Brief Report

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Effects of a new type of clear overlay retainer on occlusal contacts

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The popularity of clear overlay retainers (CORs) has increased recently because of their advantages such as better esthetics, cost effectiveness, easy fabrication, and good compliance. However, a deficiency in posterior occlusal settling is a reported limitation of CORs. The aim of this study was to evaluate the posterior occlusal contact changes in a new type of clear orthodontic retainer called Oral-treaper (OTP), which consists of three layers and has stronger mechanical characteristics than do conventional retainers. Three patients who completed fixed orthodontic treatment received OTP as a removable retainer. Cast models were fabricated after the removal of fixed appliances (T1) and after 4 to 11 months of using the retainers (T2). We evaluated all the cast models to compare the post-orthodontic settling pattern during the use of the OTPs. The depth of occlusal contacts was evaluated using color maps. The OTP did not prevent vertical settling in all patients but resulted in an improvement in posterior occlusal contact points.
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Key words: Clear overlay retainer, Occlusal contacts, Settling

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INTRODUCTION

Retention after active orthodontic treatment is essential to prevent relapse. Removable retainers are typically used in the retention phase after active orthodontic treatment. Hawley retainers and clear overlay retainers (CORs) are the most commonly used clinical retainers. On the basis of survey results, Keim et al.[1] reported an increase in the use of CORs and fixed retainers between 1986 and 2008. Moreover, Pratt et al.[2] predicted a definite shift in preferred retainer types from Hawley retainers to CORs and fixed retainers among United States' orthodontists. More compliance of patients with "invisible" retainers than with Hawley retainers could be a reason for this shift in retainer preference. CORs are advantageous because they are easier to clean and fabricate, inexpensive, and comfortable; they also offer better esthetics and improved durability. CORs are also more effective than Hawley retainers at maintaining the correction of the maxillary and mandibular segments.[3,4]

However, a few studies that have compared Hawley retainers and CORs with regard to their post-treatment settling have concluded that Hawley retainers offered better settling of the occlusion than did CORs.[5-7] Sauget et al.[5] compared Hawley retainers and CORs and showed that CORs allowed significantly fewer occlusal contacts on the posterior teeth than did Hawley retainers. Dinçer and Isik Aslan[6] studied the occlusal contacts of CORs and found no significant increases in occlusal contacts. Later, they developed a modified COR to encourage posterior occlusal contacts. The modified COR had posterior occlusal surfaces that were not covered by thermoplastic materials. They compared a modified partial-coverage COR and full-coverage COR and found increased posterior occlusal contacts in the modified COR group.[7]

The limitations of CORs containing thermoplastic polymer materials are dimensional instability, low strength, and poor wear resistance. To overcome these disadvantages, in 2014, Ahn et al.[8] designed a new COR composed of multilayered hybrid materials. The new COR, called Oral-treaper (OTP), demonstrated improved mechanical strength and rate of water absorption (Figure 1). In this preliminary study, we evaluated the changes in the posterior occlusal contacts of patients who received OTP as a retainer and investigated the effects of OTP as a post-orthodontic retainer.

MATERIALS AND METHODS

The OTP is composed of three layers. The outer layer is polyethylene terephthalate glycol (PETG), the middle layer is thermoplastic polyurethane (TPU), and the inner layer is a reinforced resin core. The resin core covers the incisal and lingual sides of the anterior teeth and the occlusal surfaces of the posterior teeth but does not extend to the second molars. The outer and middle layers cover all the teeth in the maxillary dentition.

Three patients who completed active orthodontic treatment from the Department of Orthodontics, Kyung-Hee University Dental Hospital (Seoul, Korea), were included in the study. In every patient, after the removal of fixed appliances, lingual-bonded retainers were bonded on to the maxillary and mandibular anterior teeth. Two weeks later, they received OTP for the maxillary dentition. One qualified laboratory technician

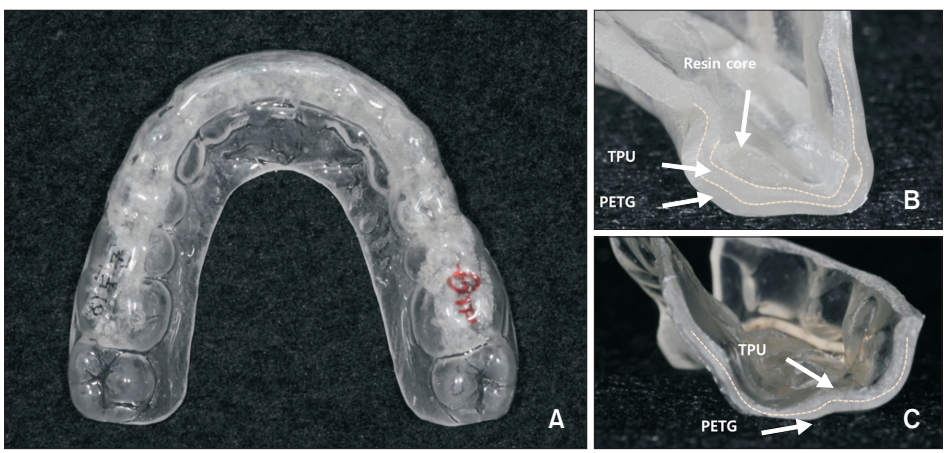

Figure 1. A new clear overlay retainer (named Oral-treaper [OTP]) composed of multi-layered hybrid materials. **A**, Occlusal view. **B**, Sectioned view of the three layers of the OTP at the incisor. **C**, Sectioned view of the two-layer portion of the OTP on the second molar.
TPU, Thermoplastic polyurethane; PETG, polyethylene terephthalate glycol.

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fabricated all the OTPs. Each OTP was constructed with three layers. The innermost layer was the resin core, which did not exceed 1 mm and extended from the right first molar to the left first molar. The middle and outer layers extended to the most distal tooth. The total thickness of the OTP was less than 3 mm. The mandibular occlusal contact points in the OTP were adjusted to make more than three-point contacts with the mandibular dentition. Patients were instructed to wear the retainer only while sleeping.

Alginate impressions of the study models were taken immediately after the removal of fixed appliances (T1) and after 4 to 11 months of using the retainers (T2; mean duration, 7.5 months). Every cast model was scanned using a model scanner (Orapix 3D Scanner KOD600; Orapix, Seoul, Korea) for digital analysis, and the model analysis was performed using the 3DXer software (Orapix, Seoul, Korea).

We evaluated all cast models to compare the post-orthodontic settling patterns during OTP use. The occlusal contacts in the digital models were expressed by different colors according to the depth of the occlusal contacts. The depth was measured as the closest distance between surfaces by using the 3DXer software. In the color spectrum, "red" color indicated shallow occlusal contacts and "blue" color indicated deeper occlusal contacts.

CASE REPORTS

In Figures 2–4, the posterior settling for each patient and the occlusal color depth spectrum are shown. In case 1, the female patient was 42.5 years old when appliances were removed. Her chief pre-treatment complaint was anterior crowding. She had four premolars extracted and was treated with fixed orthodontic appliances. At the end of treatment, the distal cusps of the left first and second molars were not in occlusion. After 7.5 months of using the OTP, interdigitation of the posterior molar was observed in the buccal and lingual views of the cast model. The color depth spectrum showed an increase in the blue-colored area in the posterior teeth at T2 (Figure 2).

In case 2, an adolescent girl had a chief complaint of a protruded mandible. Owing to a potential of mandibular growth, we waited and observed without any orthodontic treatment. After 6 months, we superimposed and analyzed her lateral cephalograms and decided to start non-extraction, Class III camouflage orthodontic treatment. Nineteen months later, when she was 15.7 years old, all fixed appliances were removed. At that time, the right second molars were not fully seated. After 11 months, even though she used a full-coverage OTP every night, interdigitation of her second molars was improved (Figure 3).

In case 3, another adolescent girl had a chief com-

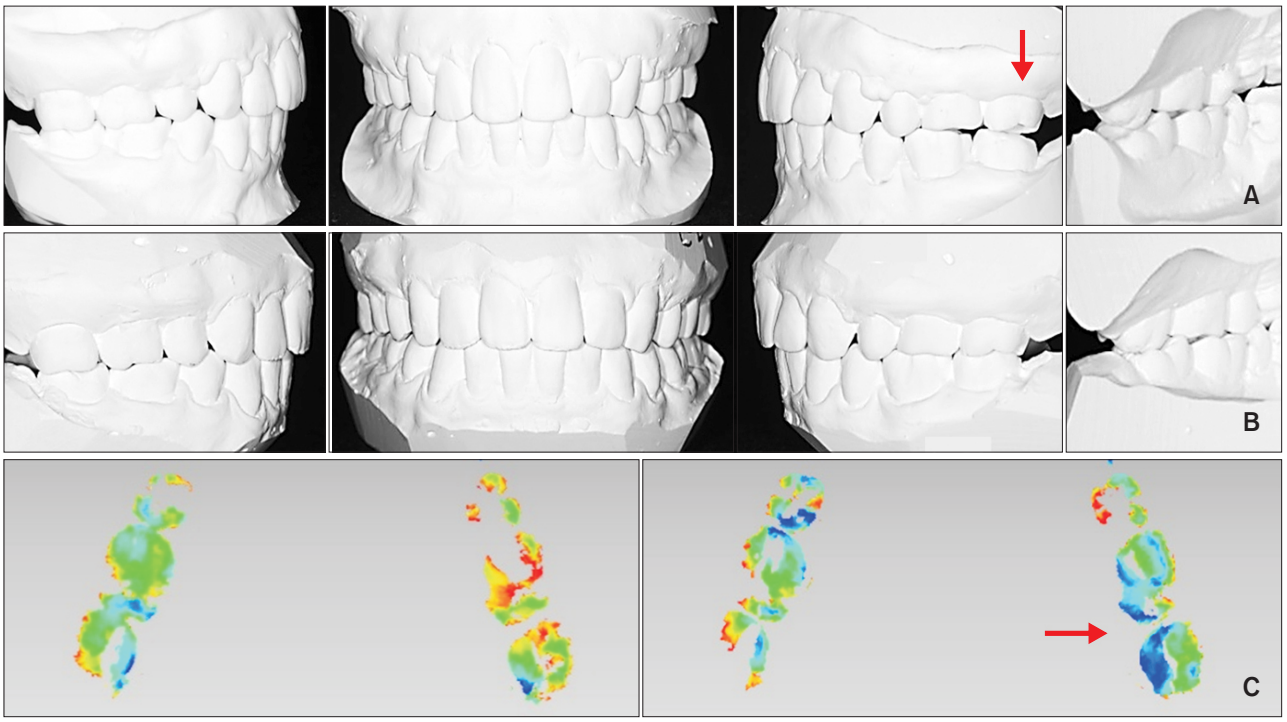

Figure 2. Patient 1, a 42.5-year-old woman. **A**, T1, at the completion of orthodontic treatment. **B**, T2, after 7.5 months of using the Oral-treaper. **C**, Color depth spectrum at T1 and T2.

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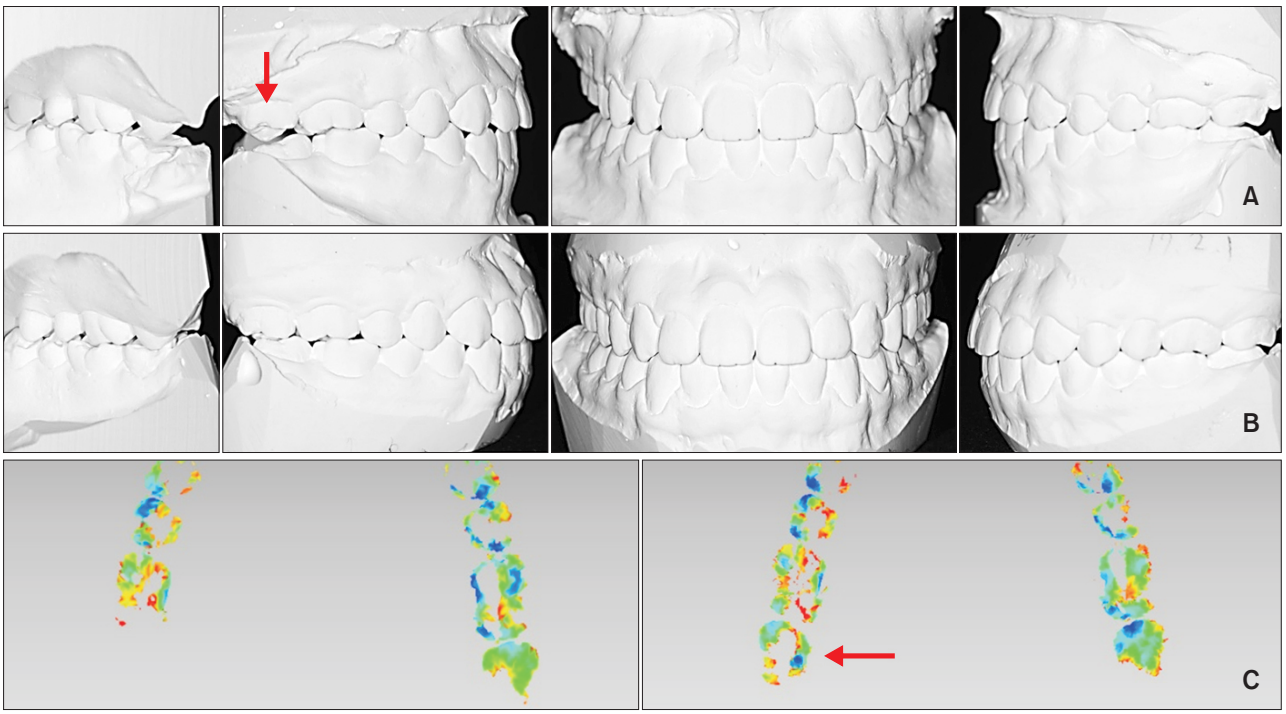

Figure 3. Patient 2, a 14-year-old girl. **A**, T1, at the completion of orthodontic treatment. **B**, T2, after 11 months of using the Oral-treaper. **C**, Color depth spectrum at T1 and T2.

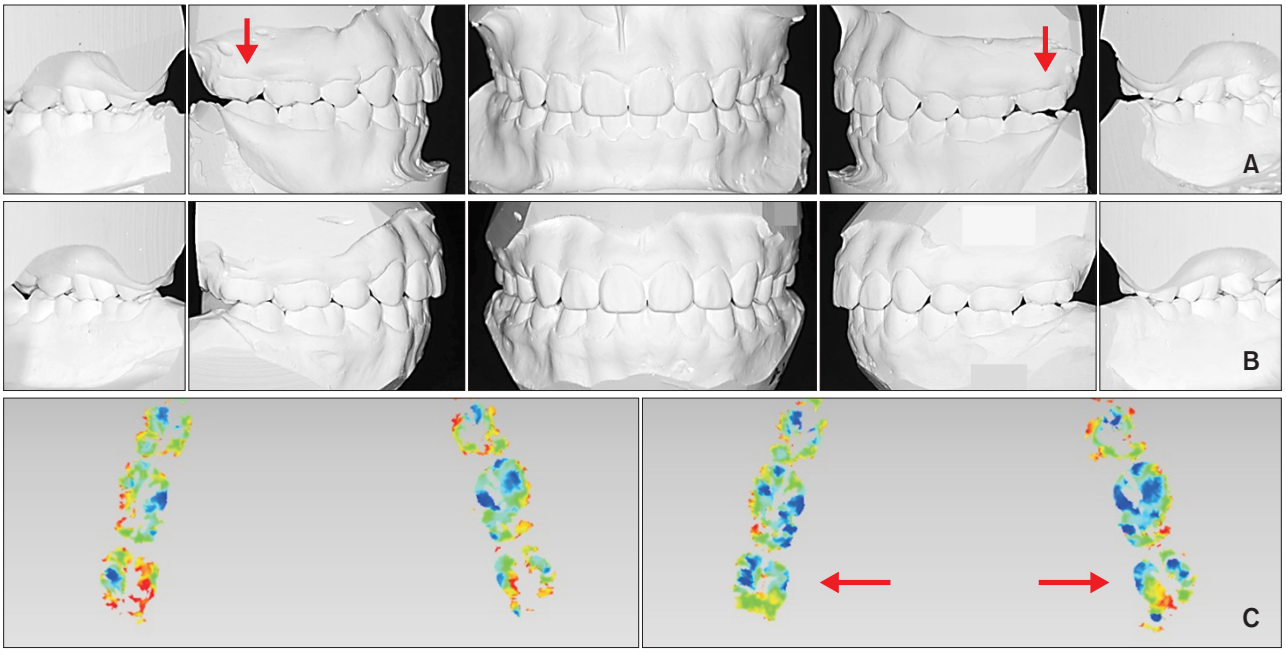

Figure 4. Patient 3, a 12-year-old girl. **A**, T1, at the completion of orthodontic treatment. **B**, T2, after 4 months of using the Oral-treaper. **C**, Color depth spectrum at T1 and T2.

plaint of a retruded mandible. Two upper first premolars and two lower second premolars were extracted. After 25 months of fixed orthodontic treatment, when she was 14.11 years old, she started using an OTP at night. All second molars were not perfectly seated at the time of debonding, and we decided to wait for natural eruption.

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After 4 months, eruption of the second molar was not prevented by the full-coverage retainer and occlusion of the posterior teeth was improved (Figure 4).

DISCUSSION

"Settling," or relative tooth movements in the occlusal direction after orthodontic treatment, is one of the measurements used to evaluate the best fit and stability of the dentition. With settling, the number of occlusal contacts increases and the interdigitation of the teeth improves. If vertical settling is not complete during orthodontic treatment, it needs to occur during the retention period and the retention appliances should enable vertical settling. However, several studies have concluded that CORs will prevent vertical settling during post-orthodontic occlusion.[5-7,9] To increase vertical settling after orthodontic treatment, Aslan et al.[7] developed the partial-coverage retainer by opening the posterior occlusal surfaces and reported increased occlusal contacts. They used thicker sheets and incorporated 0.7-mm stainless steel round wires to strengthen the retainer. However, removing the occlusal portion of the posterior surface could compromise the durability of the remaining retainer.

The design of the OTP improves its mechanical strength and provides higher durability. The PETG in the outer layer is a hard polymer with good formability, fatigue resistance, optical qualities, and dimensional stability. The TPU in the middle layer is a soft polymer that has good elasticity. Moreover, the inner layer composed of a reinforced resin core has good wear resistance and mechanical strength. Because the resin core does not extend to the second molars, settling could be facilitated on the terminal molars. The middle TPU layer also has good elasticity, which allows the second molars to settle better into good occlusion.

Studies on retainer wear time have shown that part-time wear is preferred over full-time wear.[10,11] Thickett and Power[10] found no significant differences in occlusal stability and showed that part-time wear enables deeper overbite and more rapid settling than does full-time wear. We instructed our patients to wear the OTP when sleeping. This was not only easier for the patients but also increased compliance.

In this study, two adolescent girls and one adult woman used OTPs as retainers when sleeping at night. The second molars in two of the adolescent girls were not fully seated at debonding, and the adult patient's left mandibular molars were distally tipped, and hence, interdigitation of the molar teeth was not ideal at the completion of active treatment. However, at T2, the posterior molar occlusion demonstrated better interdigitation and increased occlusal contacts in all patients. Unlike reports of other full-coverage retainers, the OTP did not prevent favorable vertical settling of the second molars.

The results of this study show the potential of improved settling when using the OTP thermoplastic retainer. One might think that vertical deficiency, due to the core thickness, could restrict second molar eruption. However, we minimized the core volume to the central fossa area, not extending it to the buccal or palatal marginal ridges. The average thickness of the core was approximately 1 mm. After thermoforming, we did not find any clinically significant clearance on the second molar area. A further adaptability test would be necessary. Under repetitive insertion/removal of the appliance, the OTP showed good dimensional stability because of core integration, and the lateral wall of the appliance was well maintained without distortion or expansion. In contrast, the TPU layer on the second molar showed good elasticity, thereby permitting comfortable insertion and removal of the appliance even as the second molars changed their position during settling. OTP is a new alternative thermoplastic retainer that overcomes the reported limitations of other types of thermoplastic retainers, such as low wear resistance, fracturing, and poor settling.

OTP is mainly used on the maxillary dentition. We did not determine whether the vertical settling of the posterior teeth in this study was from the upper or lower molars, or both. Further studies could focus on the pattern of settling during OTP use. In this study, the period between T1 and T2 for each patient was different; therefore, we could not ascertain the optimal settling time. Determining the maximum settling time through periodic visits would be an interesting research topic. We expect that the night-time wearing of the OTP can be a preferred retention protocol.

CONCLUSION

During the use of the three-layered COR named OTP, patients showed favorable settling of the occlusion of the second molars. The OTP did not prevent vertical settling in the adolescent or adult patients. The OTP also has fewer limitations compared to the conventional COR and can be used as an effective retainer after active orthodontic treatment.

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