Accelerated Orthodontics – A Review

Dr. J. Susan Roy1*, Dr. J. Jason Roy2

1Post-Graduate Student, Department of Orthodontics and Dentofacial Orthopaedics, Thai Moogambigai Dental College and Hospital, Dr. M.G.R Educational & Research Institute, Golden George Nagar, Mugappair, Chennai 600107, Tamil Nadu, India
2Associate Professor, Department of Dentistry, Dr. Somervell Memorial CSI Medical College & Hospital, Karakonam, 695504, Kerala India

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*Corresponding author: Dr. J. Susan Roy
Post-Graduate Student, Department of Orthodontics and Dentofacial Orthopaedics, Thai Moogambigai Dental College and Hospital, Dr. M.G.R Educational & Research Institute, Golden George Nagar, Mugappair, Chennai 600107, Tamil Nadu, India

Abstract

Orthodontic treatment duration is one of the most challenging factors faced by all orthodontists till date but thanks to the surge in science and technology there are many ways to step up the treatment thereby reducing the overall treatment time. This review article will provide an insight on the various methods of accelerating the orthodontic treatment time duration.

Keywords: Accelerated Orthodontics, Corticotomy, Microosteoperforations, Lasers, Piezosurgery, Vibration.

INTRODUCTION

Acceleration of tooth movement during orthodontic treatment is nowadays becoming more popular due to patient’s interest to finish the treatment in a lesser span of time and also to minimize the number of visits. Prolonged treatment duration is also associated with periodontal complications, caries and root resorption [1]. By enhancing the body’s response to these forces, tooth movement can be accelerated and there are many methods such as drugs/biologic approach, surgical methods, mechanical/ physical stimulation methods. These modalities have also been shown to reduce relapse, and pain and root resorption caused due to orthodontic forces [2].

DRUGS/ BIOLOGIC APPROACH

Various drugs such as vitamin D, prostaglandin, interleukins, parathyroid hormone, misoprostol etc. have been used since long to accelerate orthodontic tooth movement [3-5]. But most of these drugs have some or the other unwanted adverse effect. For example, vitamin D when injected in the periodontal ligament increases the levels of LDH and CPK enzymes; prostaglandin causes a generalized increase in the inflammatory state and causes root resorption [2]. Hence drugs are the least preferred method for accelerating orthodontic tooth movement. However Yamasaki et al. studied the effect of prostaglandins by a clinical trial on humans and found that local administration of it may cause safe and effective orthodontic tooth movement [6].

SURGICAL METHODS

The following are the most common surgical procedures done.

Corticotomy

Corticotomy is the procedure in which cut and perforation given on the cortical bone and this will accelerate the tooth movement as it reduces the resistance caused by cortical bone [7].

Procedure

Elevation of full thickness mucoperiosteal flaps of both buccal and/or lingual region and then the corticotomy cuts which is done using piezosurgical armamentarium or micromotor under irrigation and it is followed by placement of a graft material, in required sites to enhance the thickness of the bone [8].

Wilcko et al. reported that a surface-computed tomographic evaluation of corticotomized patients clearly showed a transient localized demineralization & remineralization process consistent with the accelerated wound-healing pattern of the regional acceleratory phenomenon [2]. A systematic review by Hoogeven et al. concluded that the evidence available till now is of low to moderate quality and is not sufficient to suggest corticotomy as a safe procedure [9].

Corticision

Kim et al. established a technique with minimal surgical intervention called corticision which is also called as minimally invasive rapid orthodontics (MIRO). Corticision was initiated as a supplemental dento-alveolar surgery in orthodontic therapy to achieve accelerated orthodontic tooth movement with minimal surgical intervention [10].

Procedure

Separation of the inter-proximal cortices with a reinforced scalpel is used as a thin chisel and a mallet transmucosally without reflecting a flap. With 45°-60° an inclination to the gingiva at the long axis of the canine a reinforced surgical blade with a minimum thickness of 400 μm should be located on the inter-radicular attachment. The surgical injury should be 2 mm from the papillary gingival margin in order to preserve the alveolar crest and should be 1 mm beyond the mucogingival junction. The blade should be pulled out in a swing motion. Studies concluded corticision effectively fastens tooth movement similar to corticotomy and is advantageous because it’s less invasive [11, 12].

Piezocision

Piezocision is a procedure which is a combination of piezosurgical cortical microincisions with selective tunnelling that helps in soft tissue or bone grafting. Dibart et al. introduced piezocision which was minimally invasive. The micro incisions were limited to the buccal gingiva for the use of piezoelectric knife to give osseous cuts on buccal cortex to initiate RAP. This technique allows rapid tooth movement by maintaining benefits of soft tissue or grafting associated with a tunnel approach and there is no suturing required [13, 14]. It was found that combing piezocision with Invisalign was found to be esthetic and more effective [15].

Microosteoperforations (MOPs)

A device used for this method is called PropEdTM, which was launched by Propel Orthodontics. It reduces the invasive nature of surgical irritation of bone. This procedure was initially popularized as alveocentesis, which literally means puncturing of bone. The device has an adjustable depth dial at 0mm, 3mm, 5mm, and 7mm of tip depth and an indicating arrow on the driver body. This device comes as ready-to-use sterile disposable device [16].

Procedure

A soft tissue flap was raised in the premolar and molar region and small perforations of about 0.25 mm are made using a round bur and hand piece through the cortical bone 1-3 micro-osteoperforations are to be done depending on proximity of anatomical structures. Perforations can be made on buccal or lingual side of both maxillary and mandibular arch in linear or triangular patterns. Two randomized control trials studies were reported on microosteoperforations among these one was animal study and other was a human trial [17].

Inter-septal alveolar surgery

This is also called as distraction osteogenesis as it involves displacement of fractures that are created surgically in a controlled and gradual manner and is termed as sub-periosteal osteotomy by incremental traction as it leads to expansion of soft tissue and bone volume because of mechanical stretching of the site. It is divided into the distraction of dentoalveolar bone or distraction of periodontal ligament [18]. Studies have shown that the pathway of canine movement is more due to the reduced resistance [15].

Procedure

The interseptal bone distal to canine is undermined by 1 to 1.5mm surgically during extraction of first premolar resulting in reduced resistance on pressure site. A stainless steel custom made toothborne device is used for distraction. The surgery causes acceleration of the tooth movement especially in first week and also becomes easier because the compact bone is replaced by woven bone [19].

Mechanical/ physical stimulation methods

These are also called as device aided methods. They are less invasive and are more patient friendly than other methods.

Low level laser therapy

Also known as photo-biomodulation therapy, it is known to fasten wound and fracture healing. Laser light stimulates the proliferation of osteoclast, osteoblast and fibroblasts and thereby affects bone remodelling and accelerates tooth movement. The mechanism involved in the acceleration of tooth movement is by the production of ATP and activation of cytochrome C which increases the velocity of tooth movement [20].

Kawasaki et al. found that administration of low level laser increased the orthodontic tooth movement by 1.3 times [21]. However contraindactory results were found by Seifi et al. who stated that it had reduced the rate of tooth movement in rabbits [22].

Direct electric current

Histological studies have shown that electric current leads to an increase in the number of osteoblasts owing to increased cellular activity in periodontal ligament due to increased phosphorylation [23]. Kim et al. suggested that the exogenous electric current from the electric device might accelerate OTM by one third [24]. Electric currents can cause certain complications like ionic reactions which could lead to damage of tissues and displacement of the bone connective tissue [15].
Pulsed electromagnetic fields

Electromagnetic field increases the level of a group of enzymes responsible for the regulation of intracellular metabolism, therefore, cellular proliferation by altering the rate of sodium-calcium exchange in the cell membrane. Histological studies have shown that alveolar bone remodeling increases not only the bone cell activity in the magnetic field, but also the formation of new bone in the stress zone [25].

Stark et al. found that pulsed electromagnetic fields in guinea pigs doubled the rate of tooth movement [26]. Darendeler et al. found that pulsed electromagnetic vibrations produced either by Samarium cobalt or Neodymium-Iron-Boron magnets along with coil springs induce greater rate of tooth movement [27].

Cyclic vibrations

The cyclic vibratory method is used by placing light alternating forces on the teeth via mechanical radiations. The initial response of cells appears within 30 minutes to the mechanical stress in vitro [16]. Oral vibrating devices such as Acceledent®T, AcceleDent® and electric tooth brushes and found to be effective in increasing the rate of tooth movement [28].

Suamphan et al. observed acceleration in tooth movement using vibratory stimulus via electric tooth brush and there was increase in the levels of IL-1 beta also [29]. Contraindicator results were found by Dobie et al. who found no change in the rate of tooth movement in rats when used along with a Niti coil spring even after application of vibration of different intensities [30].

CONCLUSION

Most of the techniques mentioned have been proven to accelerate the treatment duration time with less discomforts to the patient. Incorporating these methods would be beneficial and the newer methods are also less invasive than the previous ones.

REFERENCE


