed until orthodontic therapy is completed. If still indicated, the root coverage procedure will show higher predictability if performed after rather than before the tooth movement

Movement of teeth with infrabony defects:

In patients who have periodontal disease infrabony pockets are frequently found. Whether orthodontic tooth movement in those areas with infrabony pockets may have a detrimental effect on the supporting tissues was evaluated. The effect of bodily tooth movement into infrabony defects has been evaluated experimentally. Provided

elimination of the sub-gingival infection was performed before the orthodontic tooth movement was started, no detrimental effects on the attachment level were observed.¹¹

Bodily tooth movement of tooth with infrabony pockets showed

- Angular bony defect was eliminated by the Orthodontic treatment.
- No deleterious effect on level of connective tissue attachment.
- No coronal shift or gain of the connective tissue attachment was found.
- A thin junctional epithelium covered the root surface to a level pre-treatment.

However, it was possible to move teeth with reduced healthy periodontium without additional attachment loss. On the other hand, the orthodontic treatment involved movement of teeth into and through a site with inflammation and angular bone loss an enhanced rate of periodontal destruction was noted, therefore periodontal maintenance is the key for tooth movement of tooth within the infrabony pocket.¹²

Orthodontic tooth movement into edentulous areas (Reduced alveolar bone height):

In patients with partially edentulous dentitions, due to congenitally absent or the extraction of teeth, orthodontic treatment often has to be performed into, the edentulous area, improved esthetic and functional results may be gained. In many of these individuals there is a reduced alveolar bone height. With tooth movement:

- On tension side original height and width of the supporting bone were fully maintained.
- On the pressure side, supporting alveolar bone was also present with a limited reduction in vertical bone height, averaging (-1.3 mm)
- On pressure side histological sections showed that the supporting bone on the pressure side was much thinner than the original bone.

On pressure side histological sections showed that the supporting bone on the pressure side was much thinner than the original bone due to a thin bone

plate was to recreated or newly formed ahead of the moving tooth. So a tooth with normal periodontal support can be orthodontically moved into an area of reduced bone height with maintenance of height of connective tissue attachment level and alveolar bone support.

Orthodontic implant site development:

It is sometimes difficult to achieve stable and aesthetically satisfactory results with artificial crowns on single-tooth implants, and orthodontist may play a role in the interdisciplinary treatment planning team.¹³

Orthodontic ridge augmentation (Implant site development) by tooth movement into bony defects occurs:

- By Vertical tooth movement (for Esthetics)
- By Horizontal tooth movement (for Stability)

Orthodontic ridge augmentation by Horizontal tooth movement: If an implant cannot be placed because of reduced bucco-lingual ridge thickness after a previous extraction, one option is to move a tooth into the edentulous space and to place the implant in the position previously occupied by the moved tooth. It should be emphasized that there is much less shrinkage of the alveolar bone after horizontal tooth movements than after extractions of teeth as shown

Orthodontic ridge augmentation by vertical tooth movement: During selective orthodontic extrusion of one single tooth, both the alveolar bone and the soft periodontal tissues will follow the extruded tooth in an incisal direction (Forced eruption with Periodontium)

CONCLUSION

Thus, with synergistic collaboration, orthodontic therapy with other specialties can enhance the treatment outcome with decreased cost, time and morbidity with more benefit than expected to the patient

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Source of Support: Nil
Conflict of Interest: Nil