Restoration of an Endodontically Treated Tooth Utilizing a Single-Unit Crown and Core System

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The Challenge

Recent advances in biomaterials and adhesive technology have allowed the fabrication and delivery of conservative indirect restorations that exhibit increased strength and function as well as a natural appearance.[1] Contemporary adhesive systems, for instance, have demonstrated the capacity to bond at strength values that approach or equal those of vital tooth structure.[2,3] In addition, the enhanced physical properties of adhesive materials have positively impacted the utilization of full-coverage crown restorations on endodontically treated teeth. The reduced wear characteristics (particularly to the opposing dentition)* and polymerization shrinkage as a result of improved laboratory processing have indicated the use of adhesive restorations as a viable alternative to methods that employ conventional cementation principles.

Endodontically treated teeth have traditionally been restored with various metal post and core systems. This treatment modality was utilized to prevent the tooth from fracturing due to the brittleness of the remaining tooth structure, and to aid in the long-term retention of the definitive full-coverage crown restoration.[3] It has been demonstrated that brittleness is the result of dramatic architectural changes that occur during the preparation of access openings and the extent to which the majority of these teeth are extremely compromised with either decay or large amalgam restorations.[6,7] The use of posts has also been a primary topic of debate in the last five to ten years. It has recently been concluded that a post neither reinforces nor strengthens the root, and in fact may be detrimental to the root of a tooth as a result of increased fracture potential. According to numerous clinical investigations, a post should only be used as a means of providing retention for full-coverage crown restorations in situations where excessive tooth loss is exhibited.[8,9] This option is also becoming undesirable due to the aggressive removal of healthy tooth structure required and the ability of bonding agents to strengthen teeth. Due to the wide use of magnification (eg, loupes, operating microscopes) in dental operatories, clinical preservation of the root and coronal aspect of the tooth is increasingly feasible. As a greater degree of tooth structure is maintained, increased strength, flexibility, and aesthetics can be achieved in the endodontically restored tooth through the utilization of adhesive restorations.

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Patient Presentation

A 47-year-old female patient presented following the successful completion of endodontic treatment that involved teeth #18(37) and #19(36) (Figure 1). An extensive clinical evaluation revealed that no thermal or occlusally advanced symptoms were evident, and radiographic analysis demonstrated no obvious signs of pulpal pathology. The patient's medical history, general health, and periodontal condition were all within normal parameters. Despite undergoing a dental emergency in which teeth #18(37) and #19(36) experienced an acute flare-up of pulpitis, the patient elected not to restore adjacent tooth #20(35). Based on these criteria, a decision as to the optimal method of treatment had to be rendered by the clinician.

Figure 1. Preoperative view of compromised posterior teeth following the completion of endodontic treatment.

The Solution

Based on the existence of irreversible pulpitis, advanced marginal breakdown around the amalgam restorations, and the patient's desire for tooth preservation and an enhanced aesthetic appearance, a treatment plan was formulated. Following a discussion of various traditional core and crown restorative modalities, the patient approved the utilization of an adhesive single-unit crown and core system (Monobloc)[10] that would provide increased resistance to root fracture.[11]

Clinical Procedure

Once the patient was anesthetized and shade taking was accomplished, intraoral camera prints and color photographs were obtained. A detailed color prescription was developed, a rubber dam was placed to facilitate moisture control, and the failing amalgam restorations and provisional materials were subsequently removed under copious irrigation. Caries detection material (Seek, Ultradent Products, South Jordan, UT) was applied and the remaining carious tooth structure was removed. Large horizontal cracks were evident on the buccal and lingual aspects of tooth #18(37) and the buccal aspect of tooth #19(36). While the obvious leakage and wedging effect of the restorations necessitated an aggressive preparation, the resulting dimensions were conservative in comparison to those required for traditional full-coverage crown restorations (Figures 2 and 3). The preparations for the laboratory-fabricated composite resin restorations exhibited a minimum depth of 1.5 mm in the fissure area and a minimum isthmus width of 1.5 mm. The axial walls of the proximal box area were exposed with a cavo-surface angle of approximately 60 to 80 degrees. The final impressions were made with a polyvinylsiloxane impression material (Half Time, Discus Dental, Culver City, CA). The preparations were cleansed with a 2% chlorhexidine solution (Consepsis, Ultradent Products, South Jordan, UT) and lightly air dried without desiccation prior to provisionalization with a medium-heavy material (Fermit-N, Ivoclar Vivadent, Amherst, NY) while the definitive restorations were fabricated in the laboratory (Figures 4 and 5).

Following approximately three weeks of provisionalization, a rubber dam was placed and the restorations were removed. The preparations were initially cleansed with hydrogen peroxide and the 2% chlorhexidine solution. The teeth were then lightly air dried, and the definitive restorations were tried-in and clinically verified for marginal fit, contour, and interproximal contacts. The restorations were subsequently removed from each preparation and all internal aspects were cleansed utilizing phosphoric acid. A prehydrolized silane coupling agent (Ceramic Primer, 3M Dental, St. Paul, MN) was then applied to the internal aspect of the restoration in order to improve the chemical bond between the polymers in the resin luting cement and the ceramic filler particles and glass fibers in the laboratory-fabricated

Figure 2. Due to the leakage and wedging effect of the amalgam restorations, a preparation design was required that was more aggressive than originally anticipated.

Figure 3. Occlusal view of the master model demonstrates the required preparation design.

Figure 4. The adhesive single-unit crown and core system has demonstrated increased strength characteristics and the ability to distribute occlusal forces evenly to the roots.

Figure 5. The definitive restoration is tried-in on the master model prior to seating.

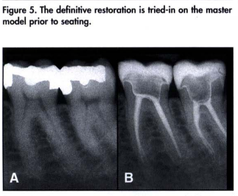

Figure 6A. Preoperative radiograph prior to endodontic and prosthetic treatment. Figure 6B. Postoperative radiograph depicts integration of single-unit crown and core.

Figure 7. The definitive restorations exhibit optimal form, function, and aesthetics.

composite. Excess silane was evaporated with an air drier following one minute of saturation.

The preparations were once again disinfected, thoroughly rinsed, and etched for 10 to 15 seconds using a 35% phosphoric acid solution. A second antimicrobial solution (Tubilicid Red, Global Dental, North Bellmore, NY) was used to rehydrate the dentin and decrease the bacterial count. In order to establish a hybrid layer, multiple coats of a hydrophilic dentinal primer (Optibond, Kerr/Sybron, Orange, CA) were applied to the moist surface and allowed to penetrate into the dentin tubules. Any excess alcohol from the primer was lightly air thinned. A dual-cured, radiopaque luting resin (Variolink II, Ivoclar Vivadent, Amherst, NY) was mixed carefully and placed into the preparations prior to seating the restorations with firm pressure. Excess luting material was removed, and the restorations were spot tacked in place using a 3 mm light guide attached to a curing light for 10 seconds on the buccal and lingual surfaces. Excess resin was removed interproximally using dental floss. All exposed margins of the restorations were then coated with a glycerin layer (De-ox, Ultradent Products, South Jordan, UT) to eliminate the potential formation of an oxygen-inhibiting layer. Final polymerization was achieved using a plasma arc light. Excess polymerized cement was removed utilizing a curette and carbide and diamond finishing burs. Proper occlusion and anatomy were established, and final polishing was accomplished. The postoperative evaluation revealed two aesthetic restorations that exhibited optimal form, function, and strength (Figures 6 and 7).

Conclusion

The demand for restorations that replicate natural dentition has risen with the increasing level of patient awareness. Contemporary materials, techniques, and proper training have enabled clinicians to deliver restorations that are virtually indistinguishable from the adjacent dentition, and that exhibit long-term function and aesthetics.

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