Introduction

The trend of adults seeking orthodontic treatment has been on the rise. Indeed, adults have become a significant population of the total orthodontic patient pool.¹

The use of conventional metal braces is trialed and tested to be efficient and effective in orthodontic treatment. However, social concerns have led to the development of more esthetic options for orthodontic tooth movement. The use of clear-aligner therapy in particular has become increasingly popular with the adult orthodontic patient population. As with most modalities of treatment, clear-aligner therapy when combined with sound case selection, diagnosis and treatment planning has been shown to be an effective alternative to conventional braces.²
Regardless of which modality of orthodontic treatment is selected, the movement of teeth is a biological process and has been shown to be limited by biological mechanisms. There is a biological saturation point at which the rate of tooth movement will hit a plateau, and applying additional force will have no additional effect on moving teeth faster. Researchers from the Consortium for Translational Orthodontic Research (CTOR) at New York University College of Dentistry have applied the same biological principles activated during fracture healing and have developed a technique to increase the rate of tooth movement up to 2.3-fold, with the possibility of treatment durations by up to 62 percent. Utilizing these advantages inherent to the bone-repair mechanism, this technique to accelerate tooth movement is called micro-osteoperforations (MOPs).

When MOPs are performed, small holes are created in the alveolar bone adjacent to the teeth that need to be moved, under local anesthesia, without the need for raising a tissue flap. This technique has shown to be a reliable and minimally invasive method of increasing the rate of orthodontic tooth movement. The advantages of combining clear-aligner therapy and MOPs are self-evident; they give us the double advantage of both esthetics and reduced treatment duration times.

**Clinical procedure**

In the case series of three patients discussed here, we utilized MOPs to enhance the rate of tooth movement. The MOP device used was a version of Propel (osteoperforation instrument developed by AlveoLogic in collaboration with NYU). The clear-aligner system used was Invisalign by Align Technology.

The clinical procedure is as follows:

1. Obtain an up-to-date panoramic radiograph or periapical radiograph of the region of interest.
2. Apply infiltrative local anesthesia.
3. Verify the regions of tooth movement with the tooth movement prediction software (Clincheck by Align Technology).
4. Manually perform the MOPs (Fig. 1. Clinical photographs of MOPs being performed on Patient A).
5. Place about two to three MOPs proximal to the teeth/tooth to be moved.
6. Prescribe a non-anti-inflammatory analgesic such as acetaminophen or paracetamol (Tylenol).
7. Evaluate the patient every four to six weeks and repeat the procedure, if necessary.
Case series of three patients

**Patient A**

A 25-year-old female patient presented with a Class I crowding malocclusion. Her diagnosis revealed 5mm and 8mm of crowding on the maxillary and mandibular arches, respectively. Multiple teeth also had rotations of more than 30 degrees (Fig. 2a) and the initial panoramic radiograph (Fig. 2b) showed that some of the roots required improved parallelism. Her treatment plan consisted of using clear-aligner therapy (full Invisalign) with a total of 18 aligners for completion, the crowding was alleviated primarily by IPR and secondarily by expansion and proclination.

On a traditional protocol, the aligners would be changed every two to 2.5 weeks, resulting in total treatment duration of 36-45 weeks. We performed MOPs during her initial aligner visit and subsequently every six to eight weeks until completion (Fig. 3). The accelerated protocol prescribed was to change the aligners every 10 days, resulting in total treatment duration of approximately 26 weeks, a reduction of treatment duration of up to 42 percent. The patient was satisfied with the final outcome (Fig. 4a), and the final panoramic radiograph (Fig. 4b) exhibited improved root parallelism. No bone loss was evident, either.

**Patient B**

A 29-year-old female patient presented with a Class I spacing malocclusion. Her diagnosis revealed 3mm and 5mm of spacing on the maxillary and mandibular arches, respectively (Fig. 5a). Her initial panoramic radiograph exhibited satisfactory root parallelism (Fig 5b). Her treatment plan consisted of using clear-aligner therapy (Invisalign Express) with a total of 10 aligners for completion.

Due to a limited number of aligners, the movements per aligner were increased by 50 percent compared to the traditional protocol. With this increase in movements the aligners would typically be changed every three weeks, resulting in a treatment duration of 30 weeks. We performed MOPs during her initial aligner visit and subsequently every six to eight weeks until completion. The accelerated protocol prescribed was to change the aligners every eight days, resulting in a treatment duration of 12 weeks and a reduction of treatment duration of 60 percent. The patient was satisfied with the final outcome (Fig. 6a), and the final panoramic radiograph (Fig. 6b) still exhibited good root parallelism and bodily movement after space closure; no bone loss was evident, either.

Regardless of which modality of orthodontic treatment is selected, the movement of teeth is a biological process and has been shown to be limited by biological mechanisms. There is a biological saturation point at which the rate of tooth movement will hit a plateau, and applying additional force will have no additional effect on moving teeth faster.
Patient C

A 62-year-old male patient presented with a Class I malocclusion. His diagnosis revealed a midline diastema on the maxillary arch of 5mm at the gingival margin and 5mm of lower incisor crowding (Fig. 7a). His initial panoramic radiograph exhibited mild misalignments in root parallelism (Fig. 7b). His treatment plan consisted of using clear-aligner therapy (full Invisalign) with a total of 31 initial and 10 refinement aligners for completion, following traditional protocols for aligner change of two to 2.5 weeks per aligner. This would result in treatment duration of 82 to 102.5 weeks.

As the patient wanted the maxillary diastema closed, we decided to extract the lower right central incisor and perform enamel recontouring as needed. We performed MOPs during his initial aligner visit and subsequently every six to eight weeks until completion. The accelerated protocol prescribed was to change the aligners every eight days, resulting in a treatment duration of 46 weeks—a reduction of treatment duration by up to 55 percent. The patient was very satisfied with the final outcome (Fig. 8a), and the final panoramic radiograph (Fig. 8b) exhibited improved root parallelism. No additional bone loss was evident, either.

This technique has shown to be a reliable and minimally invasive method of increasing the rate of orthodontic tooth movement. The advantages of combining clear-aligner therapy and MOPs are self-evident; they give us the double advantage of both esthetics and reduced treatment-duration times.

Contraindications to using MOPs

These guidelines are definitely not prescriptive or exhaustive and it is always prudent for the clinician to consult the patient’s physician before performing any MOPs:

- Patients with bleeding or immune disorders
- Patients who require prophylactic antibiotics
- Patients who have had previous radiotherapy of the mandible
- Patients who are taking anti-inflammatory medications

Discussion and conclusion

From the above case series of three patients, it clearly shows that in conjunction with MOPs, clear-aligner therapy is able to deliver clinically acceptable results with marked reductions in total treatment-duration times. The patients above described only mild discomfort and gingival inflammation the day after the procedure, while bleeding on the day of the procedure was minimal and hemostasis was easily achieved. The effectiveness and efficacy of MOPs with clear-aligner therapy may be considered a viable treatment modality for accelerated esthetic orthodontic treatment.
References


What is your experience with clear-aligner therapy? Comment on this article at Orthotown.com/magazine.aspx.

Author Bio

Dr. Edmund Khoo is an orthodontist certified with the American Board of Orthodontics. He teaches orthodontics and dentofacial orthopedics full-time at his alma mater, New York University. Dr. Khoo has been published in several journals and has been invited to chair numerous scientific sessions. His awards and achievements include the American Association of Orthodontists Charley Schultz Scholar Award; Academy of Distinguished Educators Faculty Award; and the Faculty Council Teaching Recognition Award. He is the current chair-elect for the American Dental Education Association (ADEA) Section on Orthodontics and is a founding member of the Consortium for Translational Orthodontic Research (CTOR). He holds multiple positions at NYU and is heavily involved in the board-certification training program for his residents. His professional interests are accelerated tooth movement, evidence-based orthodontics and biomechanics, and mechanotherapy.