

Effects of Microosteoperforations on Rate of Orthodontic Tooth Movement

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Abstract

Review Article

Orthodontic treatment usually requires a long period of time, and patients experience pain and discomfort during treatment. Accelerating orthodontic tooth movement (OTM) and reducing the length of orthodontic treatment may help to reduce not only discomfort but also possible dental and periodontal complications in patients. MOPs are the least invasive surgical procedure. The aim of this review article is to conduct a review of current literature to evaluate the effects of micro osteoperforations on the rate of orthodontic tooth movement and pain.

Keywords: Micro osteoperforations, orthodontic tooth movement.

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INTRODUCTION

One of the most common problem patients not seeking orthodontic tooth movement is the prolonged duration of the treatment time. Because of this problem, many patients seek alternative option such as implants or veneers with less than optimal results. The other problems include higher predisposition to dental caries, gingival recession and root resorption.

Orthodontic tooth movement is the result of increased stress in periodontal ligament (PDL) by orthodontic forces that initiates the targeted resorption and apposition of the bone surrounding the tooth. The PDL stress leads to the release of cytokines and inflammatory mediators to boost the activities of osteoblasts and osteoclasts for bone resorption [1]. It is generally accepted that the rate of tooth movement is controlled by the rate of bone resorption, which in turn is controlled by osteoclast activity [2]. Therefore, one can assume that the factors recruiting osteoclast precursors from the circulation and stimulating the differentiation of these cells into osteoclasts should play significant roles in tooth movement [3]. Accelerating orthodontic tooth movement (OTM) and reducing the length of orthodontic treatment may help to reduce not only discomfort but also possible dental and periodontal complications in patients [4].

Types of accereleted tooth movement

A number of innovations have been described over recent years that aim to reduce orthodontic treatment time with fixed appliances [5]. These have been broadly categorized into non-surgical and surgical methods.

Non- surgical methods include the use of limited orthodontic treatment, self-ligating brackets, customized appliances, medications, micro vibrations, low intensity laser, electromagnetic fields and direct electrical currents. Surgical methods include micro-osteoperforation (MOP), piezocision, cortectomies, and osteotomies/PDL distraction [6].

Out of the surgical methods outlined, corticotomies, piezocision and micro osteoperforations can be utilized in a regular clinical setup without the need for general anesthesia. These may prove to be a clinical tool, which is readily available to the clinician to accelerate the tooth movement and decrease the overall treatment time, without the need for additional inventory. Following is a biological rationale and a brief narrative about three procedures [7].

Micro-osteoperforations

MOP is a concept and technique developed by CTOR less than a decade ago. Its effectiveness and

efficiency in accelerating tooth movement were first proven by animal and human studies conducted by scientists and clinicians at CTOR. The technique/device was then patented by CTOR, and licensed to Propel Orthodontics (Ossining, NY, USA) to commercialize the device [8]. MOP is a new method to accelerate orthodontic tooth movement through small perforations in the alveolar bone without introducing great surgical trauma. The application of MOP in animal models has shown that small and shallow perforations in the alveolar bone increased the rate of tooth movement without requiring raising flaps, bone graft, or suture [9]. MOPs are the least invasive surgical procedure, as there is no need of reflecting a full thickness flap as required in conventional corticotomy or incisions as required in piezocision. Micro-Osteoperforation (MOP) stimulates cytokine activity and has been scientifically proven in studies to accelerate alveolar bone remodelling. This micro invasive technique can be performed in minutes by an orthodontist in the office. There is little to no discomfort to the patients postoperatively and there is zero recovery time with no postoperative restrictions [3].

Micro osteoperforation application techniques

Micro-osteoperforation is a surgical less invasive technique, which can accelerate OTM creating predictable results. MOP can be completed chairside in a minute and does not require any advanced training [10]. There are studies in which different methods are used in order to create MOPs on alveolar bones.

Aboalnaga et al. performed MOPs under local anesthesia using a TAD (Unitek™ TAD, 1.8×8mm). The TAD was screwed slowly into the alveolar bone, perpendicular to the bone surface, till slight blanching of the surrounding soft tissue was obtained to ensure full-length penetration of the TAD then the TAD was unscrewed and removed [11].

Alikhani et al. performed MOPs using a device called Propel. Propel is an appliance which is designed to apply alveocentesis procedure. The foremost part of the device, which is like an orthodontic stainless steel

screw is patented, allowing perforation of alveolar bone traumatically over keratinized gingiva and moving mucosa. It is a device, which enables tissue remodelling and micro-osteoperforations between tooth roots over both stable and moving tissue of 1.5 mm diameter and 3, 5, and 7 mm depth without flap surgery in order to accelerate tooth movement. The device was also reported not to cause soft tissue damage while enabling remodelling process [3].

All of the methods are applied without a need for additional periodontal surgeries which is considered as a significant advantage but additional clinical studies are required in order to evaluate the efficiency of each technique and their advantages and disadvantages over each other in detail.

Advantages of micro osteoperforations over other surgical techniques

When micro osteoperforations are compared with several surgical techniques, which are provided to accelerate tooth movement, they are considered as more advantageous because they are less invasive with no need for removing flaps eliminating possible side effects of the surgery [12]. Additionally, all techniques which make use of micro-osteoperforations do not include an invasive surgical procedure represent that they are easily applicable in the clinics by the orthodontists and can be added to clinical routine. Patients did not report any pain or discomfort in the clinical studies with micro-osteoperforations which shows that it is easily accepted and tolerated by the patients who are under orthodontic treatment. These advantages also enable the micro-osteoperforations to be periodically repeated until the desired results are achieved [13].

Disadvantages of micro osteoperforation

The increase in cytokine activity due to micro osteoperforation decreases after a period of two months. Therefore the procedure has to be repeated in every one or two months. The micro osteoperforation device is expensive which increases the cost of the treatment [14].

Table-1: Various studies that evaluated the effect of micro osteoperforation on the rate of orthodontic tooth movement

Author	Study design	No of patients	Observation period	Type of tooth movement	Result
Aboalnaga et al. [9]	Spilt mouth RCT	18	16weeks	Maxillary canine retraction	Canine retraction not accelerated
Alkhani et al. [3]	Spilt mouth RCT	20	28 days	Maxillary canine retraction	Tooth movement increased
Sivarajan et al. [15].	Spilt mouth RCT	30	16 weeks	Maxillary and mandibular canine retraction	Tooth movement increased but clinically insignificant
Attri et al.[5]	Parallel group RCT	60	Over aperiod of space closure	Maxillary and mandibular en mass retraction	Tooth movement increased

Author	Study design	No of patients	Observation period	Type of tooth movement	Result
Feizbakhsh et al. [16]	Spilt mouth RCT	20	28 days	Maxillary and mandibular canine retraction	Tooth movement increased
Kundi, I. et al.[17]	Parallel group RCT	28	28 days	Maxillary canine retraction	Tooth movement increased
Haliloglu et al. [18]	Parallel group RCT	32	8 weeks	Maxillary and mandibular canine retraction	Tooth movement increased
Zamora EY et al. [19]	Spilt mouth RCT	10	12weeks	Maxillary canine distalization	Tooth movement increased
Abdelhameed et al. [20]	Spilt mouth RCT	10	12 weeks	Maxillary canine retraction	Tooth movement increased

CONCLUSION

Micro-osteoperforations increases the rate of tooth movement and reduces the duration of treatment time in physiologic manner. Micro-osteoperforations are outstanding as a minimal invasive, easy-to-use, repeatable, and efficient new method that can eliminate some disadvantages of surgery among the defined invasive techniques. Many animal studies and clinical trials have been done showing that MOPs favorably increase the osteoclast numbers by inducing an aseptic inflammatory reaction, thus increasing tooth movement rates with no or little discomfort. A few studies concluded that there are no significant increases in the rate of tooth movement by micro-osteoperforations. Thus we can conclude that micro –osteoperforation is an effective method to increases the rate of tooth movement.

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