Applications of controlled local inflammation in aligner treatment

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An increase in local inflammation via trans-mucosal osteo-perforations (Propel Excellerating Technology) promotes osteoclastogenesis, osteoclast recruitment and differentiation. This causes the bone to remodel faster and hence teeth move faster through the bone. In combining aligner therapy with controlled localized inflammation, Propel-aided aligner treatment enables clinicians to proactively deliver better outcomes, in shorter treatment times or to reactively respond to resolve and complete stubborn and challenging movements. Experience and evidence of either approach has evolved to make Propel-aided aligner treatment be a valuable, double-edged tool in the clinician's armamentarium. The scope of this paper is to convey such experience and evidence while attempting to suggest techniques for easy clinical adoption and delivery. (Semin Orthod 2017; 23:90–98.)

You May Delay, But Time Will Not and Lost Time Is Never Found Again.

–Benjamin Franklin.

Introduction

It can no longer be argued that aligner therapy is the lesser means to provide orthodontic treatment. To still deny, it is tantamount to be the proverbial ostrich with its head in the sand. In order to stay relevant, the private practitioner should not hold this denial-driven mindset or procrastinate to embrace the evolving landscape of our orthodontic industry.

As aligner therapy advances to make fixed appliances, the minority of treatment modalities and clinician's ability to advantageously augment host–tissue response to orthodontic forces in an effort to facilitate tooth movement is also becoming common place.[1] More so, the advent of micro-osteoperforations via Propel's Excellerator technology helps prepare bone and tissue for orthodontic tooth movement. What was once thought of as science fiction has now transitioned into a reality in private practice?

Modestly put, an increase in local inflammation via transmucosal osteoperforations (Propel Excellerating technology) promotes osteoclastogenesis, osteoclast recruitment, and differentiation. This causes the bone to remodel faster, and hence teeth move faster through the bone.[2] This process has been proven to be a safe and repeatable procedure that is well tolerated and accepted by patients, who report minimal discomfort, when compared to orthodontic tooth movement alone.[3]

In combining aligner therapy with controlled localized inflammation, Propel-aided aligner treatment enables clinicians to *proactively* deliver better outcomes, in shorter treatment times *or* to *reactively* respond to resolve and complete stubborn and challenging movements. Experience and evidence of either approach has evolved to make Propel-aided aligner treatment to be a valuable, double-edged tool in the clinician's armamentarium. The scope of this article is to convey such experience and evidence while attempting to suggest techniques for easy clinical adoption and delivery.[4–7]

Brief review of science behind Propel's Excelleration technology

Orthodontic tooth movement (OTM) is a controlled trauma. As such, there is an inflammatory response that is elicited and necessary for OTM to occur. Research shows that without this

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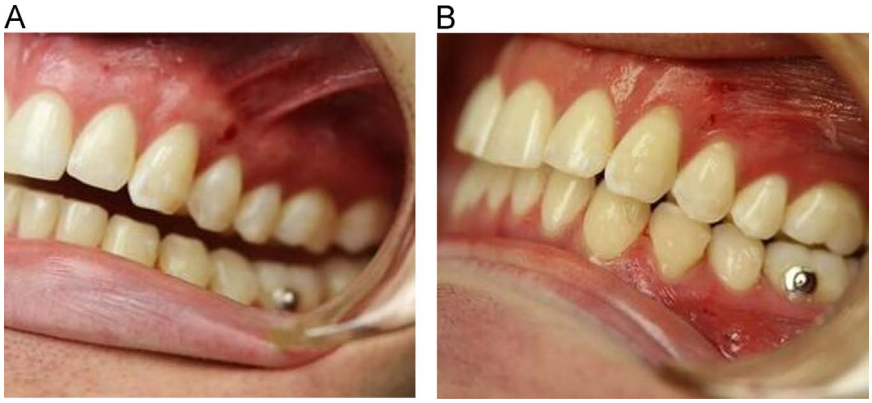

Figure 1. (A) Clinical appearance of tissue response at the time of the procedure and (B) 30 min after the procedure.

inflammatory response OTM will not occur. More so, efforts to thwart it will also retard OTM.[8]

As previously stated, the micro-insults or micro-trauma caused by transmucosal osteoperforations elicits a localized inflammatory response. It stimulates osteoclastogenesis, osteoclast recruitment, and differentiation. In turn, the bone remodels faster and temporarily becomes less dense. The net result is that the teeth move faster through the bone. There is no recovery time that is necessary following the procedure. There are no sutures to be removed at subsequent follow-up appointments that would necessitate taking more time off the work or school. There is no swelling that occurs in days following, and thus far, no reported cases of infection following the procedure. It is a quick and safe procedure that is able to be performed in the clinic without disruption to the office schedule.

Reported data suggest this stimulated inflammatory response peaks in 24–36 h following the procedure and remains elevated only to return to pre-treatment levels 10–12 weeks subsequently. Furthermore, the inflammatory response radiates 6–10 mm around each perforation.[2] This is significant when it comes to deciding how many perforations to perform. If Propel is used *reactively* on one or two teeth, it would be beneficial to perform three perforations around (mesial and distal) these teeth to stimulate as much localized inflammation as possible. If, however, one is *proactively* perforating a whole quadrant, due to the radiating effect, experience has shown that two perforations are sufficient to elicit the desired enhanced bone remodeling response. Currently, there are clinical trials underway assessing the optimal number of perforations necessary to accomplish certain types of movement. At the time of this publication, however, the best practiced protocol is described as above.

It is necessary to go through the cortical plate of bone and into the medullary bone. Rather than "cutting" the bone or "coring" a sample from the bone, osteoperforations should be thought of as to "displace" the medullary bone. As such, there is minimal physical trauma to both hard and soft tissues, bleeding, and recovery time following the procedure. There are no potential negative sequelae such as swelling or infections as there can be with other surgical approaches that attempt to augment a patient's own biological response during tooth movement.

To explain the phenomenon by analogy, imagine a block of ice drilled with a handpiece. The ice would be cut and removed leaving a perfectly smooth path where the bur once was, and the remaining ice untouched or unphased. If this was bone, it would respond by a lot more bleeding and coagulation, and also a lot more necessary recovery time for the bone to heal, fill in, and return to homeostasis. In contrast, now imagine slowly twisting a threaded screw into the same block of ice. Rather than coring a hole into the ice like a drill bit, the threaded screw would instead cause radiating fractures in the block of ice. Clinically, this same process creates radiating fractures in the medullary bone. In effect, these radiating micro-fractures elicit a larger amount of radiating inflammatory response with much less bleeding and recovery time, compared to boring a hole into the bone. It is this unique