Journal of Research in Medical and Dental Science
2022, Volume 10, Issue 11, Page No: 182-185

Available Online at: www.jrmds.in
eISSN No.2347-2367: pISSN No.2347-2545

Review Article on Accelerated Orthodontics

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ABSTRACT

Reconstruction of skeletal and/or dental tissues is the goal of orthodontic treatment. One of the biggest concerns of people dealing with cancer is the length of treatment. The permanently fixed braces therapy is very extensive. There are various disadvantages too in such situations to patients such as higher proclivity for root infection, resorption, dental cavities, and gingival recession, to name a few examples.

As a result, researchers devised a few strategies for increasing the speed of tooth movement while avoiding any downsides. Accelerated orthodontics was a term used to describe these types of orthodontic procedures. The goal of this paper is to define and assess techniques of accelerated orthodontics.

Key words: Accelerated orthodontics, Orthodontic treatment, Procedures

HOW TO CITE THIS ARTICLE: Vedanti Mundhada, Vikrant Jadhao, Review Article on Accelerated Orthodontics, J Res Med Dent Sci, 2022, 10 (11):182-185.

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E-mail: vedantimundhada17@gmail.com
Received: 05-Sep-2022, Manuscript No. JRMDS-22-49605;
Editor assigned: 07-Sep-2022, PreQC No. JRMDS-22-49605 (PQ);
Reviewed: 19-Sep-2022, QC No. JRMDS-22-49605;
Revised: 07-Nov-2022, Manuscript No. JRMDS-22-49605 (R);
Published: 15-Nov-2022

INTRODUCTION

Orthodontic treatment falls under the criteria of critical importance and advanced dental procedures as it ensures attainment of aligned teeth naturally by treating the malocclusion and restoring one aesthetic, which in today's world has become a matter of prime concern. Orthodontic treatment other than improving the looks comes with the advantage of preventing the problems of malocclusion that are likely to occur in future like caries, speech deformity, periodontal problems, altered masticatory forces, temporomandibular joint problems, early edentulism, root resorption [1]. But, these treatments demand a sincere patient commitment and patience as they last for a prolonged time.

In today's world where speed is the need of the situation, advancement and modification in the routine orthodontic treatment procedure are much required. Considering this fact, a modification has come up referred to as accelerated orthodontics to match with the speed of the fast moving world. Accelerated orthodontics refers to speedy techniques that help in rapid movement of the teeth followed by faster recovery of the lost bone involving the use of various drugs, surgeries or devices that offer mechanical stimuli. The conventional orthodontic treatment can take as long as 3 years whereas newly introduced techniques help to finish this very same treatment in 6 to 12 months of span.

LITERATURE REVIEW

This recent method of orthodontic treatment ensures the formation of new bone in the jaw. When accompanied by teeth aligning systems like aligners or braces, accelerated bone growth can assist in shifting the teeth to their respective positions more rapidly and with much less inconvenience.

Various methods involved in accelerated orthodontics can be subdivided into three categories:

- Biologic methods
- Mechanical stimulation or device assisted methods
- Surgical methods

Biologic methods

To accelerate treatment duration various studies were done on various molecules such as vitamin D_3, prostaglandin E, parathyroid hormone, cytokines, MCSF, RANKL, etc. [2-4].

Vitamin D_3: Calcium reabsorption is a function of vitamin D that is comparable to that of parathyroid hormone. The biologically active form of vitamin D (1, 25 dihydroxycholecalciferol), causes calcium reabsorption through the small intestine. It has a comparable effect on bone, resulting in bone resorption. Vitamin D treatment to the PDL promotes a rise in the LDH and CPK enzymes [5-9]. The number of osteoclasts was found to be larger on the pressure side, which was reinforced by vitamin D, than on the PGE2 side, showing that vitamin D plays an important role in bone remodelling [10].

Prostaglandins: Inflammatory mediators such as Prostaglandins (PGs) are a type of inflammatory mediator. PGs enhance osteoblastic cell growth and increase osteoclastic activity. The majority of studies on the impact of PGs on OTM acceleration and root resorption have been conducted on animals. According to these investigations, PGs boosted OTM speed by 1.6 times more than the control group.

Hormone parathyroid: Due to bone resorption induced by the parathyroid hormone, a rise in the level of blood calcium is seen. The constant rise of PTH causes bone resorption. Because locally given parathyroid hormone produces local bone resorption, it is much more beneficial than the systemic route of infiltration of parathyroid hormone. Local delivery of Parathyroid hormone in an injectable gel form for progressive release accelerates the amount of tooth movement by 1.6 times when compared to a daily injection of parathyroid hormone mixed in saline. This happens in a dose response fashion [11].

Cytokines: Cytokines help accelerate the movement of the tooth by changing the pattern of bone remodelling and inflammatory processes that occur during the movement of the tooth. They help in the proliferation, stimulation, and death of bone and PDL cells. Interleukin-1 (IL-1), Interleukin-2 (IL-2), Interleukin-3 (IL-3), Interleukin-6 (IL-6) and Tumour Necrosis Factor alpha (TNF) all play a role in the remodelling process, with Interleukin-1 boosting osteoclastic activity *via* its receptors. Together with interleukins and TNF alpha, RANKL on osteoblasts binds to RANK on osteoclasts and initiates osteoclast formation.

Osteoclastogenesis is inhibited as a result of Osteoprotegerin (OPG) binding to the binding site, which competes with RANKL. During bone remodelling, this process keeps RANKL, RANK, and OPG in balance.

Relaxin: During parturition, it causes expansion of pubic ligament seen precisely in women. It is also seen in PDL and cranial sutures. It induces soft tissue remodelling instead of bone remodelling. When the quantity of collagen on the tension zone is increased, the rate of tooth movement increases. Relaxin's remodelling of PDL may lower the rate of recurrence after orthodontic therapy [12].

Osteocalcin: Osteocalcin appears to increase the number of osteoclasts, according to histological data. The effect of osteocalcin on local administration accelerated OTM due to an increase in osteoclastogenesis on the pressure side [13].

Thyroxin: It has an effect on calcium absorption in the intestines. It accelerates tooth movement by accelerating bone resorption. It has an indirect effect on bone turn over and osteoporosis development.

Chemokines: These are cytokines that bind to heparin. They stimulate osteoclast and enhance the resorption of bone, causing tooth movement to accelerate it.

Mechanical stimulation

Lower Level Laser Therapy (LLLT: One of the brightest prospects now is photo bio modulation, often known as Low Level Laser Therapy (LLLT). Laser light stimulates the development of osteoclasts, osteoblasts and fibroblasts, which alters bone remodelling and enhances tooth mobility. Tooth movement is accelerated by ATP synthesis and cytochrome C_{30} activation, while RANK or RANKL and macrophage colony stimulating factor and its receptor expression improve tooth moving velocity [14].

Cyclic vibrations: Light alternating forces operate on the teeth *via* mechanical radiations, with the initial response to stress happening within 30 minutes. The vibration controller receives signals from the force sensor and accelerometer. These impulses are then sent to the vibrator, which causes it to vibrate, causing excitement. At around 1 meter per square second (m/s^2), the acceleration is maintained. The vibrator's top adheres to the tooth with glue. In experiments, the rate of tooth movement increased dramatically [15].

Electromagnetic field: By modifying the rate of sodium calcium exchange in the cell membrane, an electromagnetic field increases the amount of a group of enzymes involved in the regulation of intracellular metabolism and, as a result, cellular proliferation. Alveolar bone remodelling enhances not only bone cell activity in the magnetic field, but also the production of new bone in the stress zone, according to histological investigations [16].

Electric current: Electric current causes a rise in the population of osteoblasts in the periodontal ligament due to increased cellular activity, according to histological investigations [17-23]. Electric currents can produce difficulties such as ionic reactions, which cause tissue injury and bone connective tissue displacement. According to Kim, et al., the exogenous electric current from the electric gadget could speed up OTM by a third [24]. The evidence currently available is insufficient. This method does not appear to be relevant in people at this time due to the method's lack of reliability.

Surgical approaches

There are a couple of surgical techniques that help obtain faster results during orthodontic treatment. Tooth movement mainly depends upon the resorption and deposition of the bone and the periodontal ligament. Following grafting, fracture and osteotomy, bone regeneration is shown to increase. To speed up the treatment process, surgeons use a variety of surgical methods [25].

Corticomyotomy: It is a surgical procedure that was first attempted by Kole. In this technique, tooth movement is accelerated by perforating the cortical bone. This decreases the resistance generated by the cortical bone against the tooth movement [26].

Wilko, et al. observed in 2001 that a superficial CT assessment of people who have undergone corticomyotomy revealed a temporary localized

demineralization and remineralisation process compatible with the regional acceleratory phenomenon's faster wound healing pattern [27].

Advantages: It has been seen to prevent periodontal problems as it permits the augmentation of the bone. It's also been noticed to accelerate the treatment. Root resorption following this is also noticed to be reduced.

Disadvantages: As it is an aggressive procedure so it is associated with threats same as that any other surgery. It may alter the health of the regional vital structure, post-operative discomfort, infection, oedema and death of surrounding tissue. In addition to all this, it also happens to be an expensive technique.

Corticision: (MYRO) Minimally Invasive Rapid Orthodontics is the other name for corticision introduced by Kim, et al. It involves less surgical intervention.

Method: To separate the interproximal cortices without reflecting a flap, a reinforced scalpel is utilised as a chisel and a mallet is used by the trans mucosal approach. At the long axis of the canine, a sharpened surgical blade with a nominal thickness of around 400 m must be placed upon this inter radicular connection with a 45°-60° tilt to the gingiva. To protect the alveolar crest, the post-operative injury should be 2 mm from the papillary edge of the gingiva and 1 mm further than the mucogingival junction. A swing action must be used to draw the blade out. According to studies, corticision efficiently stops tooth movement in the same way that corticotomy does, but it is less aggressive [28].

Piezocision: It is a technique which is introduced by Dibart, et al which involves creating micro incisions in addition to selective tunnelling which helps in bone grafting. The incisions given are limited to buccal gingiva.

This technique does not only accelerate the tooth movement but provides an advantage of grafting which is associated with the tunnel approach. There is no use of suturing in this technique. Later on, they fused this technique with the use of invisalign which proved to provide more efficient and aesthetically acceptable results [29].

Micro Osteo Perforations (MOPs): Propel orthodontics introduced the propel TM device, which minimized the invasiveness of surgical bone discomfort, and the process became known as alveolocentesis, which means perforation of the bone. A sterile disposable machine includes an adjusting depth dial that may be adjusted at 0 mm, 3 mm, 5 mm, and 7 mm depth, as well as an indicating arrow. The soft tissue flap in the premolar and molar areas is raised, resulting in 0.25 mm spherical bur holes. MOPs enhanced the migration rate in humans by 2.3 times when compared to the unaffected tooth, according to Alikhani, et al. [30].

Interseptal alveolar surgery: It is also known as distraction osteogenesis since it involves the gradual displacement of fracture that is made surgically. It is also known as sub periosteal osteotomy by incremental traction as it causes soft tissue as well as bone quantity to expand due to mechanical stretching of the region. It is classified into two types: dento alveolar bone distraction and periodontal ligament distraction [31].

Method: During removal of the first premolar, interseptal bone presents distally from canine is surgically undermined by 1 to 1.5 mm, resulting in lower resistance at the pressure site. For distraction, a stainless steel custom made tooth born gadget is employed. Because the compact bone gets replaced by woven bone, the procedure causes tooth movement to accelerate, especially in the first week. It also makes tooth migration easier. Twenty four experiments have shown that the canine motility channel is more effective as a result of less resistance.

DISCUSSION

Because patients want their orthodontic treatment to be finished quickly and with fewer visits, there is a growing demand for tooth movement acceleration during orthodontic therapy. Although more expensive and invasive, surgical procedures are more effective and have fewer adverse effects.

With increasing interest and compliance of patients surgical techniques are easy to go for. Apart from that it also skips the side effects which can be seen in pharmacological approach. Since there is an enhanced rate of tooth movement with every technique utilised, using accelerated orthodontic treatments can greatly shorten the length of treatment making it more acceptable by the patients and the dentists.

CONCLUSION

Acceleration of tooth migration during orthodontic treatment is becoming more popular these days due to the desire of patients to finish their treatment in a shorter span as it would save time and reduce the number of trips. And luckily, we now have improved procedures and resources that allow us to give orthodontic treatment to both adults and children in a timely and pleasant manner. Even though these treatments have some limitations, they are one step closer to receiving quicker orthodontic treatment putting patients closer to orthodontic triumph.

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