Replacement of Fractured Teeth in One Visit with CAD-CAM Technique: Case Report

Kron Harabiyeti Olmuş Dişlerin Tek Seansta CAD-CAM Tekniğiyle Restore Edilmesi: Olgu Sunumu

ABSTRACT
The present case report series demonstrate the effective usage of CEREC 3 Omnicam system for fabricating endodontically treated and fractured teeth in one appointment. By this methodology, production stages of restorations are reduced and technical errors in production were minimized. The traditional methods of ceramic restoration fabrication have been described to be time-consuming, technique sensitive and unpredictable due to the many variables and CAD/CAM may be a good alternative for both the dentists and laboratories. Restorations can be delivered to the patient in one visit and described fabricating method can be presented as an alternative method to other conventional techniques.

Key words: CAD-CAM, Onlay, Feldspathic Ceramic

INTRODUCTION
The availability of new treatments or technologies in dentistry has two consequences: on one side it expands the range of therapies given to patients and on the other hand it simulates the development of decision-making algorithms for specific medical conditions (1,2). In dental practice, for endodontically treated and fractured or teeth which has got excessive loss there are different treatment options and different fixed indirect restorations to restore the teeth. Some of the treatment options are; post-core restorations, composite resin restorations, traditional fixed prosthesis, implant supported fixed prosthesis, inlay-onlay-overlay restoration.
Feldspathic glass ceramics, leucite-reinforced glass ceramics, lithium disilicate glass ceramics, aluminum-oxide and yttriumtetragonal zirconia polycrystals are commonly used in CAD-CAM fabricating technique. Prefabricated feldspathic glass ceramic blocks provide adequate esthetic and strength in fixed prosthesis.

Studies showed that the use of intraradicular posts alone did not increase the retention of the restoration (3,4). Moreover, the placement of posts in root canals could be limited by root anatomy, such as dilacerations or short roots. Inlay-onlay-overlay restorations are considered a less time consuming and cheaper choice when compared with others. And with the developing techniques in adhesive dentistry, it has become possible to restore teeth with excessive loss by overlay restorations. Restoring posterior teeth with direct composite resin, indirectcomposite resin, or a ceramic inlay-onlay restoration seems to give an equally acceptable treatment modality regarding marginal adaptation (5). However, all-ceramic inlays and onlays seem to transfer less stress than composite resin restorations to tooth structure and when compared with vital teeth, endodontically treated teeth are less resistant to fractures.

Since their introduction on clinical routine, the porcelain laminate veneers and all-ceramic crowns have proven to have satisfactory long-term aesthetic results superior to other restorative materials as long as they are properly planned and fabricated. Up to date there are a lot of fabricating techniques in all ceramic materials have been presented like conventional lost wax technique, pressable ceramics, glass infiltrated ceramics. Recently, in the fabricating process of all ceramic dental restorations computer-aided design and computer aided manufacturing (CAD-CAM) are frequently used in dental practice and during the last decade CAD-CAM systems in dentistry have rapidly gained importance and popularity.

The use of chairside CAD-CAM systems in dental practice enables the clinician to fabricate all-ceramic crowns in single visit and provide many advantages for both the patient and dentist. Acquiring optical images of the prepared teeth directly with intra-oral camera eliminates the need for conventional impression procedures and improves patient comfort. Single visit ceramic crowns eliminate the need for provisional restorations, increase durability of adhesion to dental tissues and also reproduce postoperative sensitivity. The CEREC 3 Omnicam system (Sirona Dental Systems GmbH, Bensheim, Germany) is a chairside application of CAD-CAM technology for reconstructive dentistry. The absence of conventional laboratory fabricating procedures achieves to avoid from potential inaccuracies resulting from these fabrication steps. Also by this fabricating technique, milling the restoration from optimum controlled ceramic blocks should be possible.

Case REPORT

All the patients that presented in this report were attended to the Ondokuz Mayis University, Faculty of Dentistry, Department of Prosthodontics with aesthetic and functional concerns about their teeth.

Diagnosis and Treatment Planning

Case 1

A 26 year old male patient referred to prosthodontics clinic with a recent fracture of the left mandibular molar. By the result of intraoral examination, it revealed that previously a large composite resin restoration was applied to the tooth. And after 6 months later from the therapy, composite resin restoration fractured (Figure 1A, Figure 1B). Radiological examination showed that fractured tooth have an endodontic therapy and the patient reported no discomfort. The patient has good oral hygiene, low susceptibility to caries. No periodontal and periapical pathology was revealed. Gingival tissue was inflamed only in the fracture region. Although there wasn’t enough coronal tooth structure for a preparation to be made with all the margins in enamel, the adhesive restorative materials making possible to make an overlay restoration. The patient declared that he has got no time and rejected post-core therapy. A minimally invasive approach was suggested to the patient and the treatment plan presented as a fixed overlay prosthesis fabrication with CEREC 3 Omnican system. Informed consent was obtained from the patient and the overlay feldspathic prosthesis treatment planning was approved. 

Case 2

A 26 year old male patient referred to prosthodontics clinic with a recent fracture of the left maxillary premolar. By the result of intraoral examination, it revealed that previously after post-core fabrication a conventional fixed partial denture was constructed. The patient
located. Although an extraction and after implant therapy was indicated, the patient declared that he has got no time and rejected the suggested therapy. A minimally invasive approach was suggested to the patient and the treatment plan presented as a fixed overlay endocrown prosthesis fabrication with CEREC 3 Omnican system.

Figure 1: A) Buccal view, B) Occlusal view, C) Virtual model, D) Buccal view of cemented restoration, E) Occlusal view of cemented restoration, F) Design of proposal.

Figure 2: A) Buccal view, B) Occlusal view, C) Virtual model, D) Buccal view of cemented restoration, E) Occlusal view of cemented restoration, F) Design of proposal.
Informed consent was obtained from the patient and the overlay endocrown feldspathic prosthesis treatment planning was approved.

**Preparation and CAD-CAM Procedures**

First step of the fabrication process involved the preparation of tooth. The axial walls and insertion path were prepared with a tapered trunk diamond coated bur (KG Sorensen, Barueri, Sao Paulo) at high speed and under constant cooling. A thin layer composite resin (Tetric Ceram, IvoclarVivadent, Liechtenstein, Germany) above the gutta-percha was applied and polymerized and the pulp chamber was again prepared.

After the preparation completed, scanning procedures were performed and the optical impression was made with the digital camera of the CEREC 3 Omnicam acquisition unit (Figures 1C, 2C). Also the opposite side and the buccal side of the teeth were scanned with buccal scanning technique. The first step at the designing of the virtual restoration is trimming the virtual model to obtain a virtual die. Removal of neighboring teeth reveals the interproximal margins in detail. Second restoration margins were outlined by the help of the system software. Parameters settings of the present case were; proximal contact strength: 25 µm, Occlusal contact strength: -200 µm, minimal thickness: 1000 µm, space: 60 µm. The biogeneric overlay crown proposal was automatically seated to virtual model according to adjusted settings (Figures 1F, 2F). By the help of the software’s design tools some minor changes were performed. When the design of the proposal was accomplished, the milling process has begun. The restoration was placed in the feldspathic ceramic block (CerecBlocks; Sirona Dental Systems GmbH, Bensheim, Germany) with the shade of S2M according to the Cerec Blocks shade guide. And the milling unit was milled the restoration from the prefabricated feldspathic block.

After the try in procedures were performed successfully, custom characterization was accomplished and the restoration was fired according to manufacturer’s recommendations. The restorations were dried at 600 °C for 4 minutes. Then the temperature was increased at the rate of 70 °C/min for 5 min to 950 °C and held for 1 minute. Cooling time was 3 minutes. The total glaze phase was 13 minutes.

For the cementation of the restorations, a dual cure adhesive resin cement (Panavia F, Kuraray, Okayama, Japan) was selected. The ceramic restoration were etched with %5 hydroflouric acid for 60 seconds (IPS Empress Ceramic Etching Gel, IvoclarVivadent, Schaan, Liechtenstein), rinsed and air dried with oil free air. A thin layer of silane agent (Monobond S; IvoclarVivadent, Schaan, Liechtenstein) was applied the etched ceramic surfaces of the restorations for 60 seconds and again air dried. For the dentin conditioning, according to manufacturer recommendations, self-etching primer system were used. Equal amounts of ED primer II liquids A and B (ED Primer II, Kuraray, Okyama, Japan) were mixed, and applied to teeth surfaces for 30 seconds and gently air dried. The ceramic restorations were cemented with adhesive resin cement with a constant finger pressure. Photopolymerization was performed with using an LED curing unit (Bluephase, KerrGmbH, Rastatt, Germany) at an intensity of 1100 mW/cm² for 20 seconds each from buccal and lingual directions.

Intraoral view of the restorations are shown in Figures 1D, 1E, 2D, 2E. An adequate esthetic results were
obtained. Both of the patients were observed for two years. Marginal integrity, absence of chipping and decrement, good gingival health status were observed at 2-year follow up period (Figures 3, 4). Both of the patient was also highly satisfied with the selected rehabilitation.

**DISCUSSION**

This case report series describes a chairside CAD-CAM technique, which, enables overlay restoration fabrication process in one visit. By this methodology, production stages of restorations are reduced and technical errors in production were minimized. The major concerns about chairside CAD-CAM restorations is the accuracy of intraoral impressions and the resulting internal and marginal fit discrepancies(6). The marginal discrepancies is directly responsible from the clinical success of the restoration. Indirect fabricating methods, because of the number of steps, may cause misfit in the marginal adaptation and affected periodontal tissue’s health. Especially fractured teeth with subgingival margin, it is difficult to obtain an adequate marginal adaptation. According to previous studies, marginal gap of the feldspathic glass ceramic crowns fabricated with Cerec 3 system ranged from 53-94.4 µm and are clinically acceptable limits(6). The clinical procedure that involves the fabrication of these restorations, compared with the fabrication of crowns with cores or posts, may be considered less complex, more practical, and easier to perform.

In the years which this production technique first introduced, prefabricated block type and variety was not enough but nowadays the expansion of manufacturing techniques and in order to meet the expectations, manufacturers presented different ceramic blocks with content of different chemical compositions. Among these, feldspathic glass ceramic blocks are commonly preferred because of adequate adhesive success with resin cements and satisfactory aesthetic features in fabricating single crowns, inlays-onlays and laminate restorations(7). Although adequate fracture strength values can be obtained by lithium disilicate glass ceramic blocks and they have high flexural strength values, but they require additional firing process after milling, which was time consuming for single visit treatment modalities. Zirconium oxide blocks have superior strength values but in some cases achieving esthetics may become a problem (6).

Adhesive cementation is considered as the gold standard for cementation of the glass ceramics(8). With adhesive cementation enhancing the resistance of all ceramic restorations as well as the marginal leakage is effectively prevented(8). Adhesive cementation is directly related to the success of the polymerization and the intensity of light used is effective in maintaining the adequate polymerization. The color and thickness of all-ceramic restorations affects the amount of light thus engage the degree of polymerization of light-curing resin cement beneath ceramic restoration. In the other words, polymerization of the adhesive resin luting agent beneath all ceramic restoration is directly related with light intensity. Feldspathic glass ceramic materials showed high light transmission especially in thick restorations. In this case report feldspathic glass ceramics have been evaluated, because the restorations are very thick and the polymerization may effect the clinical success directly.

Factors associated with clinical success of ceramic inlay/onlay restorations appear to be related to cavity preparation, cementing agents, insufficient thickness, and internal defects in ceramics (9). Debonding of the adhesive interface represents a common failure of overlay and endocrown restorations. During clinical function might stress the restoration and the absence of the remaining tooth structure can not resist this stress and as a possible this factors cause of debonding. The patients were monitored clinically for two years. When the dentin surface were not contaminated with temporary cements an adequate and stable bonding can be achieved with single visit chairside CAD-CAM restorations. Also feldspathic ceramics can be etched by hydrofluoric acid effectively and strong micromechanical interlocking can be achieved between the ceramic and bonding agent. So, no chipping or debonding complication were observed. It also may be related with direction of the main masticatory forces because in the posterior region it is particularly true that the forces in which occurs in this area the direction of the forces are parallel to the long axis of the tooth.

Endodontically treated teeth are often severely damaged by decay, excessive wear, resulting in a lack of coronal tooth structure. These teeth with significant loss of coronal tooth structure may require placement of post to ensure adequate retention of a core foundation. With changing trends, in comparison to metallic post, nonmetallic materials are used for the fabrication of posts based on the carbon-fiber reinforcement principle. Fiber posts together with composite core build-up materials are currently perceived as promising alternatives, for providing more aesthetic outcomes. The traditional methods of ceramic restoration fabrication have been described to be time-consuming, technique sensitive and unpredict-
able due to the many variables and CAD/CAM may be a good alternative for both the dentists and laboratories (2). Root fractures, bonding problems between post and composite resin core materials, microleakage are the main problems. In the present report, patients stated that they have no time and desired a simple solution in one dental visit, so the CAD-CAM fabricating technique has been preferred by the clinicians.

Before these kind of treatments could be recommended as an acceptable for general clinical practice further and continued observation of the cases was needed to extend the data and providing new evidence.

**CONCLUSION**
Within the limitations of the data that obtained from these case report series the technique described in this case report allows a minimally invasive approach for single tooth solution. By this technique restoration can be delivered to the patient in one visit and described fabricating method can be presented as an alternative method to other conventional techniques.

**CONFLICT OF INTEREST**
The author declare no conflict of interest.

**REFERENCES**