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Review Article

A Non-Surgical Approach to Accelerate Tooth Movement A Review

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Abstract

One of the major concerns for adults seeking orthodontic treatment is the longer duration of treatment involved. The increased treatment time not only affects the psychological status of the individual but also leads to the teeth prone to severe root resorption, poor oral hygiene, caries and gingival recession. Although surgically assisted orthodontics were proven to be a gold standard to accelerate the tooth movement it has its own share of disadvantages. With recent developments in newer techniques, less invasive methods have been invented to accelerate the tooth movement. The following review article gives a comprehensive overview of newer less invasive techniques to accelerate orthodontic tooth movement.

Keywords: Corticotomy Assisted Orthodontics; Accelerated Tooth Movement; Regional Accelerated Movement

Introduction

As the number of adults seeking orthodontic treatment is increasing in the recent era, more are their expectations towards achieving the desired outcomes. Although achieving functional efficacy, esthetic harmony and structural balance becomes the goal for a successful orthodontic treatment, orthodontist have a new challenge now to the reduce the increasing demand of patients concern to reduce the longer duration of treatment time. Fixed orthodontic treatment requires an average of 18 to 24 months to achieve desired results which has been a concern among patients as well as orthodontists. With increasing trends various methods were introduced to shorten the treatment duration in recent years. These methods can be divided broadly into surgical and non- surgical treatment approaches. The surgical approach involves the corticotomy assisted orthodontics introduced in 1893 and periodontally accelerated osteogenic orthodontics (PAOO) technique which was introduced in 1995. Both these methods were based on the principle of RAP (Regional Accelerated Phenomenon) [1] which states that any injury to the bone leads to the initiation of osteoclastogenesis which in turn increases the bone turnover and decreases the bone density leading to acceleration of tooth movement. Although these methods were widely popular in the past, high morbidity associated with the procedure, it invasive procedure, chances of damage to adjacent vital structures, post-operative pain, swelling, chances of infection, avascular necrosis has led to its low acceptance by the patient in recent years. Hence various researchers put forth newer inventions such as piezosurgery, fiberotomy, micro-osteoperforations, temporary anchorage devices, drugs and physical/mechanical stimulation methods to shorten the otherwise longer orthodontic treatment.

Various non-invasive methods to accelerate tooth movement can be broadly classified into the following categories.

1. Drugs
2. Physical/Mechanical stimulation methods
3. Non-Surgical treatment approach
    1. Piezosurgery
    2. Fiberotomy
    3. Micro-osteoperforations

Drugs

Parathyroid Hormone [PTH]

Parathyroid hormones are the most common drug involved in treating patients with severe osteoporosis. The main action of

this drug is to increase the concentration of calcium in the blood. An animal study conducted by Li F., *et al.* in 2013 [2] in rats concluded that short-term parathyroid hormone injection might be a potential method for accelerating orthodontic tooth movement by increasing the alveolar bone turnover rate. Another experimental study on rats by Soma., *et al.* [3] stated that continuous administration of PTH is applicable to accelerate orthodontic tooth movement.

Vitamin D

According to a study conducted by Collins and Sinclair., *et al*. [4] in 1988 stated that intraligamentous injections of a vitamin D metabolite, 1,25-dihydroxycholecalciferol, caused an increase in the number of osteoclasts and the amount of tooth movement during canine retraction with light forces in cats.

Prostaglandins

Yamasaki., *et al*. in 1884 [5] has concluded in his study carried out on the clinical application of prostaglandins E on orthodontic tooth movement that Local injections of prostaglandins have shown to increase the orthodontic tooth movement. Another study carried out by Seifi., *et al*. [6] in 2003 stated the importance of calcium ions working in association with PGE2 in stabilizing root resorption while significantly increasing OTM.

Physical/mechanical stimulation methods

Low Level Laser Therapy (LLLT)

Also known as cold laser, LLLT irradiation initiates a cascade of events that culminates in an increase in the osteoblastic, osteoclastic activity and collagen production. Doshi Mehta., *et al.* [7] conducted a clinical investigation on efficacy of low-intensity laser therapy in reducing treatment time and orthodontic pain and concluded that low-intensity laser therapy is a good alternative option to reduce orthodontic treatment duration and pain. Another study by Genc G., *et al.* [8] in 2013 stated that low level laser therapy accelerated tooth movement significantly.

Resonance Vibration

Recent studies have shown that mechanical vibration can enhance bone healing and bone strength, as well as reduce undesirable effects of catabolic processes. A study conducted by Nishimura., *et al.* [9] demonstrated that eight minutes of resonance vibrational activity applied weekly for three weeks increased the rate of tooth movement by 15%. Another retrospective study conducted by Bowman., *et al.* [10] stated that dental alignment using vibration device was faster than the control group.

Low Intensity Pulsed Ultrasound [LIPUS]

Low intensity pulsed ultrasound [LIPUS] has been used widely in medical field for healing of fractures as well as bone regeneration. Xue., *et al.* [11] demonstrated that LIPUS promotes alveolar bone remodeling by stimulating the HGF/Runx2/BMP-2 signaling pathway and RANKL expression. He noted that LIPUS was able to accelerate orthodontic tooth movement by 45% after 14 days of treatment.

Non- Surgical Procedures

Peizosurgery

Piezosurgery has been used widely in treating tumor resection, fracture healing promotion, bone non-union treatment, maturity and remodeling acceleration after distraction osteogenesis, Hence it is gradually introduced into orthodontic alveolar bone remodeling to promote the movement effect of tooth. A animal study conducted by Han., *et al.* [12] stated that piezosurgery may significantly accelerate the movement of orthodontic alveolar bone tooth of rats and be associated with an increasing BMP-2 expression. Another case report by Pakhare., *et al.* [13] stated that Piezosurgery assisted corticotomy may prove to be a noble and effective treatment approach to decrease the orthodontic treatment time. Another recent systematic review by Jianru Yi., *et al.* [14] stated piezocision is a safe adjunct to accelerate orthodontic tooth movement, at least in the short term.

Fiberotomy

Young., *et al*. [15] conducted a study to investigate whether fiberotomy itself can accelerate tooth movement. In his study 34 Wistar rats, alveolar bone resorption and molar tooth movement were measured after fiberotomy, apical full-thickness flap without detachment of gingiva from the roots, or no surgery. Orthodontic treatment was initiated at time of surgery and activated for 14 days, generating movement of the first maxillary molar buccal and then removed. He concluded by stating that fiberotomy solely accelerated orthodontic tooth movement and diminished relapse.

Microosteoperforations [MOP]

Microosteoperforations are one of the most safe and less invasive procedure to accelerate the tooth movement. Propel orthodontics introduced a device Profel which punctures into the bone by the process of alveocentesis. This device comes as ready-to-use sterile disposable device. The device has an adjustable depth dial and indicating arrow on the driver body. The adjustable depth dial can be positioned to 0 mm, 3 mm, 5 mm, and 7 mm of tip depth, depending on the area of operation. A single blinded study by

Akhilani., *et al.* [16] concluded that Micro-osteoperforation is an effective, comfortable, and safe procedure to accelerate tooth movement and significantly reduce the duration of orthodontic treatment. Another split mouth study by Escobar., *et al.* [17] on determining whether Microosteoperforations can accelerate tooth movement by distalizing the canine stated that MOP reduced the treatment time compared to the conventional method. Microsteoperforations with miniscrews have shown to further reduce the treatment time. A study conducted by Cheung., *et al.* [18] concluded that Mini-implant-facilitated MOPs accelerated tooth movement without increased risk for root resorption and therefore may become a readily available and efficient treatment option to shorten orthodontic treatment time with improved patient acceptance.

Conclusion

The most common concern among the adults seeking orthodontic treatment is the time needed to complete the treatment. While there are numerous surgical approaches which can shorten the treatment time, it is highly invasive. With newer non-invasive procedures patients as well as the orthodontists are benefitted by shortening the treatment time with reduced pain, relapse and lesser root resorption.

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