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A technique using resin composite with orthodontic wire to replace a missing tooth rapidly

CASE REPORT

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Abstract – A missing incisor or premolar tooth that requires a quick functional and esthetic repair, such as the case of tooth loss caused by trauma needs quick conservative treatment to maintain sound abutment teeth. The use of resin composite for direct fixed partial denture (FPD) can reduce problems associated with metal substructures, such as esthetic limitations and preparation of abutment teeth. However, mechanical failure of direct FPD often occurs because of design limitations and poor fabrication. This case report describes a direct resin composite FPD combined with an orthodontic wire framework. A small enamel dimple was prepared below the contact area, and a U-shaped wire was formed and positioned in the prepared enamel dimples and bonded with resin cements. An alloy primer was applied to the surface of the wire, which was coated with adhesive resin and veneered with resin composite. The finishing of the margins and final polishing were completed a week after insertion. The FPD was contoured using fine composite diamond finishing burs and polished with silicone points. The combination of the U-shaped wire and an enamel dimple below the contact area has shown good results over a period of more than 12 months in these two cases.

Bonding to tooth structure using resin-based materials has become more popular in recent years due to improvements in reliability and bond strengths. This allows tooth preparation to be minimal (1), and association with a high bond strength can be maintained for a long period to the remaining tooth after restoration placement (2, 3). Minimal preparation can also preserve enamel as the adhesive bonding substrate allowing a strong, reliable bond. The technique of resin composite for direct fixed partial denture (FPD) can be used with some success as a provisional or transitional approach in particular trauma cases. Mechanical failure of direct FPD often occurs because of poor design and fabrication, occasionally with rapid caries progression on abutment teeth (4, 5).

Various wire alloys are used in orthodontic treatment and removable prosthodontics. Due to their good flexibility and ability to be fabricated into various shapes, orthodontic wires have also been used for periodontal splinting. Thus the same wire is useful to form the framework for a simple adhesive FPD.

There are times that a quick functional and esthetic repair is needed for a missing incisor or premolar, such as the case of tooth loss caused by trauma, or root fracture of a dowel-retained crown requiring extraction. Often these cases need a short to medium-term replacement to maintain abutment teeth, and occlusion, with good esthetic outcome. This can be achieved with a direct restoration using a resin composite FPD combined with an orthodontic wire framework.

This study presents two cases, a missing premolar caused by root fracture and a retained primary canine that required removal resulting from trauma, where this technique was successfully used over a 12-month follow-up.

Case 1

A 44-year-old male, presented with a missing upper right first premolar resulting from a root fracture (Fig. 1). After radiographic examination, the decision was made to insert a direct resin composite FPD.

A small enamel dimple (0.8 mm wide × 1.0 mm deep) was prepared below the contact area using a diamond bur (ISO#009; Shofu Inc., Kyoto, Japan) without local anesthesia (Fig. 2). A 0.7-mm diameter cobalt-chromium alloy wire for orthodontic use (Dentsply-Sankin, Tokyo, Japan) was formed into a U-shape (Fig. 3). The wire was gripped about 10–15 mm from the end using orthodontic pliers (Fig. 3a), and then bent to form a U-shape at the

Fig. 1. Preoperative view: missing the upper right first premolar.

Fig. 2. A small enamel cavity was prepared below the contact area.

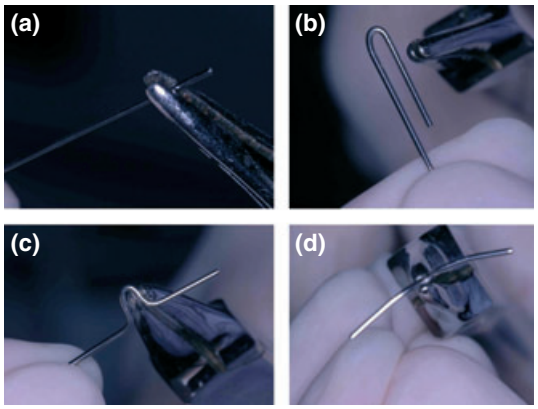

Fig. 3. Wire framework procedure for U-shaped design.

center (Fig. 3b). The centre of the U-shape is gripped, then bent outwards (Fig. 3c). Finally, the U-shaped portion is bent to follow the contour of the arch (Fig. 3d). The formed wire was portioned into the prepared enamel dimples using the orthodontic pliers and bonded with the auto cured resin cement Super Bond C&B (Sun Medical Co., Kyoto, Japan) (Fig. 4). A

Fig. 4. The formed wire was located into the prepared enamel cavities and then bonded with Super Bond C&B.

plastic matrix strip was placed on the mucosa beneath the pontic, so as to form a smooth tissue surface of the resin composite pontic against the soft tissue. An alloy primer (Alloy Primer; Kuraray Medical Inc., Tokyo, Japan) was applied to the surface of the wire, which was then coated with the self-etching adhesive system Clearfil SE Bond (Kuraray Medical Inc.) according to the manufacturer's instructions and veneered with the hybrid resin composite (Clearfil AP-X; Kuraray Medical Inc.). For an adhesive resin system, there are many commercially available systems with different chemical components and procedural steps. In the three-step resin bonding system, the first step involves applying 37% phosphoric acid to demineralize the dentin surface, this is followed by a priming step and the application of adhesive resin. Most recent developments have focused on simplification of the multi-step bonding process (6). The two-step, self-etching primer system is one of the bonding systems developed to simplify and shorten bonding procedures by combining the dentin conditioning and priming steps, and it provides high bond strength to enamel and dentin (7). The resin composite was applied to form the pontic in two or three increments (Fig. 5), which were light-cured for 40 s each. To obtain adequate retention of the FPD, a small area of resin

Fig. 5. The resin composite was applied to form the whole pontic.

composite was extended from the pontic to the approximal surfaces of the abutment teeth. Excess resin composite adjacent to periodontal tissues was removed before polymerization. Occlusal adjustment in the intercuspal position, as well as protrusive and laterotrusive positions, was accomplished and checked again at a 1-week follow-up examination. Occlusal adjustment is made to ensure minimal occlusal contact in all jaw positions to reduce the forces on the pontic. The FPD was contoured using fine composite finishing diamond burs (ISO#248/012, 248/014, 243/010, GC Co., Tokyo, Japan) in a slow-speed handpiece under water spray and polished with silicone points (ISO#13S; Shofu Inc.) (Fig. 6). The finishing of the margins and final polishing was completed a week after insertion. In this case, the patient was viewed at 3, 6, 12 and 15 months, with the FPD remaining intact without any problem (Fig. 7).

Case 2

A 63-year-old male had a primary canine retained in the position of the lateral incisor that required removal (Fig. 8). After radiographic examination, the decision was made to extract this primary canine and construct a direct resin composite FPD because of the absence of the second incisor (Fig. 9).

A small enamel dimple was prepared below the contact area (Fig. 10), the U-shaped wire was formed and then portioned in the prepared enamel dimples and bonded with Super Bond C&B, and then a plastic matrix strip was placed on the mucosa beneath the pontic which was constructed using the same technique as in case 1 (Figs 11 and 12). The patient was recalled at 3, 6 and 12 months, without problems occurring.

Fig. 6. Final result.

Fig. 7. 15 months after insertion.

Fig. 8. Preoperative view: retained primary canine that required removal.

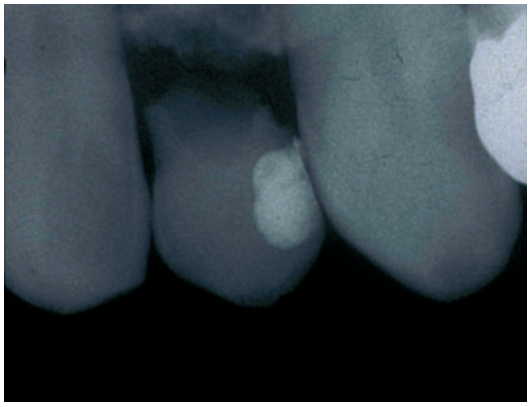

Fig. 9. Radiograph showing the absence of upper left second permanent incisor.

Fig. 10. One week following extraction of primary canine. A small enamel cavity was prepared below the contact area.

Fig. 11. A plastic strip was placed on the mucosa beneath the pontic.

Fig. 12. Final result.

Discussion

This technique was used for three other cases. Support by the approximal enamel dimples provides resistance form for the FPD to resist occlusal forces. A different design was initially used where a 'straight wire' was employed and the enamel dimple prepared at the level of the marginal ridge. The marginal ridge enamel dimple cases failed frequently due to debonding of the connector from the enamel dimples. It is believed that occlusal loading, and repeated stresses and differential movement of the abutment teeth resulted in debonding of the adhesive joints leading to failure (8). When the enamel dimple is located below the contact area, the ends of the wire are completely supported by surrounding enamel providing resistance to movement. Debonding of the composite from the wire was also observed in the 'straight-wire' cases; this was due to the resin composite on the occlusal side of the wire being too thin and unable to resist occlusal forces. The 'U-shaped wire' allows a much greater surface area to maximize the retention of the resin composite, and the composite is thicker in the central occlusal part of the pontic.

For the direct resin composite FPD, the lateral extent of the resin composite connector is necessary to aid retention of the FPD. The design of the adhesive FPD should try to maximize the bonding area on the buccal/lingual surfaces of the abutment teeth for the resin composite pontic, as this will also assist with obtaining good resistance to dislodging forces.

The direct resin composite FPD with orthodontic wire framework is a simpler alternative solution than the more complicated bonded FPD. The advantages of this direct FPD are that it conserves tooth structure, is esthetic, and can be conducted chairside in one appointment. The ideal clinical situation for this simple approach includes tooth replacement following tooth loss from trauma or in medically compromised patients who are unable to sit for extended periods of time or tolerate local anesthesia. This type of FPD can also be used as a space maintainer following orthodontic treatment or in young patients who may be considered not ready for 'permanent' restoration such as an implant (9–11).

Conclusion

The combination of the U-shaped wire and an enamel dimple below the contact area has shown good results over a period of more than 12 months.

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