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Review Article | **Orthodontics and Dentofacial Orthopaedics**

Accelerated Orthodontics – A Review

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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 as PropelTM, 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 trial 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 the 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 toothborn 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 contraindicatory 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 sodiumcalcium 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]. Darendeiler *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 AccledentTM, 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]. Contraindicatory 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

1. Parhi, S., Pal, S., Das, S. K., & Ghosh, P. (2021). Strategies toward development of antimicrobial biomaterials for dental healthcare applications. *Biotechnology and Bioengineering*, *118*(12), 4590-4622.
2. Shenava, S., Nayak, K. U. S., Bhaskar, V., & Nayak, A. (2014). Accelerated orthodontics-a review. *International Journal of Scientific Study*, *1*(5), 35-39.
3. Sekhavat, A. R., Mousavizadeh, K., Pakshir, H. R., & Aslani, F. S. (2002). Effect of misoprostol, a prostaglandin E1 analog, on orthodontic tooth movement in rats. *American journal of orthodontics and dentofacial orthopedics*, *122*(5), 542-547.
4. Collins, M. K., & Sinclair, P. M. (1988). The local use of vitamin D to increase the rate of orthodontic tooth movement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *94*(4), 278-284.
5. Bartzela, T., Türp, J. C., Motschall, E., & Maltha, J. C. (2009). Medication effects on the rate of orthodontic tooth movement: a systematic literature review. *American Journal of Orthodontics and Dentofacial Orthopedics*, *135*(1), 16-26.
6. Yamasaki, K., Shibata, Y., Imai, S., Tani, Y., Shibasaki, Y., & Fukuhara, T. (1984). Clinical application of prostaglandin E1 (PGE1) upon orthodontic tooth movement. *American Journal of Orthodontics*, *85*(6), 508-518.
7. Köle, H. (1959). Surgical operations on the alveolar ridge to correct occlusal abnormalities. *Oral Surgery, Oral Medicine, Oral Pathology*, *12*(5), 515-529.
8. Adusumilli, S., Yalamanchi, L., & Yalamanchili, P. S. (2014). Periodontally accelerated osteogenic orthodontics: An interdisciplinary approach for faster orthodontic therapy. *Journal of pharmacy & bioallied sciences*, *6*(Suppl 1), S2.
9. Hoogeveen, E. J., Jansma, J., & Ren, Y. (2014). Surgically facilitated orthodontic treatment: a systematic review. *American Journal of Orthodontics and Dentofacial Orthopedics*, *145*(4), S51-S64.
10. Kim, S. J., Park, Y. G., & Kang, S. G. (2009). Effects of corticision on paradental remodeling in orthodontic tooth movement. *The Angle Orthodontist*, *79*(2), 284-291.
11. Kim, S. J., Park, Y. G., & Kang, S. G. (2009). Effects of corticision on paradental remodeling in orthodontic tooth movement. *The Angle Orthodontist*, *79*(2), 284-291.
12. Murphy, C., Kalajzic, Z., Chandhoke, T., Utreja, A., Nanda, R., & Uribe, F. (2016). The effect of corticision on root resorption with heavy and light forces. *The Angle Orthodontist*, *86*(1), 17-23.
13. Jean-David, M. S., Surmenian, J., & Dibart, S. (2011). Accelerated orthodontic treatments with Piezocision: a mini–invasive alternative to alveolar corticotomies. *Orthodontie Française,*, *82*, 311-319.
14. Keser, E.I., Dibart, S. (2011). Piezocision-assisted Invisalign treatment. Compend contin *Educ Dent*, *32*; 46-8; 50-1.
15. Talla, R., Kamble, R., Dargahwala, H., & Banerjee, S. (2020). Acclerated orthodontics–a review. *European Journal of Molecular & Clinical Medicine*, *7*(7), 2182-2189.
16. Rohit, K., Snehal, B., Pavankumar, V., Chetan, P., & Vinay, U. Balagangadhar (2019) Accelerated Orthodontics: A Review. *J Trends in Oral Health and Care*, *1*(1).
17. Alikhani, M., Raptis, M., Zoldan, B., Sangsuwon, C., Lee, Y. B., Alyami, B., ... & Teixeira, C. (2013). Effect of micro-osteoperforations on the

rate of tooth movement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *144*(5), 639-648.
18. Mathews, D. P., & Kokich, V. G. (2013). Accelerating tooth movement: the case against corticotomy-induced orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics*, *144*(1), 5.
19. Ren, A., Lv, T., Kang, N., Zhao, B., Chen, Y., & Bai, D. (2007). Rapid orthodontic tooth movement aided by alveolar surgery in beagles. *American Journal of Orthodontics and Dentofacial Orthopedics*, *131*(2), 160-e1.
20. Fujita, S., Yamaguchi, M., Utsunomiya, T., Yamamoto, H., & Kasai, K. (2008). Low-energy laser stimulates tooth movement velocity via expression of RANK and RANKL. *Orthodontics & craniofacial research*, *11*(3), 143-155.
21. Kawasaki, K., & Shimizu, N. (2000). Effects of low-energy laser irradiation on bone remodeling during experimental tooth movement in rats. *Lasers in Surgery and Medicine: The Official Journal of the American Society for Laser Medicine and Surgery*, *26*(3), 282-291.
22. Seifi, M., Shafeei, H. A., Daneshdoost, S., & Mir, M. (2007). Effects of two types of low-level laser wave lengths (850 and 630 nm) on the orthodontic tooth movements in rabbits. *Lasers in medical science*, *22*(4), 261-264.
23. Davidovitch, Z., Finkelson, M. D., Steigman, S., Shanfeld, J. L., Montgomery, P. C., & Korostoff, E. (1980). Electric currents, bone remodeling, and orthodontic tooth movement: II. Increase in rate of tooth movement and periodontal cyclic nucleotide levels by combined force and electric current. *American journal of orthodontics*, *77*(1), 33-47.
24. Kim, D. H., Park, Y. G., & Kang, S. G. (2008). The effects of electrical current from a micro-electrical device on tooth movement. *Korean Journal of Orthodontics*, *38*(5), 337-346.
25. Darendeliler, M. A., Darendeliler, A., & Sinclair, P. M. (1997). Effects of static magnetic and pulsed electromagnetic fields on bone healing. *The International journal of adult orthodontics and orthognathic surgery*, *12*(1), 43-53.
26. Stark, T. M., & Sinclair, P. M. (1987). Effect of pulsed electromagnetic fields on orthodontic tooth movement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *91*(2), 91-104.
27. Darendeliler, M. A., Zea, A., Shen, G., & Zoellner, H. (2007). Effects of pulsed electromagnetic field vibration on tooth movement induced by magnetic and mechanical forces: a preliminary study. *Australian dental journal*, *52*(4), 282-287.
28. Nishimura, M., Chiba, M., Ohashi, T., Sato, M., Shimizu, Y., Igarashi, K., & Mitani, H. (2008). Periodontal tissue activation by vibration: intermittent stimulation by resonance vibration accelerates experimental tooth movement in rats. *American Journal of Orthodontics and Dentofacial Orthopedics*, *133*(4), 572-583.
29. Leethanakul, C., Suamphan, S., Jitpukdeebodintra, S., Thongudomporn, U., & Charoemratrote, C. (2016). Vibratory stimulation increases interleukin-1 beta secretion during orthodontic tooth movement. *The Angle Orthodontist*, *86*(1), 74-80.
30. Yadav, S., Dobie, T., Assefnia, A., Gupta, H., Kalajzic, Z., & Nanda, R. (2015). Effect of low-frequency mechanical vibration on orthodontic tooth movement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *148*(3), 440-449.