

## 2G To 4G Orthodontics: A Review

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**Abstract:** Orthodontic treatment is gradual process of moving vital tooth in the alveolar bone from one position to other. Time is very important factor for patients to decide whether to undergo orthodontic treatment or not. In this era when generation has shifted from 3G to 4G internet, no one wants slow treatments. This paper presents review of various modalities that can help an orthodontist to reduce the treatment time yet keeping all biological and mechanical principals intact.

**Key words:** Rapid Orthodontic treatment, evolution of Orthodontic Therapy.

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### I. Introduction

The efficiency of a system is defined as one 'achieving maximum productivity with minimum wasted effort or expense'.<sup>1</sup> Orthodontic treatment is always considered as time taking process, involving multiple visits of patient to the orthodontist. Orthodontic pioneers have continuously sought methods of enhancing treatment efficiency by attempting to reduce the duration of orthodontic treatment and the length of orthodontic appointment, thus the changes in traditional orthodontic treatment occurred for ease of patients as well as orthodontist. Due to diversity of patients and complexities of orthodontic treatment no conventional orthodontic biomechanical treatment approach has demonstrated any greater efficiency or effectiveness than any other.

Patient cooperation is well-recognized governing factor of treatment duration. It encompasses missed appointments, compliance with appliance wear, broken appliances, and poor oral hygiene. Ease of treatment and patient comfort are governing factor for choice of mechanics. Accelerated treatment is advantageous not only for patients who may be concerned about treatment duration, but also for those who are unable to attend frequent orthodontic appointments. Patients staying in far away areas are unable to come for emergency visits so mechanics should be planned accordingly. All these factors considerably modify treatment approach and hence affects treatment duration.<sup>1,2</sup>

A web-based search was conducted in all the websites of the major orthodontic journals from the earliest editions to the latest and a search was conducted in *Medline* wherein the keywords "time" and "orthodontics" were used. It would be safe to say that no articles were available that had compilation of various methods although individual articles were present that had illustrated individual methods. This article comprises of compilation of all the evolutions that are quoted in literature to give patient comfort during orthodontic treatment and to ease orthodontist as well, further this paper comprises of various methods to reduce duration of Orthodontic treatment.

### II. Evolution of Various Treatment Modalities To Comfort Patients And To Reduce Chair Side Treatment Duration<sup>2,3,4,5,6,7</sup>:

1. **Banding to Bonding:** Angle started orthodontic practice with full mouth banding and welding brackets and buccal tubes on the bands and then cementing it on the teeth. This process was time consuming, unaesthetic and requires accuracy. There are more chances of demineralization and caries progression under the bands. Residual spaces were also left after removal of bands. An "ugly Betty" look was the major concern for adult patients. After evolution of enamel etching, bonding of attachments like brackets and buccal tubes started and this revolutionised whole orthodontic treatment procedure. Bonding was less time consuming, Accurate and more easily accepted by the patients. Bonding causes less damage to the tooth structure and is easy to maintain hygienic also. Bonding of buccal tubes elevated painful procedure of tooth separation and thus increases compliance in children for orthodontic treatment.

2. **Gold wires to Niti wires:** Previously precious metals were used as archwires but because of less rigidity and cost it was replaced by stainless steel wires. Uptill 60's stainless was wire of choice but using it as initial wire require combursum wire bending, lots of chairside time and problems in patient compliance with oral hygiene. Due to all these problems in 1961 NiTi was introduced as initial wire and it decreases chair side time as well as time taken for completion of alignment and leveling phases. Niti wires give constant and optimum forces which are idea for orthodontic tooth movements. Evolution of NiTi to thermal NiTi and to copper NiTi wires occured. These wires are used to align severe crowding cases and they apply optimum orthodontic forces for effective tooth movement.
3. **Straight wire prescription:** evolution of brackets started from edgewise prescription to beggs prescription to straight wire bracket system. All this happened to reduce the time duration of orthodontic treatment.
4. **Niti coil springs:** previously stainless steel coil springs were used, they use to exert heavy forces. After introduction of NiTi in dentistry coil springs were also preferred by same material to exert low constant force.
5. **Implants:** Preserving anchorage is orthodontist's enigma, headgears were used to augment and preserve anchorage. Patient compliance is crucial in cases with extraoral anchorage devices so implants came in play. Mini implants are intraorally placed and they provide absolute anchorage. Multiple movements can be achieved simultaneously and treatment time is drastically reduced.
6. **Self ligation bracket system:** ligation of brackets evolved from stainless steel ligature to self ligation. Many studies prove that self ligating bracket system reduces both chair side time as well as frequency of appointment of patients.
7. **Aligners:** use of aligners became popular due to aesthetic concern of the adult patients. Aligners are meant for minor corrections in less duration than conventional bracket systems. Another benefit of aligners is ease of maintaining oral hygiene and frequency of visit to the orthodontist. Since aligners required to correct a particular malocclusion are fabricated at the start of treatment by computerised software and are delivered to patient at the start only so visits to orthodontist is reduced.

### III. Treatment modalities for decreasing overall treatment durations:

These are further divided into:

- Invasive
- Device Assisted or Mechanical stimulation
- Drug therapy

#### A: Invasive procedures[7,8,9]

- a. **Corticotomy:** It was first tried in orthodontics by Kole. Conventional corticotomy was commonly used surgical procedures. Cortical bone is cut and perforated but not the medullary bone.

##### Advantages

- 1. Corticotomy procedure causes minimal changes in the periodontal attachment apparatus.
- 2. It has been proven successfully by many authors to accelerate tooth movement.
- 3. Bone can be augmented; thereby preventing periodontal defects.

##### Disadvantages

- 1. Invasive procedure leading to high morbidity.
- 2. Chances of damage to adjacent vital structures.
- 3. Postoperative pain and swelling.
- 4. Chances of infection or avascular necrosis.
- 5. Low acceptance by the patient

- b. **Wilkodontics:** it is a periodontically accelerated osteogenic orthodontic treatment and is another very efficient way of reducing treatment duration. Wilcko et al<sup>7</sup> reported that tooth movement was not the result of bony block, but rather a process of transient remineralization/demineralization which is a concept of reversible osteopenia in the bony alveolar housing consistent with wound healing pattern of RAP. He also introduced the term "bone matrix transportation" and developed patent techniques which were called Accelerated Osteogenic Orthodontics (AOO) and Periodontal Accelerated Osteogenic Orthodontics. Modification of RAP was done by adding bioabsorbable grafting material over the injured bone to enhance

healing.[7,8,9] in this procedure cortical bone is perforated and it causes increased osteogenic activity in the bone and treatment is accelerated. Routinely orthodontic treatment takes 18-24 months to finish but with the help of wilkodontics this duration is reduced to 12-14 months. This procedure is preferred by adults.

- c. **Interseptal alveolar surgery**[8]: Interseptal alveolar surgery or distraction osteogenesis. The interseptal bone distal to the canine is undermined surgically at the same time of extraction of the first premolars, thus reducing the resistance on the pressure site. The retraction of canine is done by activation of an intraoral device immediately after surgery. It has been shown that it took 3 weeks to achieve 6 to 7 mm of full retraction of the canine into the socket of extracted first premolars
- d. **Piezocision technique**[10]: Dibart was amongst the first to apply the Piezocision. Primary incision placed on the buccal gingiva, below the interdental papilla, as far as possible, in the attached gingiva using a No.15 scalpel. These incisions need to be deep enough so as to pass through the periosteum and contact the cortical bone. Next, using ultrasonic instrumentation (they used a BS1 insert Piezotome), perform the corticotomy cuts to a depth of 3 mm through the previously made incisions. Piezocision technique does not cause any periodontal damage as reported. This technique can be used with Invisalign which leads to a better aesthetic appearance and also the treatment time is shortened
- e. **PRP injections**[12]: Submucosal injections of platelet rich plasma (PRP) is a technique developed for accelerating orthodontic tooth movement by stimulating the effect of bone insult without surgery and loss of alveolar bone. Autologous platelet rich plasma can simulate the effects induced by bone surgery. Platelets contain growth factors PDGF, TGF, EGF's and other components that regulate and stimulate wound healing and amplify osteogenesis. Technique: 0.9ml of LA injected in the labial and lingual mucosa of anterior teeth 0.7ml of PRP injected in labial and lingual attached gingiva from canine to canine (immediately after bonding)

#### **B. Device assisted therapy or Mechanical stimulation methods [13,14,15]**

- f. **Mechanical stimulation by cyclic forces**: Light alternating forces on the teeth via mechanical radiations. Acyclic device was used to produce the vibration impulses of 20-30 Hz for 20 minutes each day in human teeth. These vibrations stimulated remodeling activity and brought about tooth movement at the rate of 2-3 mm/month. A new oral vibrating device, the Aceledent has recently become commercially available.
- g. **Low-level light therapy (LLLT) or photobiomodulation (PBM)**: has recently been developed as a noninvasive method. LLLT delivers tissue-penetrating red or nearinfrared light to the periodontium to promote connective-tissue and bone remodelling. Cytochrome c oxidase, a component of the mitochondrial respiratory chain, is activated upon photon absorption, increasing adenosine triphosphate production. Nitric oxide bioavailability also increases, thus promoting microcirculation through angiogenesis at the irradiated sites. Reactive oxygen species produced in the mitochondria have also been identified as modulators of bone metabolism. LLLT from OrthoPulse—a removable intraoral device that emits a continuous light of 850 nanometers by means of LEDs in conjunction with comprehensive fixed-appliance therapy. OrthoPulse allows patients to treat themselves at home, which is more practical, time efficient, and reproducible than laser light delivery in the office.
- h. **Low laser therapy**: due to invasive nature of wilkodontics and pain after the procedure patients now a day's prefer non invasive and painless procedure like low laser therapy. Low-intensity laser therapy has an energy output that is low enough so as not to cause the temperature of the treated tissues to rise above 36.5\_C or normal body temperature. Stimulation of oestrogenic cell with lasers causes increased rate of tooth movement and it also gives potential anaesthetic result. The mechanism involved in the acceleration of tooth movement is the production of ATP and activation of cytochrome C. The low-energy laser irradiation enhances the velocity of tooth movement via RANK/RANKL and the macrophage colony-stimulating factor and receptor expression. Low-intensity laser therapy stimulates tooth movement by altering the biologic response and not by increasing forces or changing mechanics, it does not tax the anchorage. Low-intensity laser therapy will be beneficial in adult patients because it increases vascularity and cellularity of bone.

#### **C: Drugs:[16,17]**

- Vitamin D,
- Prostaglandin,
- Interleukins,

- Parathyroid hormone,
- Misoprostol

These can be administered both orally as well as injected also.

There are disadvantages of drug application. For example, vitamin D when injected in the PDL increases the levels of LDH and CPK enzymes; Prostaglandin causes a generalized increase in the inflammatory state and root resorption. Hence, as of today, no drug exists that can safely accelerate orthodontic tooth movement.

#### IV. Conclusion

Many Fast track treatment modalities are available to provide patients rapid and efficient tooth movement. No single most ideal and prudent technique for the patient is yet established. Literature is filled with articles explaining various methods to reduce treatment duration in orthodontic treatment but one even one had compilation of all the methods. Orthodontist should choose wisely according to the invasiveness and patient comfort. This article here by describe past to future trends in various mechanics to reduce orthodontic treatment duration yet keeping biomechanical principals intact.

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