



MODALITIES OF ACCELERATED ORTHODONTIC TOOTH MOVEMENT

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ABSTRACT

The duration for orthodontic treatment is always a primary concern for most of the patients. Prolonged orthodontic treatment causes several disadvantages like increased incidence of dental caries, gingival recession & root resorption being a major concern for periodontist. So there is always a need or an increased demand for change of treatment modalities to reduce the time of orthodontic movement. The constant search for a better efficacy in orthodontic treatment is always appreciated by all orthodontist. To date, a few treatment modalities to accelerate the orthodontic tooth movement include laser therapy, pulsed electromagnetic fields, electrical currents, corticotomy, distraction osteogenesis & mechanical vibration. However results are inconclusive & some are unreliable which may confuse the clinicians understanding. The aim of this article is to present a review of historical background of various treatments, indications, contraindications, complications, & side effects of such treatments so that an over all concept of accelerated orthodontic movement will be brought into view.

KEYWORDS : corticotomy, PAOO, micro osteoperforations, osteotomy

INTRODUCTION

Usually when a patient approaches a clinician for orthodontic treatment there is always a concerned question "when are you taking off my braces?" It's a question faced by all orthodontist in their day to day clinical practice. All patients are enthusiastic about the possibility of reducing the treatment time.¹

Adults have more specific objective & concerns related to facial & dental esthetics and duration of treatment. Adults are more prone to periodontal complications as their teeth are in non-flexible alveolar bone. Hyalinization occurs during treatment in adults than in children. Also, cell mobilization and conversion of collagen fibers is much slower in adults than in children, thus prolonging the treatment time.²

Since many years, surgical intervention is thought about as an aid to influence the alveolar bone housing, to accelerate tooth movement.³ If growth modification is no longer possible, surgical procedures might be necessary to attain the treatment goal.⁴

To address these issues corticotomy is followed. In this procedure, perforations or cuts are made on the cortical alveolar bone and the trabecular bone is left intact.⁴ Orthodontic forces are applied shortly after surgical procedures to get desired tooth movement & optimize bone remodeling.⁵ Mechanical or physical stimulation of the periodontal ligament has also been proven to increase the speed of bone remodeling.

Many methods have been used to induce osteoclastogenesis like stimulation of RANK/RANKL (Receptor Activated Nuclear Factor-Kappa and Receptor Activated Nuclear Factor-Kappa Ligand) and pathway and induction of signaling molecules like MAPK (mitogen activated protein kinase) & nitric oxide.⁵ These have shown reduction in relapse, pain, & root resorption caused due to orthodontic forces. Methods to accelerate orthodontic tooth movement can be classified as⁵:-

- Drugs
- Surgical methods
- Physical/mechanical stimulation methods.

These methods have been successfully proven to reduce treatment duration upto 70%.⁵ Hence, the methods are discussed in detail.

Drugs :

Drugs used for such accelerating orthodontic tooth movement includes vitamin D, prostaglandins, interleukins, parathyroid hormone, misoprostol etc. Vit D when injected in the periodontal ligament increases the level of lactate dehydrogenase & creatine phosphokinine enzymes. Prostaglandins causes inflammatory state & root resorption generally.⁶

Surgical Methods

Historical View

The first report on surgical approaches was done by L.C Brian in 1892 and later was followed by G. Gunningham in 1893. Later after 50years in 1959 Kole used combination of two surgeries i.e interradicular corticotomies and supraapical osteotomies to speed the movement of orthodontic forces to move the teeth. This treatment modality was accepted widely. But it had considerable risk to periodontium and tooth vitality.¹

Kole's procedure involves the reflection of full thickness flap to expose the buccal and lingual alveolar bone followed by interdental cuts through cortical bone.³

Corticotomy

This is not a new concept. It was suggested in the end of 19th century.⁴ Corticotomy has roots in orthopaedics when taken back to 1900s. It was first defined as a linear cutting technique in the cortical plates surrounding the teeth for mobilization of teeth for faster movement.

The development of corticotomy assisted orthodontic treatment (CAOT) opened doors to many limitations in orthodontic treatment in adults. The advantages of this treatment is enhanced expansion, decreased treatment time, differential tooth movement, increased traction of impacted teeth and post orthodontic stability.²

The conventional corticotomy procedure involves elevation of full thickness mucoperiosteal flap buccally or lingually followed by placing the corticotomy cuts using micro motor under irrigation or piezo surgical instruments. This can be followed by placement of graft material if required to augment thickness of bone.⁵

Periodontically Accelerated Osteogenic Orthodontics (PAOO)

This is a more recent technique done by Wilcko, which gave 3 to 4 times rapid movement of tooth.² This technique was combination of corticotomy surgery and alveolar grafting referred as accelerated osteogenic orthodontics (AÖO) and more recently called as periodontally accelerated osteogenic orthodontics (PAÖO). This method was safe, effective, extremely predictable associated with less root resorption and reduced time for treatment. It also decreased the need for orthognatic surgery in certain conditions.¹ PAÖO consists of 5 steps ie raising a flap, decortications, particulate grafting, closure and orthodontic force application. Clinical applications of this procedure are to resolve crowding and shortening the treatment time, accelerate canine retraction after premolar extraction, facilitate eruption of impacted teeth, slow orthodontic expansion, molar intrusion, manipulation of anchorage and open bite correction.⁷

Micro osteoperforations (MOP)

Micro osteoperforation is the only microsurgical option available for accelerating the orthodontic tooth movement. In this, a device called propel is to puncture the alveolar bone. The adjustable device dial can be positioned to 0 mm , 3mm, 5mm and 7mm depth. MOP on alveolar bone stimulates the expression of inflammatory markers leading to increased osteoclast activity and increased rate of tooth movement.⁸ MOP has been shown to increase the rate of canine retraction. Patient had mild discomfort locally after 14days and no pain was reported. MOP can reduce orthodontic treatment time by 62%.

Physical / Mechanical Stimulation Methods

Laser

The low intensity laser therapy can accelerate bone regeneration in the mid palatal suture during palatal expansion and stimulate synthesis of collagen, which is a major matrix protein in bone. The mechanism involved behind this is by the production of ATP and activation of cytochrome C in low laser irradiation, which enhanced the velocity of movement of tooth via RANKL and macrophage colony stimulating factor. In this treatment a semiconductor with wave length 800nm and a wave mode of 0.25mw to an exposure of 10seconds is used. The tooth movement has been seen to be increased by 30 to 60 %.⁹

Vibration

A vibration of 60Hz, 1m/s produced increased tooth movement. In such cases, there is increased RANKL expression in the fibroblasts and osteoclasts of periodontal ligament.¹⁰

CONCLUSION

It's a long term research by clinicians that developed all the above mentioned techniques to reduce the time needed for orthodontic treatment, improving patient acceptance, satisfaction and appreciation of orthodontic treatment. Presently several methods are available to accelerate orthodontic tooth movement safely. Different procedures mentioned in this article helps us to get a better view of various procedures depending on the patients convenience. These procedures come with advantages like reduced relapse, reduced pain, and reduced resorption. With a combination of both periodontal surgery and orthodontic treatment we can now do treatments for better and faster esthetic approach.

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