

# Products, Procedures... or a Pipe Dream? A Reality Check on the Game called “Accelerated Orthodontics”!



A patient of mine who was in treatment with me for close to 17 months had to move to the USA as he was going to go to university there. I did the usual formalities; prepared transfers forms and help him seek an orthodontist in the town he was to study. The transfer went along well. He was very happy with the new orthodontist, and the treatment was cruising along. He did come by to the office, and say the usual hellos while he visited Mumbai on winter and summer breaks. He came last, a couple of weeks ago with a dilemma. There was a 3 mm retraction space in one of the quadrants remaining, and the sophomore now was in a hurry to get rid of his appliances. When he asked his treating therapist about his desire to get this space closed fast, and thus have his braces debonded quicker; he was given two alternatives (each costing a few hundred dollars!).

Option 1 was a device to cause micro (injuries) perforations in the region that would not require patient co-operation, and option 2 was a vibratory device that the patient had to use for a given number of minutes a day. No injections, perforations, pain but compliance. The difference in cost was not something that would influence this patient’s choice of modality. He came to me for an opinion on this choice. As a researcher, who has been a part of trials on acceleration; and this topic was a formidable part of what I’ve been reading upon, in the last few years, I was faced with helping somebody make a clinical choice, where a cost benefit ratio was involved! Phew! I shouldn’t have been in office that day. What should have I told him? A versus B or a few other C’s, D’s and E’s?

It’s one thing to collate literature or research findings and make a conclusion. It’s quite another to tell a paying patient, “If you agree to spend X no of dollars for a product or a procedure, your treatment time will reduce from 5 to 2 months? Are we there yet on this “acceleration of tooth movement” terrain to make such decisions confidently?

The “acceleration of tooth movement” protocols fall basically under two groups for a clinician:

- a. Products: That is, acceledent, propel, low level lasers, electrical currents etc.
- b. Procedures: That is, corticotomies, osteotomies, interseptal procedures, piezzo surgeries, local injections, distraction of periodontal ligament (PDL), surgery first etc.

The 21<sup>st</sup> century has seen rapid developments in the science of orthodontics where achieving desired results both clinically and technically, both effectively and efficiently, matter. This is especially so by using new technologies, like stimulation soft wares that can assist in treatment planning and translational products. In addition, continuous modification of wires and brackets as a result of the biomechanical efficiencies in orthodontics has greatly improved. However, these biomechanical systems may have reached their limit, and there is a need to develop new methods to accelerate teeth movement, today.

Increased treatment times are the most common deterrents that face the profession of orthodontics and cause a reluctance among adults to embrace treatment plus increasing risks of caries, gingival recession, and root resorption.<sup>[1]</sup>

A number of attempts have been made to create different approaches both preclinically and clinically in order to achieve quicker results, but still there are a lot of uncertainties and unanswered questions toward most of these techniques. Nimeri *et al.*<sup>[2]</sup> categorize these attempts broadly into biological, physical, biomechanical, and surgical approaches. These attempts though variant in nature, are dependent on the biological variables and factors that initiate inhibition and delayed tooth movement.

Orthodontic tooth movement occurs in the presence of mechanical stimuli sequenced by remodeling of the alveolar

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bone and PDL. Bone remodeling is a process of both bone resorption on the pressure site and bone formation on the tension site.<sup>[3]</sup> Orthodontic tooth movement can be controlled by the size of the applied force and the biological responses from the PDL.<sup>[4]</sup> The force applied on the teeth causes changes in the microenvironment around the PDL due to alterations of blood flow, leading to the secretion of different inflammatory mediators such as cytokines, growth factors, neurotransmitters, colony-stimulating factors, and arachidonic acid metabolites. As a result of these secretions, remodeling of the bone occurs.<sup>[5,6]</sup>

## THE ACCELERATION TERRAIN

There are three phases of tooth movement: The initial phase, which are characterized by rapid movement after the application of force; followed by a lag period, where little or no movement and the last phase, where gradual or sudden increase of movement occurs.<sup>[7]</sup>

The early phase of tooth movement involves acute inflammatory responses characterized by leucocytes migrating out of blood capillaries and producing cytokines, which stimulates the excretion of prostaglandins and growth factors.<sup>[8]</sup> The acute phase is followed by the chronic phase that involves the proliferation of fibroblast, endothelial cells, osteoblasts, and alveolar bone marrow cells remodeling processes.

Biologically, experiments have been done using these molecules exogenously to enhance tooth movement both in animal experiments and humans. Examples of these molecules are prostaglandin E, cytokines that include lymphocytes and monocyte-derived factors, receptor activator of nuclear factor kappa B ligand, and macrophage colony-stimulating factor.<sup>[9-11]</sup> The effects of cytokines, osteocalcins, prostaglandins, Vitamin D<sub>3</sub>, and parathyroid hormone and relaxin have also been evaluated.

Another approach in accelerating tooth movement, that has been evaluated, is by using device-assisted therapy. This technique includes direct electric currents, pulsed electromagnetic field, static magnetic field, resonance vibration, and low-level laser, which was mostly investigated and gave the most promising results.<sup>[12]</sup>

The concept of using physical approaches came from the idea that applying orthodontic forces causes bone bending (bone bending theory) and bioelectrical potential develops. The concave site will be negatively charged attracting osteoblasts and the convex site will be positively charged attracting osteoclasts as detected by Zengo *et al.*<sup>[13]</sup> in his measurements on dog alveolar bone.

The bioelectrical potential is created when there is an application of discontinuous forces, which leads to the idea of trying cyclic forces and vibrations. It has been found that applying vibrations for different duration per day accelerated tooth movements between 15% and 30% in animal experiments.

## THE CLINICAL TRUTHS

Is there enough information for the clinician out there in the literature to decisively make a call on the method to induce acceleration? Corticotomies are proven beyond doubt to enhance the acceleratory phenomenon but, does the RAP phenomenon induced last the length of treatment. Is it really desirable to perform this procedure routinely? I dare not say "yes" based on the current evidence we have!<sup>[14]</sup>

The challenge for a research design to prove the therapeutic efficacy of a particular method of "acceleration" lies in probably addressing the following areas:

1. A uniform design that studies most of the modalities showing promise in similar circumstances, and over the entire treatment (most studies only study alignment or retraction or distalization etc., which gives us a part of the picture but not the entire one!). Split mouth designs are really not the best replication of a total treatment scenario and need to be assessed with caution.
2. Multi-centric evaluation of a uniform design will be the best method to test the validity.
3. Patient experience and comfort scores and scales will have to be employed for a holistic assessment. For example, if let's say, a class 1 bimax case is treated with conventional mechanics in 20 months, with corticotomy in 15 months, with micro osteo perforations in 16 months and with lasers and vibrations in 17 months in the proposed trial; was the patient experience same and level of discomfort, the same in the all the groups? The amount of costs and discomfort a patient is willing to undergo for faster treatment should also be subject of evaluation.
4. One meaningful goal is to explore and identify new means for enhancing the orthodontist's ability to provide personalized treatment. The leading specialists in this drive are the oncologists, who utilize genetic and genomic investigations of individual patients, in order to be able to choose the right medication for the specific type of cancer of each person. In orthodontics, it would be helpful to identify the genes responsible for bone growth and remodeling, and to expose biomarkers that accurately reflect the degree of involvement of systems such as the nervous, vascular,

immune, and skeletal, in the individual response to orthodontic therapy.

The goal is to include in the diagnosis, details about the molecular genetic background behind processes such as bone metabolism, wound healing, inflammation, and the cellular response to selected stimuli, physical and chemical. Additional tests can be used to examine tissues and cells in the laboratory, to better understand the outcome of the clinical operations, and to be able to predict it with confidence, with each of the proposed modality of acceleration.<sup>[15]</sup>

5. Studies often use quantitative data to reflect upon evaluations and findings. Qualitatively how the patient finished is very often not evaluated in studies accessing acceleration. "The best way to finish a case fast," something any experienced clinician will tell you, is to "not finish at all." Quicker treatment can be compromised treatment at times! The PAR indices of all treated cases in a given trial should also be the subject of evaluation, as well as the ABO deductions to evaluate the finish.
6. The "icing on any orthodontic cake" is the stability of finished results! Stability of treatment results, treated with any of the "acceleration methods" should be comparable and also be a parameter of evaluation as time goes by, in a prospective manner.

## PRODUCTS, PROCEDURES OR...

We get back to the patient we started this editorial with! Do we as a profession have answers to give him?

Confidently, that we can put on a contract, "based on scientific data," that suggesting the use of a particular kind of a procedure or a product will help us finish his treatment in X number of months/days for sure? Product manufacturers will jump on a terrain where demand beckons, and the demand for faster tooth movement is definitely there; but is "science there yet," is a bigger question?

Can current literature give us information we can use in new patient consults tomorrow morning, where by advising an additional procedure or a product, treatment time that is considerably shorter can be promised?

If the answer to any of these questions is "no" then the game has not yet panned out the way it ought to be, yet. There is information to be sought, and truths to be still known, to make shorter but meaningful orthodontics, not just another FAD or a pipe dream!



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