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A Severely Damaged Mandibular First Molar Restoration with CAD/CAM Customized Hybrid Ceramic Post and Core by Direct Intraoral Impression: A Case Report

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Abstract

The outcome of the teeth with coronal restoration may be unforeseeable when they need root canal therapy due to apical periodontitis, especially at the existence of a post. This case report describes a digital restoration strategy for the preservation of a serious defect tooth (left mandibular first molar). Tooth #36 with 10 years of a crown and post restoration needed root canal therapy due to apical periodontitis. After removal of the crown and cast post, the residual tooth showed fragility, and the distal root canal was seriously destroyed due to the post insertion. Selecting a suitable post was significant for the retention of the core to support the coronal restoration after the completion of the root canal therapy and apical barrier. The prefabricated fiber post and metal cast post were not good selections for the distal root canal. Therefore intraoral scanning was performed on the tooth and digitized to design a three-dimensional model of customized post-core and full crown by the Computer-Aided Design/Computer-Assisted Manufacture (CAD/CAM) technique. A 14-month follow-up showed a promising clinical and radiographic outcome. The digital CAD/CAM technique converted the concave surface of the root canal into the convex surface of the post, and fabricated an anatomical post and core using hybrid ceramic material close to the elastic modulus of natural dentin. It improved the biomechanics of this tooth #36 and reduced the occurrence of root fracture.

Keywords: Periodontitis • Endodontic treatment • Diagnosis

Introduction

It is generally accepted that the good outcome of teeth is primarily dependent on both adequate coronal restoration and adequate endodontic treatment [1]. Though endodontic treatment is positively correlated with outcomes, a surprisingly high proportion of teeth do not receive any endodontic treatment after the completion of coronal restoration. Teeth with coronal restoration are trouble when they need root canal therapy due to apical periodontitis, especially at the existence of a post. The removal of restoration and post presents a risk of destroying the primary structure of the teeth and could possibly result in teeth extraction. The first-line treatment option after the occurrence of endodontic infection or apical periodontitis of teeth with coronal restoration is still nonsurgical retreatment to relieve pain [2]. Endodontically Treated Teeth (ETT) are more fragile than vital ones, together with extensive loss of tooth structure, and therefore ETT usually need a coronal restoration, with or without the presence of post-core [3,4]. With the development of adhesive cement, the post is not often used in the molars of ETT because of more tooth substance and a larger pulp chamber to retain core buildup [5,6]. But the ETT with an extensive loss of tooth structure still need an intra-radicular post and a filling core to attain the definitive restoration [7]. Posts can be divided into two main categories: custom-fabricated posts and prefabricated posts. The glass fiber post is a common prefabricated post and is widely used because of its good aesthetics and elasticity close to that of dentin [8,9]. However, a prefabricated post is not a good fit for the irregular root canal. Custom-fabricated posts have been considered to apply to irregularly shaped, flared, or large-diameter root canals due to their adaptability [10,11]. Recently, computer-aided design/computer-assisted manufacture (CAD/CAM) technology has been applied to fabricated post and core restorations [12,13]. In this case report, by chairside CAD/CAM technique, we attempted to create an anatomical fabricated post-core made with a hybrid ceramic to fit the post space of the distal root canal of tooth #36, which had been restored with a cast post ten years earlier. After root canal therapy and an apical barrier, the post-core-crown restoration was completed in a single visit.

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Case Report

A 32-year-old female patient with a symptomatic (pain on chewing) left mandibular first molar was referred to the department of operative dentistry and endodontics at the Guanghua School of Stomatology, Sun Yat-sen University. Her dental history revealed that tooth #36 had ever undergone a crown restoration ten years prior but had not been endodontically treated. Intraoral examination showed a Porcelain-Fused-to-Metal (PFM) of tooth #36, which was sensitive to percussion. Radiography showed tooth #36 with a short cast post in the distal root canal and crown restoration. An apical translucency of the tooth was interpreted as apical periodontitis. A diagnosis of symptomatic apical periodontitis was given to tooth #36. The treatment options presented to the patient included no treatment, extraction, root canal retreatment after removal of crown and cast post. All reasonable risks were discussed and understood. As far as the patient's considerations of the remaining existing tooth structure, a decision of root canal retreatment and post-core-crown restoration by CAD/CAM technique at a single visit was reached. The case report was approved by Medical Ethics Committee of Hospital of Stomatology, Sun Yat-sen University, Guangzhou, China (No: KQEC-2020-27) and informed consent was obtained from the patient.

The crown and cast post were removed, and tooth #36 showed a serious coronal defect. The distal root canal wall was thin and the resin material was found in the two mesial root orifices. After dental dam isolation, the resin filling

and all soft decay were removed under a dental microscope (Zumax Medical Co., Ltd, Suzhou, China). The two mesial root canals were instrumented to X3 using ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland), and the distal root canal was instrumented to #60 using a K file, accompanied by moderate irrigation with 3% sodium hypochlorite. The tooth was temporized with intracanal Calcium Hydroxide (CH) medicament and access was temporarily restored with glass ionomer cement for a month. After one month, the patient was comfortable and there was no reaction to percussion. The CH medicament was cleaned by ultrasonic irrigation with 3% sodium hypochlorite and saline. The capillary tip connected with the Luer vacuum aspiration system (Ultradent Products. Inc, Utah, America) was used to dry the root canals. The mesial root canals were obturated using gutta percha and a tricalcium silicate–containing sealer (Iroot SP, Innovative BioCeramix Inc, Vancouver, Canada) by a single cone technique, and the distal root canal was performed a 6 mm depth of the apical barrier using iRoot BP Plus root repair material (BP-RRM; Innovative BioCeramix Inc, Vancouver, Canada). The orifice of the mesial root canals were sealed with flowable composite (Beautifil Flow Plus; Shofu Inc, Kyoto, Japan). Postoperative radiographs showed a dense obturation material from the orifice to apex with no voids (Figures 1A-1J).

After one month, the post space of the distal root canal was prepared while ensuring maintenance of a 6 mm Iroot BP Plus for apical barrier. The prepared access was coated with a titanium dioxide spray (OptiSpray, Sirona Dental Systems, Bensheim, Germany) and scanned using a chairside CAD/CAM unit (CEREC SW 4.0, Sirona Dental Systems, Bensheim, Germany). After processing 3D images and CAD design, a customized post-core was manufactured by a CAM milling machine using a hybrid ceramic vita enamic (Vita Zahnfabrik, Bad Säckingen, Germany). The bottom side of the post-core was etched with hydrofluoric acid for 45 seconds, rinsed for 45 seconds with water spray, cleaned in an ultrasonically activated ethanol bath for 5 minutes, and coated with single bond universal adhesive (3M ESPE, St Paul, MN, USA), which was air-thinned. Meanwhile, tooth surfaces were pretreated for adhesive procedures with 37% phosphoric acid for 15 seconds and then coated with single bond universal adhesive. The post-core was adhered using RelyX Ultimate Clicker Adhesive Resin Cement (3M ESPE, St Paul, MN, USA) (Figures 2A-2H). After the removal of excess cement, the adhesion of the post-core was light-cured.

After the placement of the post-core, a full crown was prepared for the tooth and black hardened dentin was masked using composite resin (IPS Empress Direct Opapue, Ivoclar Vivadent, Schaan, Liechtenstein). The prepared tooth was scanned and a full crown model was designed by CEREC SW 4.0 software. Full crown restoration was manufactured using IPS e.max CAD lithium-disilicate ceramic (Ivoclar-Vivadent, Schaan, Liechtenstein) and then polished, sprayed, stained and crystallized in a Programat P500 furnace (Ivoclar-Vivadent, Schaan, Liechtenstein) following the manufacturer's recommendations. After the placement of dam rubber, the surface of prepared tooth was etched with 37% phosphoric acid for 15 seconds. The crown restoration was etched with hydrofluoric acid for 20 seconds and then coated by a single bond universal adhesive. Luting was completed with RelyX Ultimate Clicker Adhesive Resin Cement following the manufacturer's recommendations. Intraoral examination showed a good coronal restoration. At the 14-month follow-up, the patient felt comfortable and a periapical radiograph showed healing of the mesial radiolucent root lesion and resolution of the distal root radiolucent lesion compared with the preoperative radiograph (Figures 3A-3I).

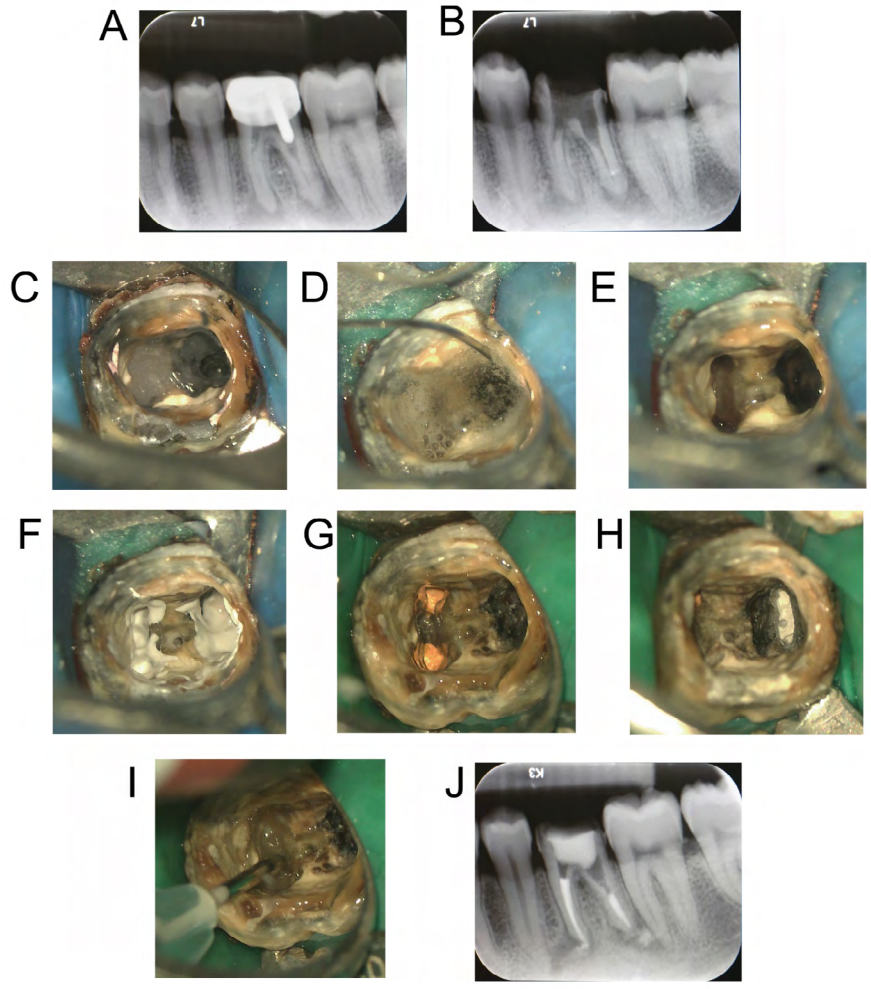

Figure 1. (A) Preoperative radiograph of tooth #36; (B) The radiograph of tooth #36 after the removal of crown and cast post; (C) The intraoral image after the removal of crown and cast post; (D) Irrigation of 3% sodium hypochlorite; (E) Preparation of root canal; (F) Calcium hydroxide dressing; (G) The obturation of mesial root canals by using Gutta percha and a tricalcium silicate–containing sealer (Iroot SP); (H) The apical barrier of distal root canal using iRoot BP Plus root repair material; (I) The mesial root canals orifice sealed with flowable composite; (J) Postoperative radiograph of root canal obturation.

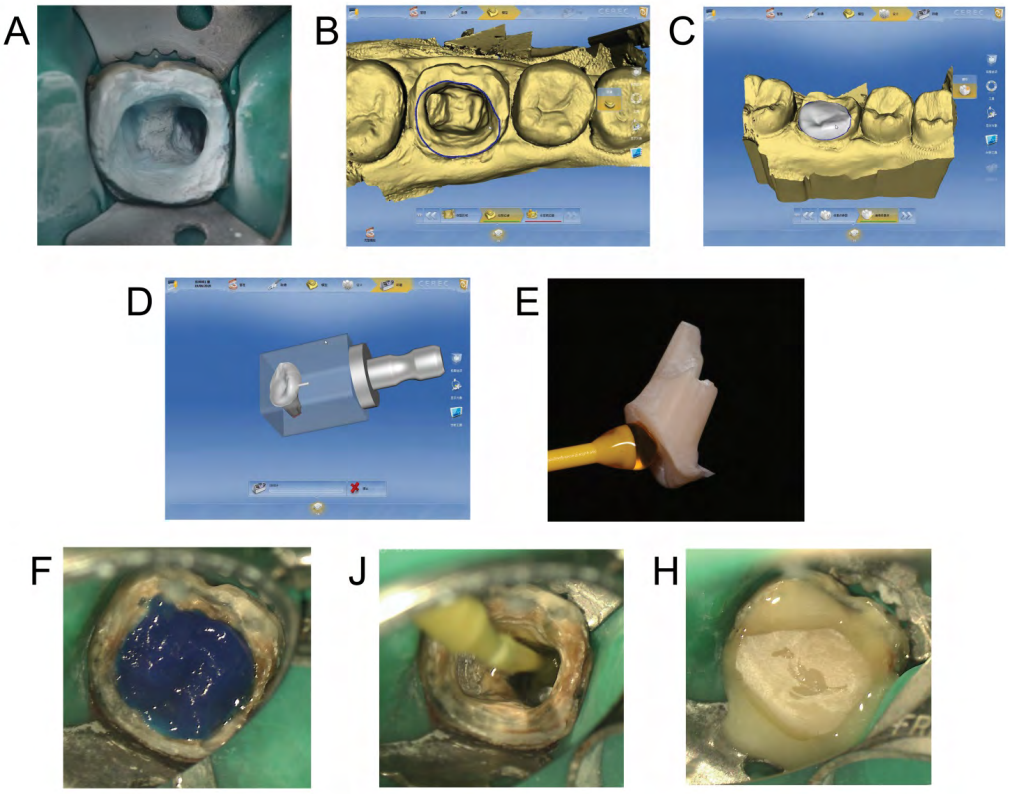

Figure 2. (A) Preparation of post space; (B-D) The design of the post-core by Cerec AC, v.4.0, Sirona Dental Systems; (E) The manufactured post-core using hybrid ceramic vita enamic; (F-H) The adhesion of post-core using RelyX Ultimate Clicker Adhesive Resin Cement.

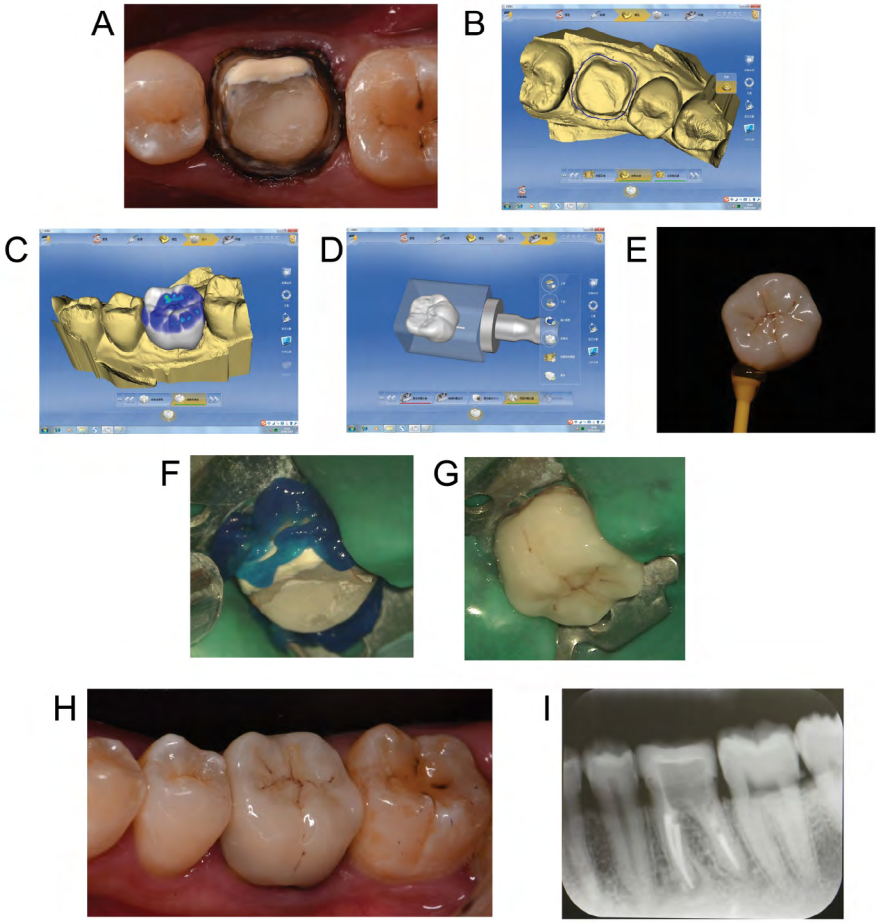

Figure 3. (A) Preparation of full crown of tooth #36; (B~D) The design of full crown by Cerec AC, v.4.0, Sirona Dental Systems; (E) The coronal restoration made by IPS e.max CAD lithium-disilicate ceramic (Ivoclar-Vivadent); (F) The surface of prepared tooth was etched with 37% phosphoric acid; (G) The full crown was cemented by RelyX Ultimate Clicker Adhesive Resin Cement; (H) Intraoral vision after coronal restoration; (I) A periapical radiograph of the 14-month follow-up showing healing of the mesial root radiolucent lesion and resolution of the distal root radiolucent lesion compared with preoperative radiograph.

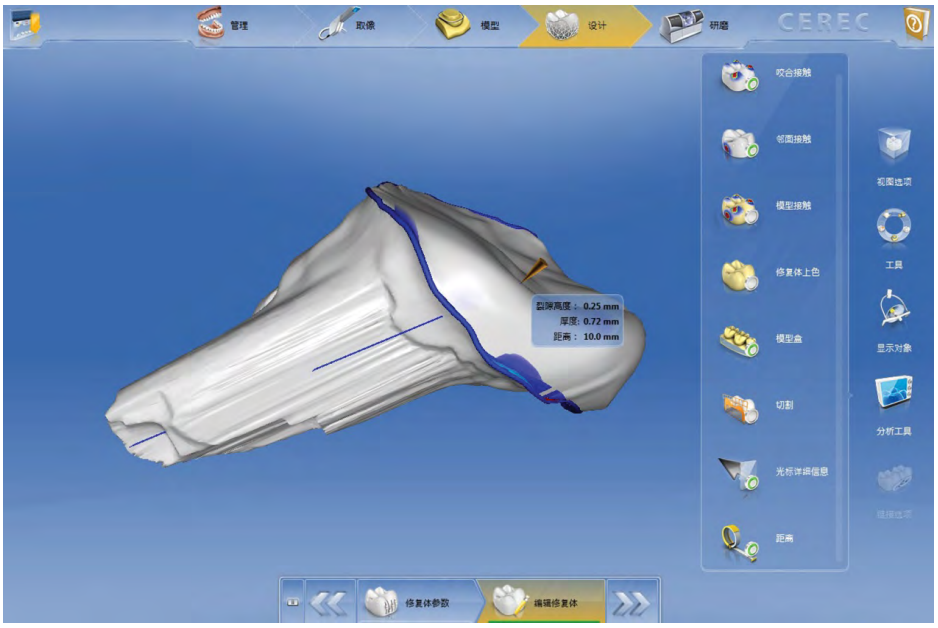

Figure 4. The height of post-core was 10 mm, less than the control of the CEREC intraoral 15 mm scanning depth.

Discussion

It is not uncommon for teeth to present with symptomatic irreversible pulpitis or apical periodontitis during the restoration period or after a crown placement. If teeth need removal of the restoration and post to complete root canal therapy, the treatment may be unforeseeable because removal of restoration and post might cause complications such as weakening, perforation or fracture of the root structure [14]. In this case, the cast post was easily removed due to its shallow positioning in the root canal. However, the cast post had severely destroyed the root canal structure, and the root canal wall had become thin. The single distal root canal of the mandibular first molar is usually an oval-shaped root canal, and the primary cast post is added to the size of the root canal in this case [15]. Selecting a suitable post is significant for retention of the core to support the coronal restoration. Though circular prefabricated fiber posts have good aesthetics and elasticity close to that of dentin, a thicker cement layer around the post may decrease bond strength between a fiber post and root dentin in the large size of an irregular distal root canal. A custom-fabricated post was considered, but the cast post was not a good selection for the root canal. The metal cast post has the potential risk of causing root fracture because of the thinner dentin wall and the difference in elastic modulus between metal and dentin [16]. Therefore a post with both an approximate elastic modulus and adaption was suitable for the distal root canal in this case. A chairside CAD/CAM technique was used to complete the restoration. CAD/CAM-fabricated posts combine the advantages of traditional custom posts and prefabricated fiber posts. The CAD/CAM-fabricated post made by Hybrid Ceramic Vita Enamic has a modulus of elasticity close to that of natural dentin [17,18].

The post space has been scanned by CAD/CAM techniques in some studies, and the scanning has been performed mostly via indirect techniques for digital data acquisition of the post space [19-21]. In this case, an intraoral direct scanning was digitized to design a three-dimensional model of the custom post-core. Direct acquisition was considered quicker, more accurate and less invasive than indirect methods [22,23]. An accurate intraoral scanning requires the skill, experience and knowledge of the operator, which might affect the outcome due to patient-related factors such as intraoral humidity, tongue movement and saliva flow. The height of the post-core in this case was 10 mm, less than the control of the CEREC intraoral 15 mm scanning depth, and therefore the post-core could be fabricated by digital scanning (Figure 4). Despite being within the depth scope of scanning, a titanium dioxide powder application improved the vertical fit as well as the volumetric 3D internal fit and showed perfect sharpness in the post space [24]. In this case, we used CEREC bluecam in combination with titanium dioxide spray to clearly scan the post space and manufactured a three-dimensional model of a hybrid ceramic post-core. After accurate accomplishment of the digital custom post-core, a full crown restoration by lithium-disilicate ceramic was immediate fabricated by CAD/CAM techniques to complete the final restoration of tooth #36. The post-core-crown restoration was completed at a single visit, and the total clinical treatment time was significantly reduced in this case.

Conclusion

This clinical report describes that the post-core by intraoral direct scanning is used to rehabilitate the severe defects of teeth with an irregular root canal. The development of CAD/CAM techniques could facilitate the preservation of teeth and decrease the number of patient visits.

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References

1. Brian M. Gillen, Stephen W. Looney, Li-Sha Gu and Bethany A. Loushine, et al. "Impact of the Quality of Coronal Restoration *Versus* the Quality of Root Canal Fillings on Success of Root Canal Treatment: A Systematic Review and Meta-Analysis." *J Endod* 37 (2011): 895-902.
2. Mahmoud Torabinejad and Shane N. White. "Endodontic Treatment Options after Unsuccessful Initial Root Canal Treatment: Alternatives to Single-Tooth Implants." *J Am Dent Assoc* 147 (2016): 214-220.
3. Dietschi Didier, Duc Olivier, Krejci Ivo and Sadan Avishai, et al. "Biomechanical Considerations for the Restoration of Endodontically Treated Teeth: A Systematic Review of the Literature, Part II (Evaluation of Fatigue Behavior, Interfaces, and *in-vivo* Studies)." *Quintessence Int* 39 (2018): 117-129.
4. Cheung, William. "A Review of the Management of Endodontically Treated Teeth, Post, Core and the Final Restoration." *J Am Dent Assoc* 136 (2005): 611-619.
5. Gislaine Rosa Biacchi, Beatriz Mello and Roberta Tarkany Basting. "The Endocrown: An Alternative Approach for Restoring Extensively Damaged Molars." *J Esthet Restor Dent* 25 (2013): 383-390.

6. Marcia M. Belleflamme, Sabine O. Geerts, Marie M. Louwette and Charlotte F. Grenade, et al. "No Post-no Core Approach to Restore Severely Damaged Posterior Teeth: An up to 10-year Retrospective Study of Documented Endocrown Cases." *J Dent* 63 (2017): 1-7.
7. Francesca Zicari, Eduardo Couthino, Jan De Munck and André Poitevin, et al. "Bonding Effectiveness and Sealing Ability of Fiber-Post Bonding." *Dent Mater* 24 (2008): 967-977.
8. Carlos Torres-Sánchez, Vanessa Montoya-Salazar, Paola Córdoba and Claudia Vélez, et al. "Fracture Resistance of Endodontically Treated Teeth Restored with Glass Fiber Reinforced Posts and Cast Gold Post and Cores Cemented with Three Cements." *J Prosthet Dent* 110 (2013): 127-133.
9. Ivana Parcina, Amizic and Anja Baraba. "Esthetic Intracanal Posts." *Acta Stomatol Croat* 50 (2016): 143-150.
10. Nino Tsintsadze, Jelena Juloski, Michele Carrabba and Cecilia Goracci, et al. "Effects of Scanning Technique on in *vitro* Performance of CAD/CAM-fabricated Fiber Posts." *J Oral Sci* 60 (2018): 262-268.
11. Anamika Thakur and Sathyanarayanan Ramarao. "An *In-Vitro* Comparative Evaluation of Fracture Resistance of Custom Made, Metal, Glass Fiber Reinforced and Carbon Reinforced Posts in Endodontically Treated Teeth." *J Int Oral Health* 7 (2019): 53-55.
12. Rita Y. Eid, Serhat Koken, Nadim Z. Baba and Hani Ounsi, et al. "Effect of Fabrication Technique and Thermal Cycling on the Bond Strength of CAD/CAM Milled Custom Fit Anatomical Post and Cores: An *In-Vitro* Study." *J Prosthodont* 28 (2019): 898-905.
13. Nino Tsintsadze, Jelena Juloski, Michele Carrabba and Cecilia Goracci, et al. "Performance of CAD/CAM Fabricated Fiber Posts in Oval-shaped Root Canals: An In-Vitro Study." *Am J Dent* 30 (2018): 248-254.
14. Joel H. Altshul, Gordon Marshall, Leslie A. Morgan and Craig J. Baumgartner. "Comparison of Dentinal Crack Incidence and of Post Removal Time Resulting from Post Removal by Ultrasonic or Mechanical Force." *J Endod* 23 (1997): 683-686.
15. Carolina Filpo-Perez, Clovis Monteiro Bramante, Marcelo Haas Villas-Boas and Marco Antonio Húngaro Duarte, et al. "Micro-Computed Tomographic Analysis of the Root Canal Morphology of the Distal Root of Mandibular First Molar." *J Endod* 41 (2015): 231-236.
16. Paulo César Maccari, Dúcia Caldas Cosme, Hugo Mitsuo Oshima and Luiz Henrique Burnett, et al. "Fracture Strength of Endodontically Treated Teeth with Flared Root Canals and Restored with Different Post Systems." *J Esthet Restor Dent* 19 (2015): 30-36.
17. Kinney John, Marshall Sally and Marshall Gtayson. "The Mechanical Properties of Human Dentin: A Critical Review and Re-Evaluation of the Dental Literature." *Crit Rev Oral Biol Med* 14 (2003): 13-29.
18. Renan Belli, Michael Wendler, Dominique de Ligny and Maria Rita Cicconi, et al. "Chairside CAD/CAM Materials, Part 1: Measurement of Elastic Constants and Microstructural Characterization." *Dent Mater* 33 (2007): 84-98.
19. Ju-Hyoung Lee, Dong-Seok Sohn and Cheong-Hee Lee. "Fabricating a Fiber-Reinforced Post and Zirconia Core with CAD/CAM Technology." *J Prosthet Dent* 112 (2014): 683-685.
20. Aijie Chen, Xiaoli Feng, Yanli Zhang and Ruoyu Liu, et al. "Finite Element Analysis to Study the Effects of using CAD/CAM Glass-Fiber Post System in a Severely Damaged Anterior Tooth." *Biomed Mater Eng* 26 (2015): 519-525.
21. George Hebert Ruschel, Érica Alves Gomes, Yara Terezinha Silva-Sousa and Rafaela Giedra Pirondi Pinelli, et al. "Mechanical Properties and Superficial Characterization of a Milled CAD-CAM Glass Fiber Post." *J Mech Behav Biomed Mater* 82 (2018): 187-192.
22. Jan-Frederik Güth, Christine Keul, Michael Stimmelmayr and Florian Beuer, et al. "Accuracy of Digital Models Obtained by Direct and Indirect Data Capturing." *Clin Oral Investig* 17 (2013): 1201-1208.
23. Graziela Ávila Prado Galhano, Eduardo Piza Pellizzer and José Vitor Quinelli Mazaro. "Optical Impression Systems for CAD-CAM Restorations." *J Craniofac Surg* 23 (2012): 575-579.
24. Marcel S. Prudente, Letícia R. Davi, Kemilly O. Nabbout and Célio J. Prado, et al. "Influence of Scanner, Powder Application, and Adjustments on CAD-CAM Crown Misfit." *J Prosthet Dent* 119 (2018): 377-383.

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