Acclerated Orthodontics

Dr. Devinder Preet Singh
Senior Lecturer

Dr. Deepak K Gupta
Professor & HOD

Dr. Kanish Aggarwal
P.G. Student

Dept. Of Orthodontics, Dr.Harvansh Singh Judge Institute Of Dental Sciences & Hospital, Panjab University, Chandigarh, INDIA.

The comprehensive fixed orthodontic treatment is usually associated with a very prolonged treatment time, which remains one of the major concerns in the orthodontic treatment. The long treatment duration has been a constant deterrent for the patients seeking orthodontic care. The prolonged duration of the orthodontic treatment many times, prompts the patients to either avoid treatment or seek shorter alternative solutions, which may provide with suboptimal results.

The duration of the fixed orthodontic therapy depends on large number of factors including type of malocclusion, extraction vs. non-extraction treatment plan, mechanics involved in the treatment and to factors as simple as timely reporting of the patients for the appointments. Debra Fink et al [1] (1992) reported an average orthodontic treatment time of 21.95 months for non-extraction cases, 25 months for two premolar extraction cases and 26.18 months for 4 premolar extraction cases. Beckwith F.R.[2] (1999) found that the average treatment time for fixed appliance therapy is 28.6 months with a range of 23.4 to 33.4 months. This lengthy treatment time is more so problematic in the adult patients in whom the esthetics during the treatment is of much more concern. The reduction in the treatment time is thus a long sought after goal to encourage the adults to take up orthodontic treatment.

The prolonged treatment time is also associated with the concern of increased risk of white spot lesions, dental caries and periodontal problems. Tufekci E [3](2011) reported that 38% and 46% of patients undergoing orthodontic treatment had atleast one white spot lesion after 6 months and 12 months of treatment respectively. This increased incidence of white spot lesions leads to poor esthetics and increased restorative needs in the patients. The simple solution to minimize the problems associated with the prolonged treatment duration is to reduce the treatment time. Therefore it has been a constant endeavor to search for the methods that decrease the treatment time without compromising on the treatment outcomes.

The variables that control the treatment duration needs to be understood to overcome the treatment time challenge. These variables can be broadly grouped into three categories: Practitioner dependent factors, Patient dependent factors and Biological factors.[4] Practitioner-dependent factors include accurate diagnosis and treatment planning, sound mechanotherapy and delivery of treatment in a timely fashion. Patient-dependent factors include attending scheduled appointments, compliance with practitioners' instructions and maintaining the integrity of the appliances. Biological factors are tightly regulated by different molecular and cellular pathways and vary in magnitude for each individual. In an ideal scenario where both the treatment rendered by clinicians and patient cooperation is flawless, biology would be the only factor that dictates the rate of tooth movement in response to orthodontic forces.

In the past, major changes have been witnessed in the mechanotherapy and the appliance system with the development of advanced brackets and wires. According to Nimeri G et al [4] (2013), continuous modifications in the properties and design of the brackets and wires have greatly improved upon the biomechanical efficiency of the orthodontic treatment. However, the biomechanical systems thus made are nearing the peak of their modifications and there is a need to develop newer methods to accelerate orthodontic tooth movement. The focus to accelerate orthodontic treatment has now been shifted to modify the biology of the tooth movement. Many new methods are being devised to intervene and modify the biological pathways of tooth movement to accelerate the rate of orthodontic treatment.

The various techniques, which have been proposed to accelerate orthodontic tooth movement, can be categorized as : [4] direct technique, which activate the target cells involved in orthodontic tooth movement e.g. photobiomodulation, vibration, ultrasound etc.,Indirect techniques increase the levels of upstream cytokines, which affect the target cells to increase the rate of orthodontic tooth movement e.g. corticotomy, microsteo-perforation, peizocision etc.

L. C. Brian (1892) and G. Cunningham (1893) [5] were the first to report on attempts to accelerate orthodontic tooth movement. Cunningham advocated linear cutting technique in the cortical plates surrounding the teeth, to produce mobilization of the teeth for immediate movement. The faster tooth movement was believed to be because of the decreased resistance of the bone through which the teeth need to be moved. For many years surgery in the form of osteotomy and later corticotomy remained as the method of choice for accelerating tooth movement. But due to the morbidity and the pain associated with surgical technique it couldn't gain wide patient acceptance.

The ever-growing understanding of biology of orthodontic tooth movement led to introduction of newer methods, which included injections of mediators of osteoblastogenesis and osteoclastogenesis for e.g. Prostaglandins, RANK-L, Vitamin D, Osteocalcin and Relaxin.[3] These methods were based on the increase in number of cytokines, which are an important mediator in the biological pathways. These mediators required frequent injections and were absorbed in the blood circulation producing systemic effects. The pain associated along with increased cytokine activity led to a poor patient acceptance of these methods.

The focus of the accelerating tooth movement was shifted back to the surgical approach by Wilckoet al [7]. They explained the accelerated tooth movement on the basis of concept of Regional Acceleratory Phenomenon indicating increased bone

remodeling activity. The method involved the use of bone grafts along with the corticotomy cuts to accelerate the orthodontic tooth movement so as to enhance and strengthen the alveolar bone at the same time. The technique was named as Periodontally Accelerated Osteogenic Orthodontics (PAOO) and was very commonly used to accelerate the orthodontic tooth movement. But the invasiveness of the approach necessitated for development of newer techniques, which were less invasive and were more accepted by the patients.

Recently introduced methods like photobiomodulation, vibration are non-invasive and have high patient acceptance. Some of these, methods can be used by the patients themselves. Minimally invasive methods like microsteoperforation and peizocision are also becoming part of routine orthodontic care.

Photobiostimulation is a physical method of accelerating tooth movement, which has gain wide acceptance in the current scenario, majorly due to its non-invasive nature.[8] It includes Low-Level laser therapy, which has been in use from past decade and recently introduced LEDs. Low-intensity laser therapy in its initial days was applied only in medical sciences such as orthopedics, surgery, and medicine. It was used to accelerate the callus formation at fracture sites to facilitate wound healing. Saito and Shimizu [9](1997) found that low intensity laser therapy could accelerate bone regeneration in the midpalatal suture in rats during rapid palatal expansion and stimulate the synthesis of collagen, which is major matrix protein in bone. Cruz et al [10] (2004) were the first to use Low-level laser therapy (LLLT) in human subjects. The effects of the LLLT are based on the biostimulatory effects of the lasers as they have been shown to increase the cellular ATPs leading to stimulating effect on the cells .[11] Various studies have been conducted to evaluate the efficacy of the LLLT to accelerate the orthodontic tooth movement. But the results of these studies are contradictory, with certain studies showing an increase of around 30% in tooth movement while others showing no effect of LLLT. This varying evidence has been attributed to the different wavelengths and energy outputs used in various studies (Figure 1).[12,13]

Figure 1. Application of LLLT in areas of intended tooth movement.[13]

Vibration is another non-invasive mechanical stimulation method. It is based on the principle of dynamic loading of the bone according to which dynamic loading improves bone formation and increases orthodontic tooth movement compared to a static force.[14] Osteocytes being the pressure receptors in the bone get activated by the vibrations, which in turn recruit the osteoclasts leading to bone resorption. Nishimura et al [15] (2008) showed that application of resonance vibration accelerates orthodontic tooth movement via enhanced RANKL expression in the periodontal ligament. The patients can use this therapy themselves by the means of commercially available products like Acceledent™.

Microsteoperforation and peizocision are two new techniques, which have been introduced to surgically facilitate the orthodontic tooth movement. Kim et al [16] (2009) introduced a minimally invasive technique as an alternative to induce surgical damage to the alveolar bone without any flap surgery. This technique, also known as piezocision, involved the insertion of a scalpel and mallet into the gingiva and the placement of incisions using an ultrasonic tool (Figure 2). These incisions or bone injuries were responsible for the initiation of demineralization process leading to regional acceleratory phenomenon (RAP), hence accelerating the tooth movement. Teixeira et al [17] (2010) found that bone remodeling can be accelerated by creating small perforations in the bone after raising the flap. This technique was called as microsteoperforation and worked by increasing the local levels of cytokine activity around a tooth. This technique was modified and small perforations were created in the bone without raising the flap. Study done by Alikhaniet al [18] (2013) have shown that Micro-osteoperforation is an effective, comfortable, and safe procedure to accelerate tooth movement and significantly reduce the duration of orthodontic treatment (Figure 3).

Figure 2 : Peizocision

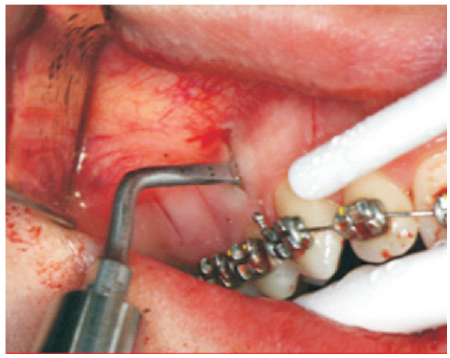

Figure 3 : Micro-osteoperforation

In general, the newer techniques for accelerated orthodontics have their draw backs and uncertainties due to which they have still not become the part of everyday orthodontic practice. However, there has been a rapid increase in their interest to enhance the effects of biology in orthodontics as these new approaches have the potential to be the next frontier for orthodontics.

References

References are avaialable on request at editor@healtalkht.com