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Non-Surgical and Surgical Methods to Fasten Orthodontic Tooth Movement

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Abstract:- A variety of surgical and non-surgical methods to shorten the course of orthodontic therapy are advocated which is successful in enhancing the rate of orthodontic tooth movement. Over the last decade, orthodontics have been interested in techniques to accelerate tooth mobility. Since orthodontic treatment time has been related to consequences such as white spot lesions(WSL), root resorption(RR), fenestration and dehiscence, bone loss due to periodontitis progression, gingival recession, TMJ dysfunction and discomfort, iatrogenic alterations in pulp. Hence, lowering orthodontic treatment time may give various benefits to the patient.

Keywords:- *Microosteoperforations, Corticision, Piezocision, Low level laser therapy.*

I. INTRODUCTION

According to Andrews (1972), Deviation from a normal bite can be defined as malocclusion. One-third of young people may benefit from orthodontic (braces) treatment due to an abnormal bite or malocclusion.[1] Fixed appliances are used for most of comprehensive orthodontic cases, and treatment times of 18 to 24 months are typical. In other situations, such as management of ectopic canines, adult patients, and combination orthodontic-surgical cases the course of treatment tends to be longer. Reduced treatment durations would have advantages for patients and clinicians like less expensive and reduced possibility of iatrogenic side effects from lengthy orthodontic treatment such as decalcification and root resorption.[1]

In recent years, a variety of surgical and non-surgical methods to shorten the course of orthodontic treatment have been advocated. Surgically assisted orthodontics may use any of the following techniques - Distraction of the Periodontal ligament (PDL), Distraction of the dento-alveolus, Alveolar decortication, Corticision, Microosteoperforations (MOP), Regional acceleratory phenomenon(RAP), Piezocision. Non-surgical interventions to accelerate orthodontic tooth movement include Low energy laser radiation, Intermittent resonance vibration, Pulsed electromagnetic waves, Chewing gum or muscle exercises, Injection of 1,25-(OH)2D3 and prostaglandin E2 and pharmacological methods. However, numerous side effects have been reported, including drug-induced side effects, severe root resorption, and localised pain.

Table 1 Surgical Vs Non-Surgical

SURGICAL	NON-SURGICAL
Corticision	Pulsed Electromagnetic field
Distraction of periodontal ligament	Electric current
Dentoalveolar Distraction Osteogenesis	Vibratory stimulation
Microosteoperforation (MOP)	Photobiomodulation / Low-level laser therapy
Piezocision	Chewing gum or muscle exercises

II. CORTICISION

Corticision is cortical bone incision which is a minimal invasive surgery which does not need elevation of flap and it accelerates movement of teeth and increases rate of turnover of surrounding tissues. Selective alveolar decortication is a medically assisted orthodontic surgery that is aimed to change bone physiology and accelerate tooth movement. The word corticotomy refers to periodontal procedures in which chisel or osteotome is used to give incision deep into the medullary bone, whether or not luxation is present. The goal of selective alveolar decortication is to alter the physiology by inducing regional acceleratory phenomenon (RAP), it is an osteopenic state in which bone metabolism is increased which is maintained by the trauma of tooth movement and augmented by the introduction of purposeful surgical injury. This procedure involves No.15T paragon reinforced scalpel with scalpel holder and surgical mallet.[2] Pre operative intraoral periapical radiographs and panoramic radiograph is mandatory to check interradicular bone.

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On gingiva keep the blade at 90^0, then move towards apex by turning obliquely at $45–60^0$, as it helps to cut deep into medullary bone with minimal gingival injury. The depth of cut should be 10 mm obtaining cortical as well as cancellous bone. The papillary gingiva should be kept intact by doing corticision 5 mm apical to papillary gingiva. The patient is asked to follow up every other week in order to maintain the gap of corticision by woven bone open. If this is not done, the woven bone will mature into lamellar bone after three weeks, which will reduce the movement of the teeth in orthodontics. The effect of orthodontic tooth movement peaks after two months and decreases after three months.

- *Distraction of Periodontal Ligament*

The process of initiating new bone production by applying mechanical forces to pre existing bone is known as osteogenesis. Osteogenesis of the midpalatal suture during rapid palatal expansion is similar to osteogenesis of the periodontal ligament during orthodontic tooth movement. A new concept called "distracting of periodontal ligament" is provided for canine retraction rapidly in two weeks.[3] During the premolar extraction process, the interseptal bone distal to the canine is undermined using a bone bur. This creates vertical grooves along the buccal and lingual sides of the extraction socket, which continue obliquely towards the base of the socket. The canine is then distracted using a tooth-borne, specially designed intraoral distraction device, into the extraction space. Distraction of 0.5 mm/day causes 6.5 mm to be distracted into the extraction space in a span of two weeks.[3]

- *Dentoalveolar Distraction Osteogenesis*

Following orthodontic treatment that included upper both side first premolar extractions and bilateral canine tooth retraction, the canine tooth undergoes osteotomy. The first premolar to be extracted, along with the buccal bone. Following wound closure, a specific orthopaedic device is fitted and attached to the canine and first molar teeth. Distraction begins the same day at 0.4 mm twice a day and sustained until enough mobility of the canine teeth is obtained. The device is to be then removed, and fixed appliances should be used to continue orthodontic therapy.[4]

- *Microosteoperforation (Mop)*

Often referred to as Alveocentesis, MOP is a minimally invasive procedure that an orthodontist can carry out on their own using mini-screws and other standard orthodontic tools. When compared to other minimally invasive surgical techniques, MOP has some limitations. Other corticotomy treatments allow clinicians to use biomaterials to enhance the alveolar bone. As a result, these approaches can be utilised to improve periodontal quality and extend the biological envelope of orthodontic movement, whereas MOP cannot modify the biological restrictions for tooth movement and only increases the rate of tooth movement.[5,6] Tooth movement in MOP is a "periodontal phenomenon," with orthodontic forces inducing an aseptic inflammation that leads to increased leucocyte infiltration. This results in a continuous loop with a positive feedback mechanism courtesy of chemokines and cytokines generated by nearby native and newly formed osteoblasts and fibroblasts.[7] Perforations are placed using a variety of instruments, including mini-implant assisted perforations and round burs. PROPEL Orthodontics (Ossining, NY) created this disposable device to deliver perforations. It features a manually adjustable tool with variable lengths of 3, 5, and 7 mm for the desired depth of perforation.[8] A temporary anchorage device (TAD) was placed right away after being positioned 5 mm from the alveolar crest, between the second premolar and the first molar. In the extraction area, three little MOPs were carried out at equal intervals from the canine and the second premolar. Every perforation measured 1.5 mm in width and 2 to 3 mm in depth.[9]

- *Piezocision*

One novel, less invasive surgical technique that helps to move orthodontic teeth quickly is piezocision-assisted orthodontic treatment. In order to employ the piezoelectric knife to fracture bone and induce temporary demineralization and quicker tooth movement, microsurgical interproximal holes are made in the buccal gingivae. The cuts were made in maxilla and mandible simultaneously when this technique was first introduced. The method has evolved in recent years to a more phased approach, whereby different areas or segments of the arch are demineralized at different times during orthodontic treatment to help achieve particular objectives. Ultrasonic microvibrations are used in piezoelectric surgery to ensure that only brittle mineralized tissue is cut and that soft tissues are not, since cutting soft tissue requires a frequency above 50 kHz. Due to its selective and micrometric cutting, a piezoelectric device allows for safe, accurate osteotomies without causing in osteonecrotic injuries.[10,11] Excessive force is also avoided with piezoelectric surgery. These days, suturing is advised to reduce scarring. The patient is not too uncomfortable. The method also has the benefit of a limited surgical time and the potential for grafting. Because flap elevation is not required, the surgical time is shortened and the amount of discomfort experienced after the procedure is negligible. This technique's disadvantage is that the cuts are made blindly because there is no flap reflection.

- *Pulsed Electromagnetic Field And Orthodontic Tooth Movement*

The generalised enhancement of osseous activity is thought to be a function of applying a pulsed electromagnetic field (PEMF), while piezoelectric currents generated within the alveolar bone by the pressure and tension of the orthodontic force are thought to provide the signal for the directionality that is resorption or deposition of the remodelling process. Pulsed electromagnetic field (PEMF) works at the cell membrane by interacting with calcium ions and cyclic nucleotides to increase the receptivity and reactivity of the afflicted cells. The PEMF may potentially act as a signal to recruit undifferentiated stem cells into the osteoclastic and osteoblastic processes. Application of a 25Hz PEMF significantly increased both the amount and rate of orthodontic tooth movement.[12,13]

- *Electric Currents, Bone Remodeling, And Orthodontic Tooth Movement*

Due to their capacity to elicit local cellular responses in the alveolar bone and periodontal ligament (PDL), as well as the direction guidance they offer when moving teeth, mechanical forces are employed to shift teeth into new places within the jaws. Evidence exists to support the theory that under stress, electric currents are produced within the tissues, and that these currents could charge macromolecules that interact with particular locations in cell membranes or move ions across membranes. According to the study, the cellular reaction to the force-electric treatment was more noticeable than the reaction to force applied alone. According to the results, orthodontic teeth can move more quickly when force is used in addition to other biological techniques that cause a local reaction. In particular, research has shown that electric currents between 10 and 20 microamperes can be effectively utilised for this.[14,15]

- *Vibratory Stimulation And Orthodontic Tooth Movement*

Vibration stimulates the activation of the receptor activator of NF kappa-B and ligand (RANK/RANKL) signalling pathway, which helps to produce osteoclasts. Human orthodontic tooth movement can be accelerated without causing additional tissue damage by combining orthodontic force with a brief duration of low-magnitude, high-frequency resonance vibration.[16] One of these studies found that a commercial vibratory device might accelerate tooth movement by two to three millimetres per month without significantly altering the length of the roots.[17]

- *Photobiomodulation Therapy/ Low-Level Laser Therapy*

Using a low-intensity laser, photobiomodulation treatment (PBMT) accelerates up the synthesis of protein by promoting the synthesis of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA). Moreover, it increases the mitotic activity of cells. Photochemical effects can be produced via photobiomodulation treatment (PBMT), which is the direct application of energy from noncoherent (light-emitting diode) or coherent (lasers) light with wavelengths spanning from 405 to 1100 nm.[18,19] Orthodontic tooth movement can be effectively accelerated with a once-monthly low-level laser therapy regimen at 980 nm, 2 W power output, and 15 J/cm2 energy density in continuous mode.[20]

III. CONCLUSION

A number of adverse effects have been associated with orthodontic treatment, including White spot lesions, root resorption, bone loss due to periodontitis progression, fenestration and dehiscence, gingival recession, iatrogenic alterations in pulp, TMJ dysfunction, and discomfort. The majority of these issues are associated with the increased period of treatment. As a result, it stands to reason that reducing the period of therapy can reduce the severity and prevalence of these problems. Some writers, on the other hand, have claimed that surgical operations may introduce new undesirable effects such as bleeding and pain, as well as exacerbate iatrogenic effects of normal orthodontic treatments such as root resorption.

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