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R.Kara

***Abstract*—**The success of post-endodontic restoration in teeth with excessive crown destruction and lesions in the periapical area is directly related to the type of restoration to be made. In the traditional method, the treatment of these teeth is done with crown restorations applied on the post-core inside the canal. In this prosthetic choice, the remaining tooth tissues are weakened and their biomechanical properties are weakened by removing the remaining tooth tissue. With the development of adhesive systems, new treatment alternatives have emerged. With this development, endocrown restorations have become an alternative treatment option to post-crown restorations, and while the root canal and crown tissues are protected, adhesion is strengthened with the support provided from the pulp chamber. Fast production with a good edge alignment is provided with endocrowns produced with computer-aided design/computer-aided manufacturing (CAD/CAM) system. In this study, the restoration form, which is a combination of the CAD/CAM system and the E max lithium disilicate glass-ceramic blocks made of laminate veneer and endocrown restoration design, is presented as a new treatment alternative for teeth with excessive destruction.

***Keywords*—** Crown destruction, Devital tooth, Laminate veneer, Endocrown, E-max

I. Introduction

REHABILITION of teeth with excessive crown destruction is a challenging situation in the clinic.[1][2] Devital tooth whose root and crown dentin tissue is weakened and dehydrated due to reasons such as caries or large cavity preparation, the risk of fracture compared to the vital tooth, and the possibility of microleakage on the restoration edges.[3][4]

With advances in adhesive dentistry, endocrown restorations with a more conservative approach have been introduced as an alternative to post-core systems.[5] Endocrowns are monoblock restorations that combine core structure and crown restoration.[2]

Thanks to the macro mechanical support provided by the pulp chamber walls and the micromechanical retention gained by adhesive cementation, the restoration are completed without the need for posts.[5][6] Besides, thanks to the adhesive resin cement used, teeth with excessive material loss without adequate ferrule effect can be restored.[6] Besides protecting tooth tissue It saves time for the physician and the patient by eliminating the additional laboratory steps required for row crown restoration.[6] Another advantage of endocrown restorations is that there are no layers such as cement-post-core-crown obtained from different materials in post-core systems. Because it has been reported in the literature that more stress accumulates on the interface of materials with different elastic modulus and therefore the risk of root fracture will increase.[7][8] Also, the preparation principles applied in endocrown restorations play a role in the success of the restoration. As in the onlay preparation, in endocrown preparations with an axial wall angle of 6-10º, the correct formation of the entrance path of the restoration and obtaining smooth surfaces by removing the undercuts in the cavity are factors that increase the marginal fit of the restoration.[9]

CAD/CAM system in today's dentistry; Inlays, Onlays, endocrowns, crowns/bridges, laminae, individual implant abutments, etc..[8] Thanks to the reduction of production steps and production errors, the treatment is economical, parameters such as layer thickness and cement spacing can be controlled, the end limit can be determined at the level of µm to obtain precise restorations with high clinical acceptability and digital archiving.[10][11] Thanks to the blocks with different contents specially developed for use in the CAD/CAM system, porosity-free materials with various mechanical and aesthetic properties can be used in restorations.[12]

In studies comparing crown restorations on endocrown restorations and post-core systems; It has been reported that endocrown restorations show higher fracture strength.[1][13] Also, in a study in which 19 endocrown restorations were followed up for 28 months, it was observed that 1 restoration failed due to recurrent caries and other restorations yielded successful clinical results.[6] Crown restorations applied on endocrown and natural teeth In a study followed for 55 months, it was found that restorations on molar teeth showed a similar survival rate (crown: 94.6%; endocrown: 87.1%).[13]

Advantages of endocrown restorations

• Less removal of healthy tissues during preparation. • More economical. • Less number of sessions. • Simpler treatment. • Application in teeth with curved roots. • Can be applied in cases with calcified canals. • Can be applied in cases with insufficient interocclusal distance.• Supragingival restorations that are prepared can be listed as less plaque involvement.[7][14]

This case report aims to demonstrate a novel design style and survival times that consists of the design combination of both restorations, which includes the advantages of lamina veneer and endocron restorations.

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II. Materials and methodS

This study, it is aimed to explain the treatment protocols applied to 3 patients who applied to the clinic due to the crown fracture of the maxillary central tooth due to trauma. In all three cases, the number 11 teeth were devital, and fistula formation was observed in one. Teeth are asymptomatic. In this case report, rehabilitation with a different design including the combination of laminate veneer and endocrown restoration made from E max lithium disilicate glass-ceramic blocks prepared with CAD/CAM system due to fractures occurring in the existing restorations of patients whose restorations were repeated before were discussed in three different cases. The purpose of this case report is; The aim is to explain the preparation stages of endocrown restorations with CAD/CAM system, which protects remaining tooth tissue and canal filling in the rehabilitation of teeth with excessive loss of tooth tissue with repetitive restorations, and to indicate their advantages over traditional prosthetic restorations. A new prosthetic approach was adopted in the cases, and the teeth prepared were designed as a crown destruction endocrown design in the tooth prepared as a buccal lamina restoration.

A. Case 1

A 15-year-old male patient was admitted to our clinic with a complaint of fracture approximately 1 year after the trauma caused by impact. In the anamnesis taken from the patient, it was determined that there were no systemic disorders. In the clinical examination, a horizontal complicated crown fracture was observed in the maxillary right incisor (tooth number 11) above the equator line, and in the left central tooth (tooth number 21), enamel dentine fracture with pulp was observed (Fig. 1A). There was no additional injury involving the gum and oral mucosa, periodontal tissues, and supporting bone tissue in the area concerned. It was found that there was no percussion palpation sensitivity in the left upper central tooth and gave a negative response to the electrical pulp test (Digitest, Parkell Electronics Division, Farmingdale, USA). It was found that there was discoloration in the right central tooth and 3-4 mm exposure in the pulp. In the radiographic evaluation, it was observed that the apex formation was completed, there was no root fracture or alveolar fracture, but the presence of a periapical lesion in the periapical area and a fistula in the vestibule.

Considering the size of exposure in the pulp, the amount of hard tissue lost, the apical lesion in the root, and the time elapsed between trauma and treatment, it was decided to treat the relevant tooth with apical resection. Local anesthesia (Ultraca DS-Fort Bulb, Sanofi Aventis Ltd., Istanbul, Turkey) after the application was made of the right maxillary central incisor apical resection. Polycarboxylate cement and gutta-percha were used as canal filling and sutured with 3.0 atraumatic silk. Amoxicillin and naproxen sodium were prescribed to be used twice a day for 5 days. The sutures were removed after 1 week. The cement in the trauma area was removed using a water-cooled high-speed apple round bur (801H012, Hager & Meisinger GmBH, Heisinger, Germany). The soft dentin in the pulp chamber was cleaned with a low-speed diamond round bur. The pulp chamber was prepared to a depth of 4 mm, with cavity walls at 6-10 degrees. (Fig. 1 and Fig. 2B, C). The cavity base was sealed with high viscosity glass ionomer cement (Equia, GC Europe, Tokyo, Japan).

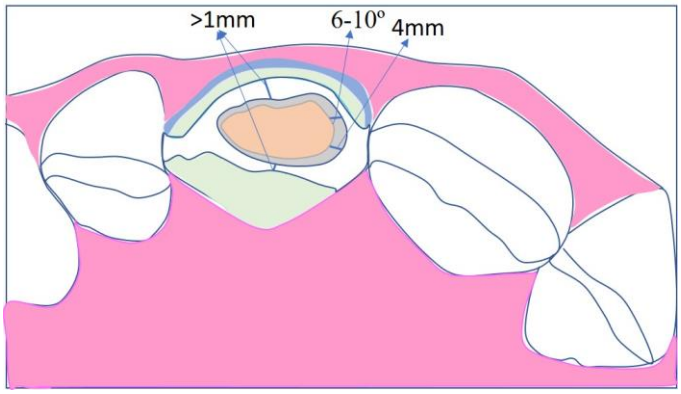

Fig. 1: Desing of preparation

The left central tooth was treated with a composite restoration. To meet the functional and aesthetic expectations of the right central tooth, endocrown preparation was made and it was decided to complete the treatment with CAD/CAM restoration.

For dental preparation, a 1mm chamfer-shaped step was prepared in the vestibular cervical of the tooth and the pulp chamber cavity was included in the preparation. All sharp corners on the inner walls were rounded (Fig. 2B, C). The restoration was designed in CAD/CAM software (Cerec 4.2.4, Dentsply / Sirona, Germany) by taking the digital measure of the preparation (Cerec Omnicam, Dentsply / Sirona, Germany). To reduce the monochromatic appearance of the CAD/CAM restoration and increase its aesthetics, the incisal trio of the tooth was abraded in the form of a cut-back. The areas reduced by enamel porcelain were restored. The designed restoration was etched using an E-max block (Lava Ultimate A2 LT, 3M Espe, Seefeld, Germany) (Cerec MC XL, Dentsply / Sirona, Germany) (Fig. 2D). After rehearsing the milled restoration, its inner surface was sandblasted with 50μ sized aluminum oxide particles. After cleaning the sand particles with alcohol and air, the inner surface of the restoration was silanized (Monobond Plus, Ivoclar, Liechtenstein), the adhesive bonding resin was applied with a brush-type applicator, (Scotchbond Universal, 3M Espe, St Paul, USA) air-dried and opaque until bonding kept in a bowl. After the application of local anesthesia, the relevant teeth were isolated with a rubber dam.

%5 Phosphoric acid (Etchant gel, 3M ESPE, St Paul, USA) was applied to the tooth surface for 15 seconds in dentine and 30 seconds in enamel to etching. After washing with pressurized water and air drying, the adhesive bonding resin (Scotchbond Universal, 3M Espe, ST Paul, USA) was applied to the tooth surface for 20 seconds, air-dried for 5 seconds. The restoration was bonded using dual-cure resin composite (RelyX Ultimate, 3M ESPE, St. Paul, MN, USA). Excess material was cleaned with a brush and dental floss and then polymerized from all directions for 40 seconds with an LED light device

(Valo, Ultradent Products, South Jordan, USA). The left tooth (21) containing enamel dentin fracture was beveled along the fracture line. %5 Phosphoric acid (Etchant gel, 3M ESPE, St Paul, USA) was applied to the tooth surface for 15 seconds in dentine and 30 seconds in enamel for etching. After washing with pressurized water and air drying, the adhesive bonding resin (Scotchbond Universal, 3M Espe, St Paul, USA) was applied to the tooth surface for 20 seconds, air-dried for 5 seconds. It was polymerized for 20 seconds with an LED light device (Valo, Ultradent Products, South Jordan, USA). Fracture restoration was completed by multilayering method using A2 dentin, A2 Body, B2 enamel composites (Filtek Ultimate, 3M Espe, St Paul, USA) (Fig. 2E). The restorations were finished with composite finishing burs and discs (Soflex, 3M), and polished with spiral composite finishing rubbers (Soflex Spiral, 3M) and polishing paste.

At 3-month intervals, the patient was called for clinical and radiological controls. In the clinical and radiological evaluation of the patient at the 12th and 24th months, it was determined that the tooth was asymptomatic and there was no pathology in the periapical region, and the restoration met the expectations in terms of aesthetic, functional, and gingival compatibility. As a result of the patient's inadequate oral hygiene, coloration was observed on the edge of the restoration. The coloration area was polished with diamond-containing polishing paste (Diamond Gloss, TDV Dental, Santa Catarina, BRAZIL).

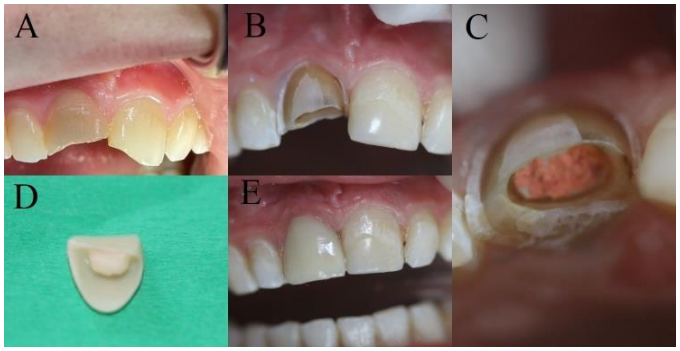

Fig. 2 A: Fracted teeth, B: Facial view of the preparation, C: Incisal view of the preparation, D: Fabricated restoration, E: Cemented CAD/CAM restoration

B. Case 2

A 28-year-old male patient presented to our clinic with a complaint of fracture approximately 1 year after the trauma caused by impact. In the anamnesis taken from the patient, it was determined that there was no systemic disorder. In the clinical examination, a horizontal crown fracture was detected in the right incisor tooth of the upper jaw (tooth number 11) above the equator line (Fig. 3A, B). It was found that there was no additional injury involving the gum and oral mucosa, periodontal tissues, supporting bone tissue, percussion/palpation sensitivity, and did not respond positively to the electric pulp test (Digitest, Parkell Electronics Division, Farmingdale, USA). It was determined that there was 3-4 mm exposure in the pulp of tooth no. 11. In the radiographic evaluation, it was observed that the apex formation was completed, and there was no pathology in the periapical area, no root or alveolar fracture. Since the patient was receiving orthodontic treatment, there was a splint wire behind the teeth. As in the first case report, considering the size of exposure in the pulp, the amount of hard tissue lost, the degree of root development, and the time between trauma and treatment, it was decided to treat the relevant tooth with root canal treatment. All steps from the preparation of the restoration to its completion were carried out as in the first case (Fig. 3C, D).

In the controls on the 12th and 24th months of the patient, it was observed that there were no symptoms in the teeth, and aesthetic, functional, and gingival harmony was good (Fig. 3E). As a result of the patient's inadequate oral hygiene, coloration was observed on the marginal of the restoration. The coloration area was polished with diamond-containing polishing paste (Diamond Gloss, TDV Dental, Santa Catarina, BRAZIL).

Fig. 3 A: Fracted tooth, B: Root-treated tooth, C: Incisal view of the design, D: Facial view of the design, D: Cemented CAD/CAM restoration.

C. Case 3

A 15-year-old male patient was admitted to our clinic with a fracture complaint about 1 day after the trauma caused by the impact at school. In the anamnesis taken from the patient, it was determined that there was no systemic disorder. In the clinical examination, a horizontal crown fracture in the maxillary right incisor tooth in the region close to the arm below the equator line and caries in the distal proximal region was detected (Fig. 5A). It was determined that there was no additional injury involving the gum and oral mucosa, periodontal tissues, supporting bone tissue, percussion/palpation sensitivity, and a positive response to the electric pulp test

(Digitest, Parkell Electronics Division, Farmingdale, USA). It was determined that there was 3-4 mm exposure in the pulp of tooth no. 11. In the radiographic evaluation, it was observed that the apex formation was completed, and there was no pathology in the periapical area, no

root or alveolar fracture. As in the second case report, considering the size of exposure in the pulp, the amount of hard tissue lost, the degree of root development, and the time between trauma and treatment, it was decided to treat the relevant tooth with root canal treatment. Root canal treatment was completed using root canal sealer (Sealapex, Kerr, Bioggio,

Switzerland) and gutta-percha. (Fig. 5B).

As in the steps in case 1, the design and fabrication of the CAD/CAM restoration were done (Fig. 4). Clinical controls were made in the same way and duration. There were no complications (Fig. 5D).

Fig. 4 : CAD/CAM desing and fabricated restoration

Fig. 5 A: Fracted tooth, B: Root-treated tooth, C: Prepared tooth, D:Cemented CAD/CAM restoration

III. Discussion

It is known that dental traumatic injuries often occur in maxillary central incisors. In such traumatic cases, healthy chewing without pulling the tooth, providing a good aesthetic appearance and continuity in the mouth is desired in terms of its functions in speech. If the patient brought fractured tooth fragments with him, it has been reported that the process of bonding the tooth restoration with its original parts can yield short-term ideal results in terms of aesthetics, functionality, phonation, and preservation of tooth integrity.[15] In teeth with excessive material loss, prosthetic and restorative approaches are emerging as an option. If the tooth can be treated endodontically, if the damage is not more apical than 1/3 of the coronal level of the root, and if the root/crown ratio of at least 1/1 can be achieved after the treatment, the maintenance of the tooth is recommended.[15]

Different treatment options are available such as direct composite resin restorations, thin laminate veneers, partial ceramic restorations to restore fractured permanent teeth exposed to trauma. Especially in recent years, the rapid development of digital technology has brought another dimension to the systems and materials used in dentistry. CAD/CAM systems, a product of this, allow the restoration to be designed and the restoration to be produced without going to the laboratory.[16]

It can be expected that endocrowns made to anterior teeth will fail more than posterior teeth. anterior teeth receive higher non-axial forces compared to the more axially directed forces encountered by the posterior teeth during oral function; consequently, this takes more stress, which increases the likelihood of restoration failure.[17] This fact may explain the lack of clinical and in vitro studies on anterior teeth and strengthen the need for well-designed studies on this subject.

Laminate veneer-style CAD/CAM restorations in which the pulp chamber is included in the anterior group teeth where it is necessary to remove the devital and pulp tissue that has undergone root canal treatment can provide successful restorations in terms of durability and survival time. Laminate restorations produced with CAD/CAM systems and designed in this shape can be an alternative to full porcelain crowns.

References

[1] J. Guo, Z. Wang, X. Li, C. Sun, E. Gao, and H. Li, "A comparison of the fracture resistances of endodontically treated mandibular premolars restored with endocrowns and glass fiber postcore retained conventional crowns," *J. Adv. Prosthodont.*, vol. 8, no. 6, 2016, doi: 10.4047/jap.2016.8.6.489.

[2] P. Magne, A. O. Carvalho, G. Bruzi, R. E. Anderson, H. P. Maia, and M. Giannini, "Influence of no-ferrule and no-post buildup design on the fatigue resistance of endodontically treated molars restored with resin nanoceramic CAD/CAM crowns," *Oper. Dent.*, vol. 39, no. 6, pp. 595–602, 2014, doi: 10.2341/13-004-L.

[3] E. S. Reeh, H. H. Messer, and W. H. Douglas, "Reduction in tooth stiffness as a result of endodontic and restorative procedures," *J. Endod.*, vol. 15, no. 11, 1989, doi: 10.1016/S0099-2399(89)80191-8.

[4] J. Papa, C. Cain, and H. H. Messer, "Moisture content of vital vs endodontically treated teeth," *Dent. Traumatol.*, vol. 10, no. 2, 1994, doi: 10.1111/j.1600-9657.1994.tb00067.x.

[5] P. Pissis, "Fabrication of a metal-free ceramic restoration utilizing the monobloc technique.," *Pract. Periodontics Aesthet. Dent.*, vol. 7, no. 5, 1995.

[6] A. Bindl and W. H. Mörmann, "Clinical evaluation of adhesively placed Cerec endo-crowns after 2 years--preliminary results.," *J. Adhes. Dent.*, vol. 1, no. 3, 1999.

[7] F. Zarone *et al.*, "Evaluation of the biomechanical behavior of maxillary central incisors restored by means of endocrowns compared to a natural tooth: A 3D static linear finite elements analysis," *Dent. Mater.*, vol. 22, no. 11, 2006, doi: 10.1016/j.dental.2005.11.034.

[8] D. Assif and C. Gorfil, "Biomechanical considerations in restoring endodontically treated teeth," *J. Prosthet. Dent.*, vol. 71, no. 6, 1994, doi: 10.1016/0022-3913(94)90438-3.

[9] T. Köksal, İ. Dikbaş, and N. Çapa, "Seramik inley ve onley restorasyonlar/ Ceramic inley and onley restorations," *J. Istanbul Univ. Fac. Dent.*, vol. 41, no. 1–2, pp. 71-82–82, 2007, doi: 10.17096/jiufd.42714.

[10] A. Mehl and R. Hickel, "Current state of development and perspectives of machine-based production methods for dental restorations.," *Int. J. Comput. Dent.*, vol. 2, no. 1, 1999.

[11] W. H. Mörmann and A. Bindl, "All-ceramic, chair-side computer-aided design/computer-aided machining restorations.," *Dent. Clin. North Am.*, vol. 46, no. 2, 2002, doi: 10.1016/S0011-8532(01)00007-6.

[12] L. Hian, "Critical review Dental Materials/Dentistry Dental ceramics: a review of new materials and processing methods," *Braz. oral Rest*, vol. 31, 2017, doi: 10.1590/1807-3107BOR-2017.vol31.0058.

[13] G. R. Biacchi and R. T. Basting, "Comparison of fracture strength of endocrowns and glass fiber post-retained conventional crowns," *Oper. Dent.*, vol. 37, no. 2, 2012, doi: 10.2341/11-105-L.

[14] A. Bindl, B. Richter, and W. H. Mörmann, "Survival of ceramic computer-aided design/manufacturing crowns bonded to preparations with reduced macroretention geometry," *J. Prosthet. Dent.*, vol. 95, no. 1, 2006, doi: 10.1016/j.prosdent.2005.09.002.

[15] A. Ramírez-Sebastià, T. Bortolotto, M. Cattani-Lorente, L. Giner, M. Roig, and I. Krejci, "Adhesive restoration of anterior endodontically treated teeth: Influence of post length on fracture strength," *Clin. Oral Investig.*, vol. 18, no. 2, 2014, doi: 10.1007/s00784-013-0978-3.

[16] C. L. Lin, Y. H. Chang, C. Y. Chang, C. A. Pai, and S. F. Huang, "Finite element and Weibull analyses to estimate failure risks in the ceramic

endocrown and classical crown for endodontically treated maxillary premolar," *Eur. J. Oral Sci.*, vol. 118, no. 1, 2010, doi: 10.1111/j.1600-0722.2009.00704.x.

[17] G. R. da Silva, P. C. de F. Santos-Filho, P. C. Simamoto-Júnior, L. R. M. Martins, A. S. da Mota, and C. J. Soares, "Effect of post type and restorative techniques on the strain and fracture resistance of flared incisor roots," *Braz. Dent. J.*, vol. 22, no. 3, pp. 230–237, 2011, doi: 10.1590/S0103-64402011000300009.

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