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Multidisciplinary approach in the treatment of subgingivally fractured anterior teeth

CASE REPORT

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Abstract – With the advances in adhesive technology, dentists have gained great popularity with their esthetics treatment options. The enamel and partially dentin adhesive systems have proved their potential effect. This study presents the multidisciplinary approach in the treatment of subgingivally fractured anterior teeth. Empress II crowns were cemented entirely on the prepared root portion of a left maxillary lateral incisor and canine after orthodontic eruption. The clinical results after 2 years were successful.

During the past decade the demand for non-metallic, highly biocompatible dental restorative material has increased markedly with the introduction of bonding procedure and new luting techniques, ceramics systems and inlays are preferred as alternatives to traditional material (1–3). With the advances in bonding techniques and materials, the bond strengths of dental ceramics to dentin now approximate to the bond strength of ceramic to enamel (4).

The Lithia-based glass ceramic and the flooroapatite-based glass ceramic of the IPS Empress 2 System (Ivoclar -Vivadent, Schaan, Liechtenstein) offers clinical benefits in terms of machinability, polishability and reduced wear of opposing tooth structure (5).

The bond to cement or dentin always represents the critical interface because the composition and morphology of these complex tissues are impossible to standardize (6, 7). Therefore, bonding to dentin and cement is not yet as predictable as is bonding to enamel (3). Thonemann et al. (8) reported warnings against the bonding to the cervical dentin. Frankenberger (9) evaluated any clinical failure for the inlay whose margins were located below the cemento-enamel junction.

Fracture of a tooth below the gingival attachment or crest of the alveolar bone presents a very difficult restorative problem. Such fractured teeth are often considered hopeless and are consequently extracted (10). Lengthening the clinical crown by removing supporting bone to expose sound tooth structure is the solution generally recommended (11). In 1973, Heithersey (12) and in 1976 Ingber (13) published articles on the use of forced eruption in the management of non-restorable teeth. The prosthetic rehabilitation of subgingivally fractured teeth patients has been previously reported by many authors (10–22). All of them used the conventional forced eruption technique. Forced eruption is indicated primarily in the anterior region of the dentition where esthetics is a major concern (14). However, controlled eruptive tooth movement alters the contour of gingival and osseous margin of the erupting tooth (13, 23). In 1988, to prevent the necessity for the extensive crown-lengthening surgery after forced eruption, a technique of crown-lengthening procedure which combines controlled eruptive tooth movement with repeated circumferential intrasulcular incision was examined by Kozlovsky et al. (23).

The aim of this study was to present the construction of Empress II crowns on the root portion of the subgingivally fractured anterior teeth after orthodontic and periodontal treatment.

Case report

A 24-year-old male patient was referred to the Dental Faculty of Marmara University with diagonally fractured crowns of left maxillary lateral incisor and left maxillary canine and an enamel fracture of a left maxillary central incisor. The fractured lines of the left maxillary lateral incisor and left maxillary canine were below the buccal gingival margins. Radiographic examinations showed no abnormality and enough root length. The teeth were treated endodontically (Figs 1, 2). While forced eruption technique was going on (Fig. 3), a circumferential supracrestal fiberotomy was performed twice every 2 weeks and root planning to the level of the bony crest was carried out (Fig. 4). After a total of 6 weeks, teeth were stabilized for 4 weeks. At the end of the stabilization period, a limited periodontal crown-lengthening procedure was performed to level the gingival margins and the underneath bone structure for esthetic requirements (Fig. 5). The examination after 6 weeks of surgery demonstrated that the clinical lengths of the abutment teeth were sufficient, and so, complete ceramic crown restorations were chosen to restore the

Fig. 1. Initial frontal view.

Fig. 2. Radiographic view of endodontic treatment.

Fig. 3. Initial orthodontics' eruption procedure.

Fig. 4. Final view after orthodontic extrusion and circumferential supracrestal fiberotomy.

Fig. 5. Minor periodontal surgery before the tooth preparation.

left maxillary lateral incisor and left maxillary. It was decided to construct a ceramic laminate veneer that covered the labial proximal and incisal surface of the left maxillary central incisor to maintain esthetics.

Tooth preparations

Tooth preparations were completed with a circumferential shoulder with rounded internal line angle for the left lateral incisor and left maxillary canine root portion. Cervical chamfer and incisal butt-end were used for the left maxillary central incisor. Medium and coarse diamond burs (Accurata, G+K Mahnhardt Dental, Thurmansbang, Germany) were used for tooth preparations. Margins were finished with a fine diamond bur (Komet, Lemgo, Germany). The width of the shoulder was 1.2 mm. Cervical margins were placed 0.5 mm subgingivally for esthetic requirements. Sharp edges or irregularities were corrected to minimize stress concentration (Fig. 6). Retraction cord (Stay-put, Roeko, Langenou, Germany) was used to isolate subgingival finish line. Complete arch impressions were made with a silicon impression material (Speedex, Coltene AG, Alstatten, Switzerland). Provisional crowns (Dentalon plus, Heraeus Kulzer, Dormagen, Germany) were prepared during the prosthetic treatment. Empress 2 full ceramic crowns were fabricated. At the first try-in, complete seating, marginal adaptation, esthetic appearance of

Fig. 6. Tooth preparations.

each crown, and occlusion were assessed. The shade of the crowns was characterized. Following the addition of veneer porcelain, a second try-in session was performed. All characteristics described above were reviewed, the premature contacts were eliminated and final agreement of the patient was obtained.

Cementation procedure

The internal surface of the ceramic veneer and crowns was etched with 5% hydrofluoric acid (IPS ceramic etching gel, Ivoclar -Vivadent AG) for 20 s. A silane coupling agent (Monobond-S, Ivoclar -Vivadent AG) was applied for 60 s. The abutments were cleaned with pumice slurry and retraction cords (Stay-put, Roeko, Langenou, Germany) were applied. The abutment surfaces were etched with 37% phosphoric acid (Total Etch, Ivoclar -Vivadent AG) for 30 s. Teeth were rinsed with water and thoroughly dried. Following the manufacturer's guidelines, Syntac Primer (Ivoclar -Vivadent AG) and Syntac Adhesive (Ivoclar -Vivadent AG) were applied. A bonding agent (Heliobond, Ivoclar -Vivadent AG) was brushed on both abutment surfaces and on the internal surface of the restorations. The bonding agent was thinned with air and cementation was performed immediately by using Variolink II high viscosity resin cement (Ivoclar -Vivadent AG). Excess cement was removed with a brush and dental floss. The restorations were polymerized for 40 s (Optilux, Demetron Inc, Danbury, CT) from all surfaces, for a total of 200 s. The occlusion was controlled (Fig. 7a,b).

A two-year recall appointment revealed a satisfactory esthetic and functional criteria for the ceramic restorations. No discoloration or carious lesions were observed on the margins. A slight opening was observed between right maxillary central and lateral. It might have occurred due to the relapse of the orthodontic therapy. Slightly edematous gingival margins were observed all around maxillary and mandible natural teeth and also around the restorations (Fig. 8).

Discussion

With the advances in the dentin bonding system, direct bonding of ceramic crowns, veneers and inlays to tooth structure are common in dental practice (2, 3). Acid etching of enamel has provided a superb mechanism for mechanical bonding. Resistance to fracture of the

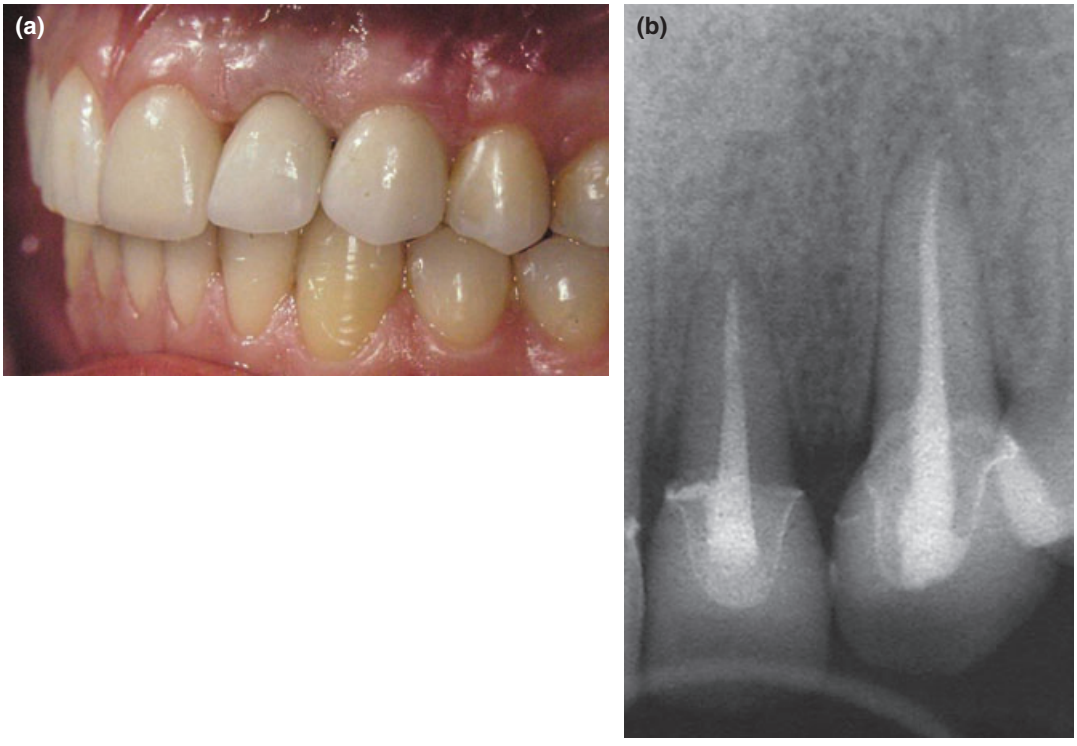

Fig. 7. (a) Empress complete crowns and laminate veneer *in situ*. (b) Radiographic view after cementation of the crowns.

Fig. 8. Two-year recall appointment view.

all-porcelain crown depends on support from the preparation and accuracy of fit. When resinous cements are used with a total acid-etching procedure, the resin film of cement may redistribute stress and reduce the risk of fracture. The clinical safety of using total etch procedures and resin cements is yet to be established (2). The challenge to adhesive researchers has been the development of agents that adhere to dentin and cement (3). McLean (2) suggested that porcelain should be bonded to peripheral enamel; unfortunately, this is not possible with a standard full-veneer crown preparation involving dentin.

Dentin consists of 35% organic matter and water and 65% inorganic material. The organic substance consists of collagenous fibrils and a ground substance of mucopolysaccharides (proteoglycans and glycosaminoglycans) (6, 7). Cement contains about 45–50% inorganic substances and 50–55% organic material and water. The inorganic portion consists mainly of calcium and phosphate in the form of hydroxyapatite, the organic portion consists primarily of type I collagen and protein polysaccharides (proteoglycans). Amino acid analyses of collagen obtained from the cement of human teeth indicate close similarities to the collagens of dentin and alveolar bone (6, 7).

Frakenberger et al. (9) reported warnings against bonding to cervical dentin. They revealed any lower clinical ratings or significant findings such as secondary caries radiographically at their 6-year clinical behavior of the Empress inlays and onlays which have proximal margins located below the cemento-enamel junction. These data were correlated with the present case report, but the main difference was that, in the presented study the whole preparation was made on the cement surface. There were no reported cases in the literature which used cement area as a restoration surface.

The margin finish lines of the presented case were placed 0.5 mm subgingivally for esthetic requirements. At the end of 2 years any secondary caries, discoloration or adhesive failure was evaluated for the complete crown restorations. Minor periodontal treatment was needed for the gingival edematous area. The patient had no complaint against his full crowns restorations. No functional or esthetic problems were reported by the patient. Further studies are needed to show the bonding ability between complete porcelain restorations and root portion of the tooth.

The prosthetic rehabilitation of subgingivally fractured teeth patients has been previously reported by many authors (10–23). All of them used conventional forced eruption technique. In this case report, Kozlovsky and Lieberman's (23) reported technique was used. The main advantages of this technique were to prevent coronal displacement of the gingiva and the attachment apparatus during the orthodontic extrusion, thus overcoming the need for corrective osseous surgery. Intrasulcular incisions required only a few minutes per session and were performed while activating the orthodontic appliances (23).

Conclusion

The prosthetic restoration of subgingivally fractured teeth was difficult and needed time. Orthodontic eruption procedure is useful, if there is enough root length. The esthetic rehabilitation of patients of broken teeth was made easy in daily dentistry with the development of adhesive dentistry. In the presented case, the complete ceramic crown restorations were cemented with resin cement on the prepared root portion. At the end of 2-year recall, any failure was evaluated. Further studies are needed to evaluate the bonding ability between prepared root portion and resin cement.

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References

1. Sjörgen G, Lantto R, Granberg A, Sundström BO, Tillberg A. Clinical examination of leucite-reinforced glass-ceramic crowns (Empress) in general practice: a retrospective study. Int J Prosthodont 1999;12:122–8.
2. McLean JW. Evaluation of dental ceramics in the twentieth century. J Prosthet Dent 2001;85:61–6.
3. Sorenson JA, Cruz M, Mito WT, Raffeiner O, Meredith HR, Foser HP. A clinical investigation on three-unit fixed partial dentures fabricated with a lithium disilicate glass-ceramic. Pract Periodontics Aesthet Dent 1999;11:95–106.
4. Prati C, Nucci C, Montanari G. Shear bond strength and microleakage of dentin bonding systems. J Prosthet Dent 1991;65:401–7.
5. Anusavice KJ. Phillip's science of dental materials, 10th edn. Philadelphia, PA: WB Saunders Co.; 1996. p. 304–11.
6. Bhaskar SN. Orban's oral histology and embryology, 11th edn. St Louis, MO: Mosby Year Book Inc; 1991. p. 106–80.
7. Avery JK, Steele PF. Essentials of oral histology: a clinical approach. St Louis, MO: Mosby Year Book, Inc; 1992. p. 94–128.
8. Thonemann B, Federlin M, Schmalz A, Schams A. Clinical evaluation of heat-pressed glass ceramic inlays in vivo: 2-year results. Clin Oral Investig 1997;1:27–34.
9. Frankenberger R, Petschelt A, Kramer N. Leucite-reinforced glass ceramic inlays and onlays after six years: clinical behavior. Oper Dent 2000;25:459–65.
10. Heithersay GS. Combined endodontic treatment of transverse root fracture in the region of the alveolar crest. Oral Surg 1973;36:404–15.

11. Brown I. The effect of orthodontic therapy on certain types of periodontal defects. I. Clinical findings. J Periodontol 1973;44:742.
12. Ingber JS. Forced eruption: Part II. A method of trating non restorable teeth; periodontal and restorative considerations. J Periodontol 1976;47:203–15.
13. Delivanis P, Delivanis H, Kuftinec MM. Endodontic management of fractured anterior teeth. J Am Dent Assoc 1978;97:483–5.
14. Simon JHS, Kelly WH, Gordon DG, Ericksen GW. Extrusion of endodontically treated teeth. J Am Dent Assoc 1978;97:17–23.
15. Iwey DW, Calhoun RL, Kemp WB, Dorfman HS, Wheless JE. Orthodontic extrusion: its use in restorative dentistry. J Prosthet Dent 1980;43:203–15.
16. Potashnick SR, Rosenberg ES. Forced eruption: principles in periodontics and restorative dentistry. J Prosthet Dent 1982;48:141–8.
17. Bielak S, Bimstein E, Eidelman E. Forced eruption: the treatment of choice for subgingivally fractured permanent incisors. ASDC J Dent Child 1982;49:186–90.
18. Lemon RR. Simplified esthetic extrusion techniques. Oral Surg 1982;54:93–9.
19. Johnson GK, Sivers JE. Forced eruption in crown-lengthening procedures. J Prosthet Dent 1986;56:424–7.
20. Baker IM. Esthetic extrusion of a nonrestorable tooth. J Clin Orthod 1990;24:323–5.
21. Wang WG, Wang WN. Forced eruption: an alternative to extraction or periodontal surgery. J Clin Orthod 1992;26:146–9.
22. Türker SB, Arun T, Sertgöz A. Orthodontic and prosthodontic management of subgingivally fractured teeth: a case report. JMU Dent 2001;4:300–3.
23. Kozlovsky A, Tal H, Lieberman M. Forced eruption combined with gingival fiberotom: a technique for clinical crown lengthening. J Clin Periodontol 1988;15:534–8.