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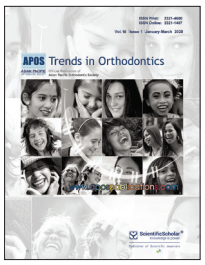

Experts Corner

Lingual bonded retainers: A case series of complications and resolutions

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ABSTRACT

Objective: The objective of the study was to describe the types, causes, and recommendations for the prevention/management of complications related with lingual bonded retainers (LBRs) during the retention period.

Materials and Methods: The retention protocol was a combined use of the LBRs made from 0.0175 multistrand wire and bonded on the maxillary and mandibular anterior teeth by DuraLay resin transfer method and a removable retainer at both arches for nighttime wear. Nine cases, which did not show bonding failure or fracture of LBR, were described to explain the complications including unexpected tooth movements and gingival problems.

Results: The types of complications were spacing, loss of alignment, change in transverse position, angulation or torque of the crown, gingival recession, and black triangle. There are three possible causes for these complications: (1) Active force generated by LBR, which was not passively fabricated or bonded, (2) deformation of LBR induced by heavy biting force or traumatic occlusion, and (3) untwisting force of strand in round flexible multistrand wire. These complications can be prevented or managed by (1) fabrication of LBR on a working model to make it passive, (2) use of a jig to position LBR during bonding to avoid deformation by finger pressure, (3) supplemental use of a removable retainer for nighttime wear, (4) early detection of bonding failure, deformation, or fracture of LBR, and (5) immediate removal of LBR and use of a new removable retainer for resolution of complications.

Conclusion: Clinicians should check the existence of these complications from the start of retention and inform the patient of the possibility of retreatment.

Keywords: Lingual bonded retainers, Unexpected tooth movements, Gingival problems

INTRODUCTION

Clinicians want to achieve long-term stability of orthodontic treatment outcome in their clinical practice. Lingual bonded retainer (LBR) is one of the most common retention appliances because it is invisible, well-tolerated, and effective in maintaining treatment results without patient compliance.[1-3] However, fabrication and bonding of the LBR passively on the lingual tooth surface are a technique-sensitive and time-consuming procedure.[4-6]

There are two types of stainless steel (ss) wires used for the LBR: Plain (solid) and multistrand wires. Since the plain ss wires have high stiffness, they are more resistant to deformation and torsion compared to multistrand ss wires.[3,7,8] However, multistrand ss wires have low stiffness, high springback, and high resilience, which can dissipate a low force over a long period of time and allow

the physiological tooth movement.[7,9,10] Therefore, it has been frequently used as appropriate material for the LBR.[5,11-15]

Approximately 10–53% of LBRs is known to fail because of bonding failure or fracture of wire.[1,6,12,15-17] Furthermore, if the intact LBR exerts undesirable active force on the aligned teeth by any reason, some complications including unexpected tooth movement and gingival problems can occur during the retention period.[3,6,10,14,18-20] The prevalence rate of these complications has been reported as 0.1%–5%.[19-22] Since unexpected tooth movement does not occur in the direction of the pre-treatment position of the tooth, it is different from relapse into crowding when an LBR is lost.[3] Therefore, the purpose of this case series report was to describe the types, causes, and recommendations for the prevention/management of unexpected tooth movement and gingival problems related with LBRs during the retention period.

CASES

The retention protocol was a combined use of (1) LBRs, which were made from 0.0175 multistrand wire (twist three-stranded ss wire; catalog number: 857–317, straight, American Orthodontics, Sheboygan, WI, USA), were bonded on the maxillary and mandibular anterior teeth by DuraLay resin transfer method[23] and (2) a removable retainer at both arches for nighttime wear.

Nine cases, which did not show bonding failure or fracture of the LBR, were described to explain the complications including unexpected tooth movements and gingival problems. The types of complications were spacing, loss of alignment, change in transverse position, angulation or torque of the crown, gingival recession, and black triangle.

These cases were treated and followed up by a single orthodontist (TKK) in his private clinic. This study was reviewed and approved by the Institutional Review Board of the Seoul National University Dental Hospital (ERI20003).

Case 1: Spacing between the maxillary central incisors [Figure 1]

A 14-year, 1-month-old girl visited the clinic with a chief complaint of crowding in the maxillary arch. After the extraction of four first premolars, she was treated with conventional fixed appliance. At 3 years and 2 months after debonding, a spacing between the maxillary right and left central incisors occurred. There was also no traumatic occlusion at the maxillary anterior teeth.

Case 2: Crown mesial angulation of the maxillary right lateral incisor [Figure 2]

A 13-year, 5-month-old girl complained of labioversion of the maxillary anterior teeth. After the extraction of four first premolars, she was treated with conventional fixed appliance. Although the treatment outcome was well maintained at 1 year after debonding, significant crown mesial angulation of the maxillary right lateral incisor was observed at 4 years and 4 months after debonding, which could be also confirmed in the panoramic radiograph.

Case 3: Crown mesial angulation of the maxillary left central and lateral incisors [Figure 3]

An 11-year, 4-month-old girl visited the clinic with a chief complaint of high canine in the maxillary arch. After the extraction of the maxillary and mandibular first premolars, she was treated with conventional fixed appliance. At 2 years and 6 months after debonding, there was slight change in the angulation of the maxillary left central incisor. Then, at 6 years and 8 months after debonding, significant crown

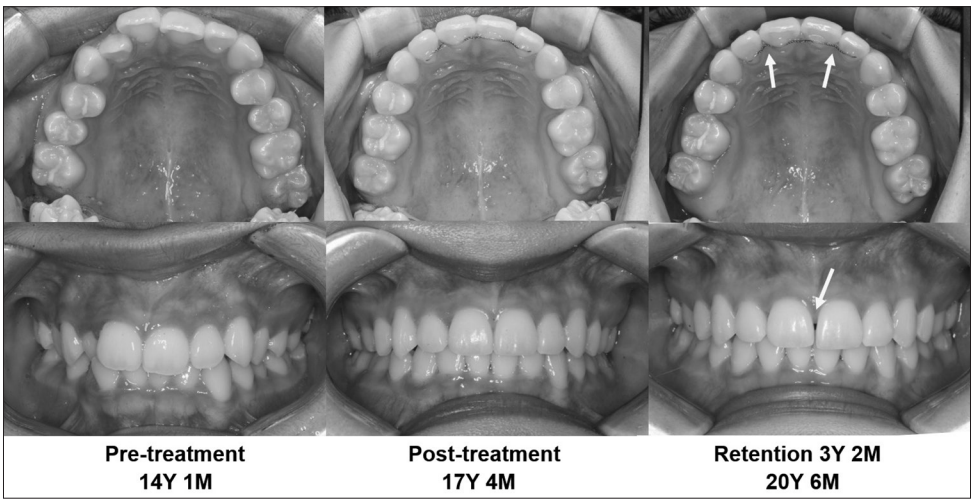

Figure 1: Occurrence of spacing between #11 and #21.

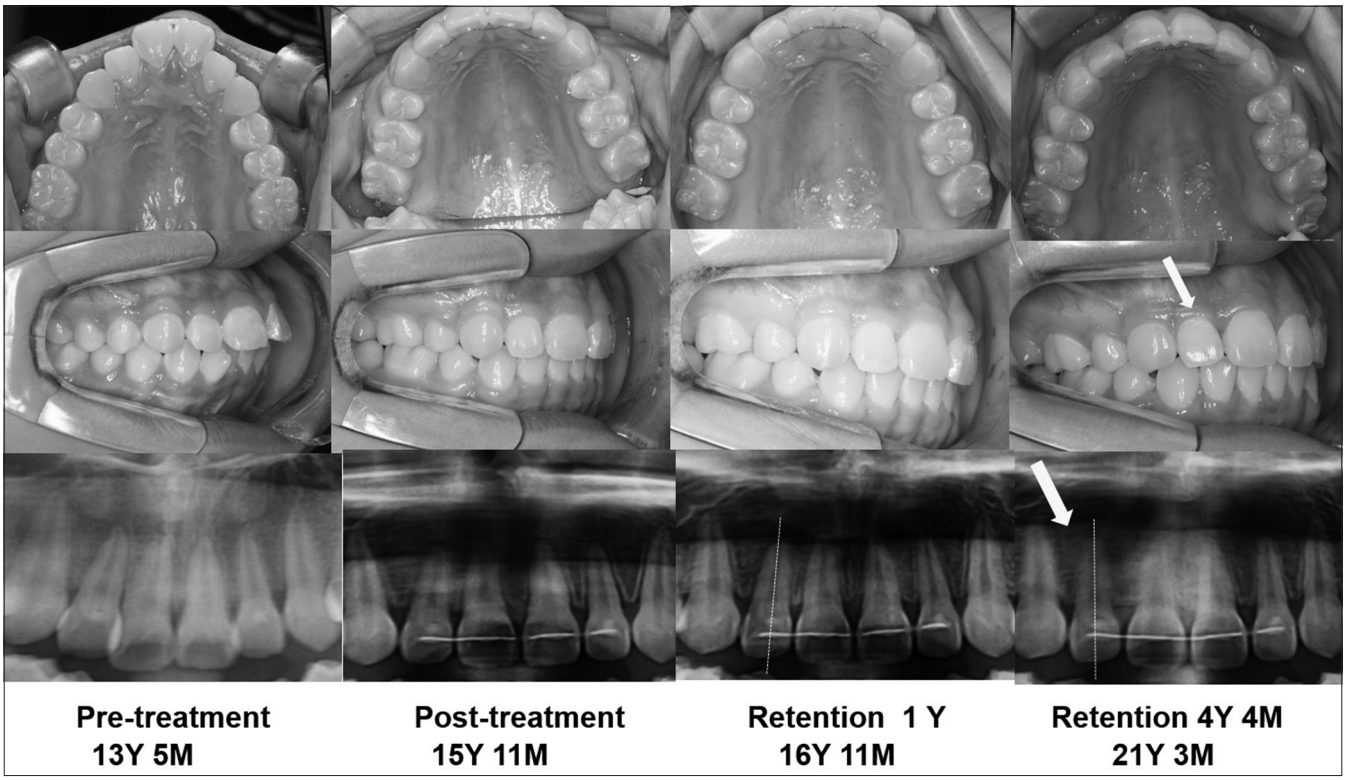

Figure 2: Occurrence of crown mesial angulation of #12.

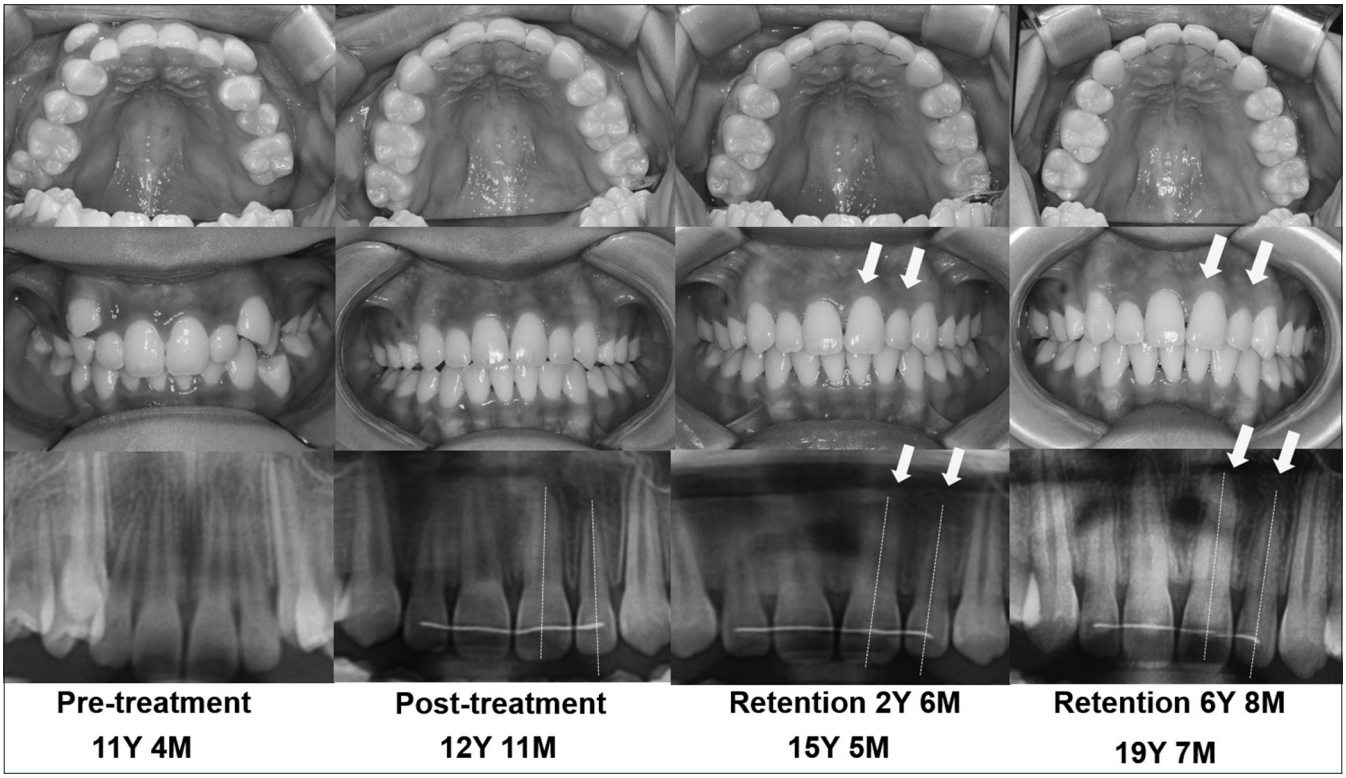

Figure 3: Occurrence of crown mesial angulation of #21 and #22 and black triangle between #11 and #21.

mesial angulation of the maxillary left central and lateral incisors was observed in the panoramic radiograph, resulting in prominent black triangle between the maxillary right and left central incisors.

Case 4: Crown labial torque of the maxillary left central and lateral incisors [Figure 4]

A 14-year, 6-month-old girl had a chief complaint of labioversion of the maxillary anterior teeth. After the extraction of four first premolars, she was treated with conventional fixed appliance. At 5 years and 6 months after debonding, significant crown labial torque of the maxillary left central and lateral incisors and difference in the incisal edge position between the maxillary right and left incisors were observed.

Case 5: Crown labial torque of the maxillary right lateral incisors and its resolution [Figure 5]

A 15-year, 10-month-old girl complained of labioversion of the maxillary anterior teeth. After the extraction of the maxillary first premolars, she was treated with conventional fixed appliance. At 2 years and 6 months after debonding, significant crown labial torque of the maxillary right lateral incisor was observed. During the next 10 months, there was no significant change in torque of the maxillary right lateral incisor. After the LBR of the maxillary arch was removed, a new removable retainer was used on the maxillary arch during nighttime. At 6 years and 5 months after debonding, there was an improvement in torque of the maxillary right lateral incisor.

Case 6: Crown lingual torque of the mandibular left central incisor and its resolution [Figure 6]

An 11-year, 4-month-old girl visited the clinic with a chief complaint of labioversion of the maxillary anterior teeth. After the extraction of the maxillary first premolars, she was treated with conventional fixed appliance. At 2 years after debonding, slight change in torque of the mandibular left central incisor was observed. Then, at 5 years and 9 months after debonding, significant crown lingual torque and gingival recession of the mandibular left central incisor occurred. Therefore, the LBR of the mandibular arch was removed. At 6 years and 6 months after debonding, the degree of crown lingual torque and gingival recession of the mandibular left central incisor were decreased.

Case 7: Crown lingual torque and change in the transverse position of the mandibular right canine [Figure 7]

A 12-year, 10-month-old girl complained of crowding in the maxillary anterior teeth and the mandibular three incisors. She was treated with non-extraction approach using conventional fixed appliance. At 3 years and 7 months after debonding, significant crown lingual torque and change in the transverse position of the mandibular right canine occurred due to premature contact with maxillary right lateral incisor. Since the LBR in the mandibular arch was not removed, the degree of the crown lingual torque and change in the transverse position of the mandibular right canine were still maintained at 7 years and 1 month after debonding.

Case 8: Gingival recession in the mandibular left central incisor [Figure 8]

A 26-year-old female patient visited the clinic with a chief complaint of crowding in the maxillary and mandibular arches. After the extraction of four first premolars, she was treated with conventional fixed appliance. Since this patient was adult and had large amount of crowding in the mandibular arch, gingival recession in the mandibular anterior teeth was expected. After treatment, significant

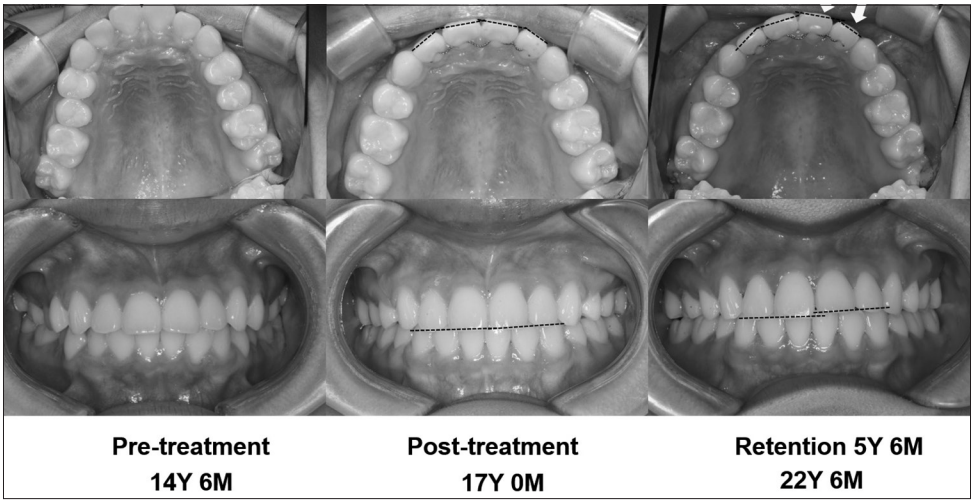

Figure 4: Occurrence of crown labial torque of #21 and 22 and difference in the incisal edge position between #11, 12, 21, and 22.

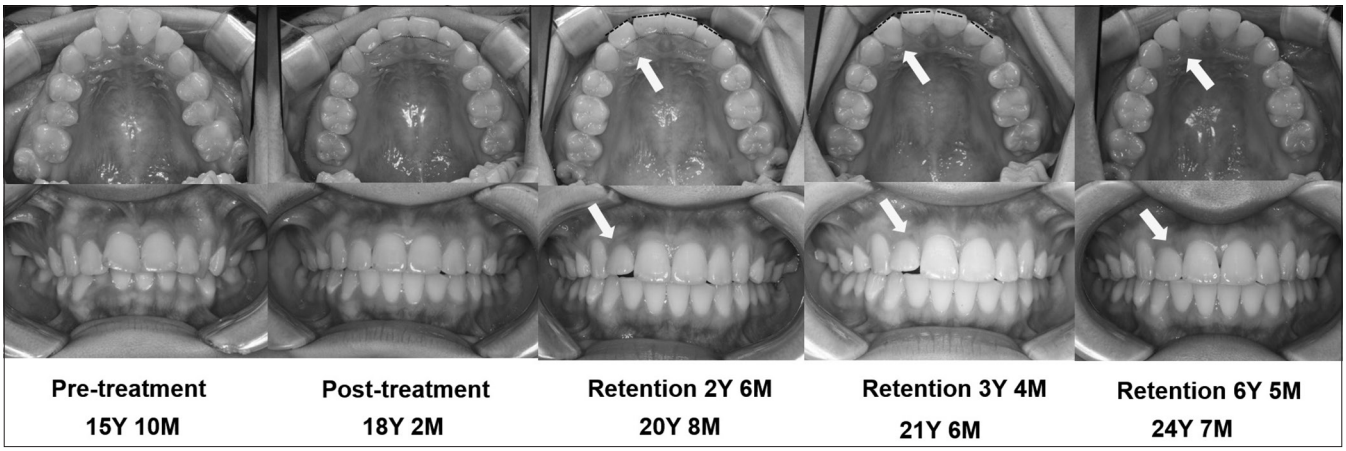

Figure 5: Occurrence of crown labial torque of #12 and its resolution after the removal of lingual bonded retainer.

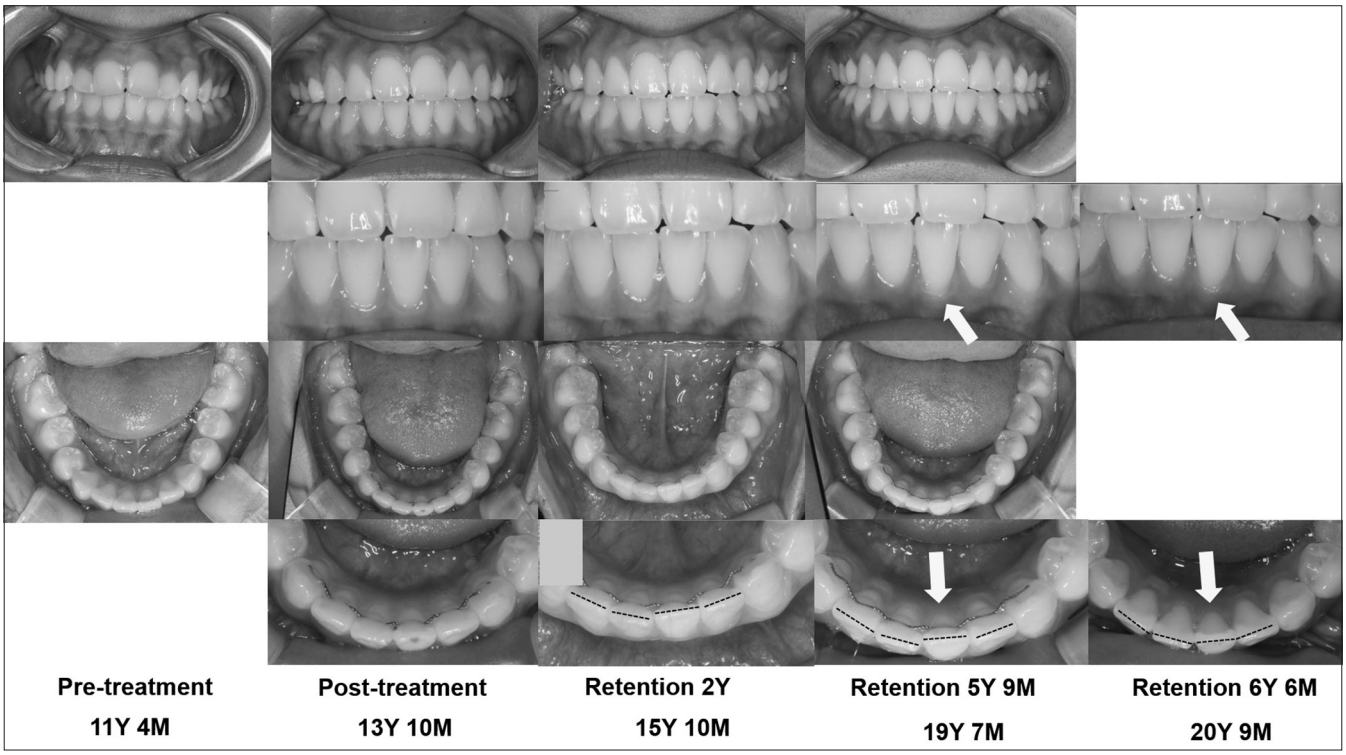

Figure 6: Occurrence of significant crown lingual torque and gingival recession of #31 and its resolution after the removal of lingual bonded retainer.

gingival recession in the mandibular left central incisor and right canine was observed. At 2 years and 6 months after debonding, the amount of gingival recession in the mandibular left central incisor was increased. At that time, the LBR in the mandibular arch was removed and a new removable retainer was used in the mandibular arch. When she visited the clinic at 6 years and 10 months after debonding, she told that she had not used the removable retainer in the mandibular arch. Although the amount of crowding was increased in the mandibular arch due to the removal of the LBR and no use of the removable retainer, there was an improvement of gingival recession in the mandibular left central incisor.

Case 9: Black triangle between the mandibular right and left central incisors [Figure 9]

A 24-year, 3-month-old female patient complained of severe crowding in the maxillary and mandibular arches. After the extraction of four first premolars, she was treated with conventional fixed appliance. Since this patient was adult and had large amount of crowding in the mandibular arch, black

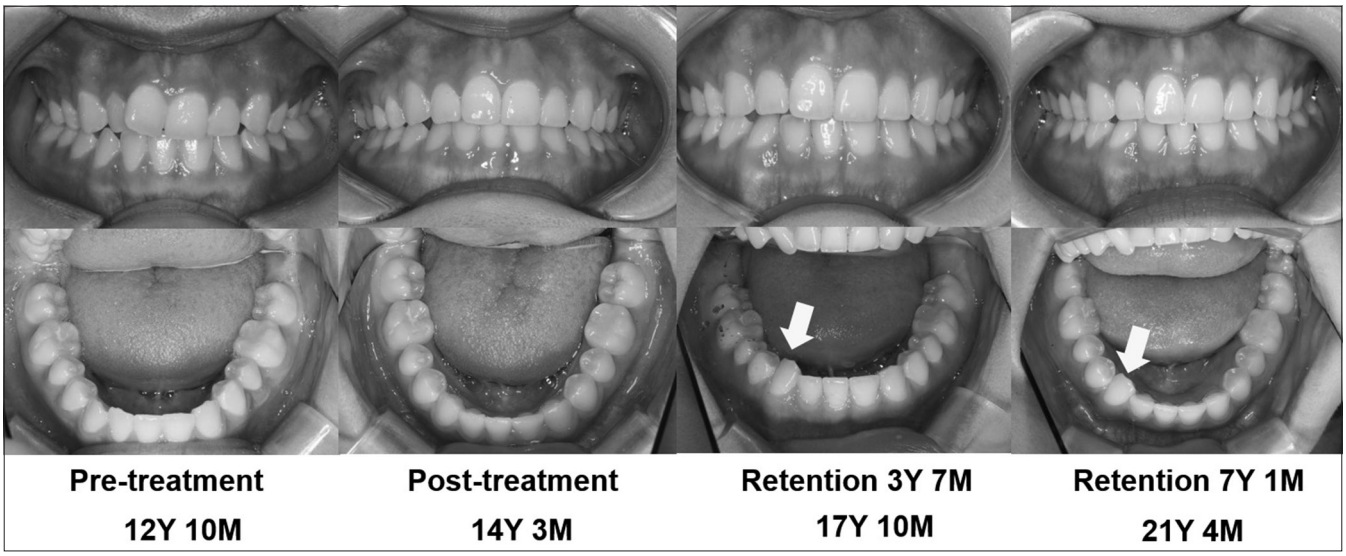

Figure 7: Occurrence of crown lingual torque and change in the transverse position of #43.

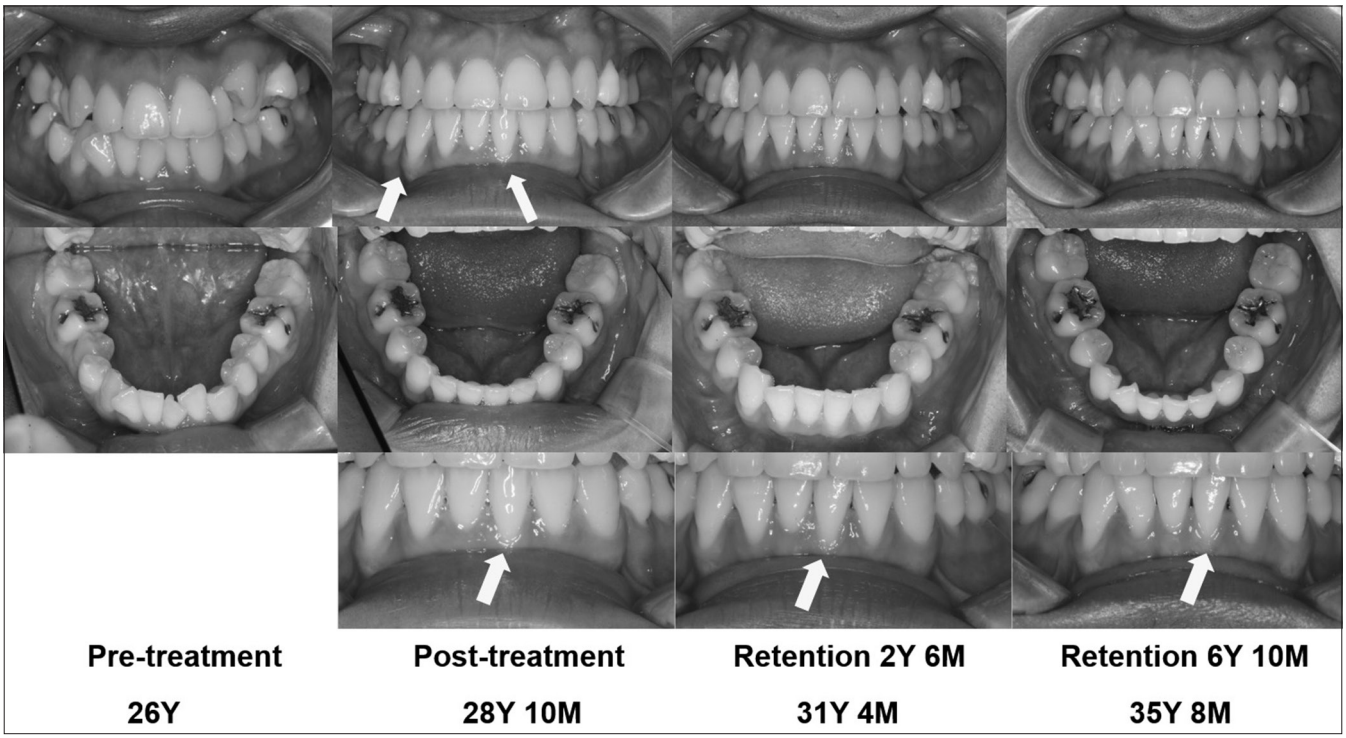

Figure 8: Occurrence of gingival recession of #31 and its improvement after the removal of lingual bonded retainer.

triangle in the mandibular anterior teeth was expected after decrowding. At the debonding stage, black triangle between the mandibular right and left central incisors occurred. Then, at 4 years and 1 month after debonding, a black triangle between the mandibular right and left central incisors became prominent compared to the debonding stage. Therefore, the LBRs of the maxillary and mandibular arches were removed and new removable retainers were used for both arches. When she visited the clinic at 10 years after debonding (3 years follow-up without use of the removable retainers), the size of black triangle between the mandibular right and left central incisors reduced.

DISCUSSION

Causes of complications related with LBRs

There are at least three causes of unexpected tooth movement and gingival problems during retention period: (1) Active

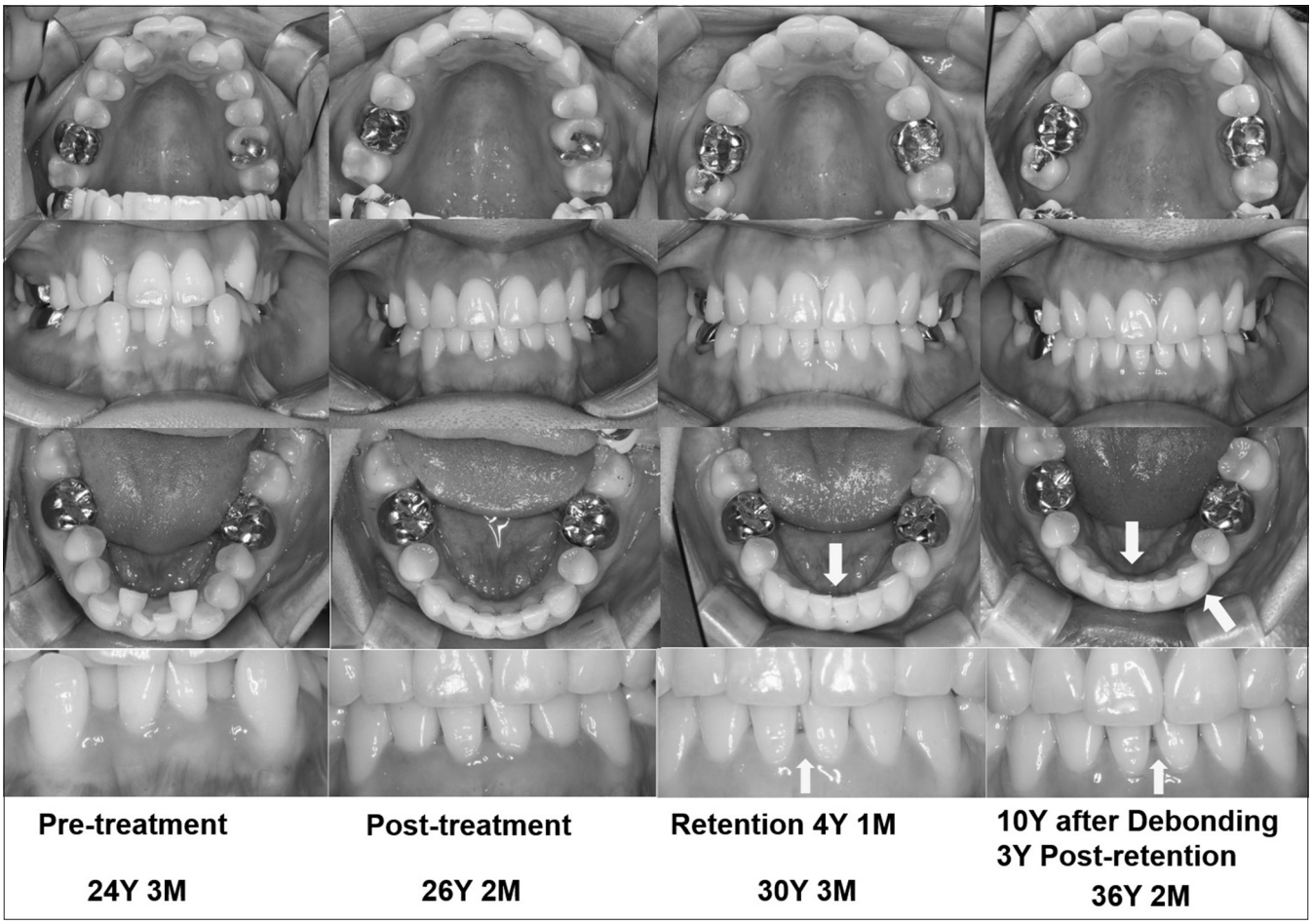

Figure 9: Occurrence of black triangle between #31 and #41 and its resolution after the removal of lingual bonded retainer.

force generated by the LBR, which was not passively fabricated or bonded, (2) deformation of the LBR induced by heavy biting force or traumatic occlusion, and (3) untwisting force of a single strand or strands in flexible multitrand round wire.[3,9]

Clinical considerations in terms of mechanical properties of the wire

Although a dead soft wire is an ideal choice of the LBR for patients with complex anatomy of the lingual surfaces, it is the most likely to be fractured and/or deformed but is the least likely to create torque problems.[3] Since deformation of wire can move teeth in an unexpected way, Sobouti *et al.*[6] suggested that a more flexible but stronger wire than a dead soft wire might be advantageous in terms of low bonding failure, low fracture/deformation, and reduced chairside time. The reason that Case 1 showed spacing between the maxillary right and left central incisors [Figure 1] seems that a portion of wire with a big bending between the maxillary right central and lateral incisors might be more susceptible to deformation by heavy biting force or traumatic occlusion, resulting in spacing between the maxillary right and left central incisors.

In *in vitro* experiment using the LBR bonded on an acrylic resin model, Sifakakis *et al.*[8] reported that 0.2 mm simulated intrusion-extrusion and buccal-lingual movements of the wire of the LBR could generate more than 1 N of force. Therefore, if heavy biting force or traumatic occlusion causes temporary or permanent deformation of the wire of the LBR rather than its bonding failure, it would produce unexpected tooth movement during retention period.

In measurement of resistance to torsional moments acting on the wire of the LBR, Arnold *et al.*[9] reported that multistrand round ss wire exhibited a lower resistance to torque compared to plain or multistrand ss rectangular wire. Therefore, when heavy biting force or large amount of torsional moment is expected, a plain or multistrand ss rectangular wire should be used for the LBR to prevent unwanted torque of the crown.

Change in angulation and/or torque of the crown can be induced by the following three factors: (1) When an intact

LBR was not passively bonded, (2) when an intact LBR is distorted by heavy biting force or traumatic occlusion, or (3) when the wire of the LBR fractures but still remains bonded to some or all teeth.[3]

If untwisting of a single strand or strands in the flexible multistrand wire bonded to each tooth occurs despite intact LBR, the mechanical property of this wire can be changed. If it produces reciprocal movement of the adjacent tooth or teeth, there would be consecutive changes in transverse position and/or torque of teeth and skewing of the arch form.[3] The reason that Case 5 showed significant crown labial torque in the maxillary right lateral incisor [Figure 5] seems that the untwisting effect of multistrand wire occurred at the right side terminal portion of the LBR.

Clinical considerations in terms of gingival problems

There has been controversy on the effects of the LBRs on periodontal health. Although several previous studies reported that it did not have any negative effects on periodontal health,[24-26] Pandis *et al*.[27] and Levin *et al*.[28] insisted that orthodontic treatment combined with LBRs promoted gingival recession. Furthermore, Renkema *et al*.[29] reported that the prevalence of gingival recession increased from the initial (7%), debonding (20%), to the 5 years retention status (38%). Since gingival health was improved after removal of the LBR in Cases 8 and 9 [Figures 8 and 9], these findings suggest that existence of LBR might hinder normal healing response of the gingival tissue.

Prevention or management of complications related with LBRs

These complications can be prevented or managed by (1) fabrication of the LBR on a working model to make it passive when bonded into position, (2) use of a jig to position the LBR securely during bonding to avoid deformation by finger pressure, (3) supplemental use of a removable retainer for nighttime wear that fits over the LBR, (4) early detection of bonding failure, deformation, or fracture of the LBR, and (5) immediate removal of the LBR and use of a new removable retainer for resolution of complications.[3]

Although the LBR made with a multistrand wire does not give significant harmful effects on the hard and soft tissues, there might be several problems in the cellular level. Therefore, it is necessary to determine in which cases the LBR is recommended or not and to investigate the circumstance, reason, and timing of removal of the LBR using a multicenter study and systematic statistical analysis.

CONCLUSION

- Clinicians should carefully check the existence of unexpected tooth movement and gingival problems from the start of retention and inform the patient the possibility of retreatment.

Declaration of patient consent

Patients consent not required as patients identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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