E-Max Restoration on an Endodontically Treated Maxillary Lateral Incisor Using an Intra-Oral Digital Scanner

Irmaleny[1], Dian Agustin Wahjuningrum[2]*, Elvi Sahara[3], Setyabudi[2*]

1. Department of Conservative Dentistry, Faculty of Dentistry, Universitas Padjajaran, Bandung, Indonesia.
2. Department of Conservative Dentistry, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Jawa Timur, Indonesia.
3. Resident of Department Conservative Dentistry, Faculty of Dentistry, Universitas Padjajaran, Bandung, Indonesia.

Abstract

Full crown is the most appropriate restoration of endodontically treated tooth with extensive loss of dental structure. A proper crown requires accurately impression and precision by virtual digital intra-oral scanner technique to get patient satisfaction. An all-ceramic crown (e-max) provides excellent aesthetics that is indicated for restoring anterior teeth.

This case report discussed restoration of endodontically treated left-upper lateral incisor. In the examination, there was loss of half coronal dental structure. The radiograph presents radiopaque images through the hermetical root canal. A fibre post was cemented with dual cure resin cement, and then core was created. Virtual impression performed with a digital intraoral scanner aimed to acquire tooth preparation accurately. Furthermore, e-max crown was performed and cemented with dual cure resin cement. Anterior teeth with extensive loss of coronal tooth structures required crown aesthetics restoration (e-max) with a fiber post to increase retention and resistance.

Virtual impression with a digital intraoral scanner was more effective to precisely and accurately record tooth preparation than conventional impression techniques. E-max restoration of endodontically treated left-upper lateral incisor with a digital intra-oral scanner results in excellent dental aesthetics and patient satisfaction.

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Introduction

Post endodontic teeth are structurally weakened due to changes in the dental structures by caries, previous restorations, fractures or trauma, endodontic access and instrumentation, and decreased moisture of the teeth[1,2,3]. Dental structure weakening deals with the loss of dentin[1].

The excessive removal of dental structures during the biomechanical instrumentation of the root canal system, mechanical stress during obturation, lack of protective cusps, and extensive restoration will weaken the teeth[1,2,3,4]. Some studies have found the joint use of irrigation agents such as NaOCl and EDTA can also damage dentin and reduce its mechanical properties due to the removal of organic and inorganic materials[4].

A root canal treatment failure is usually the result of inadequate restoration or the presence of periodontal abnormalities. The prognosis of endodontically treated teeth depends not only on the apical seal but also on the coronal seal which prevents the leakage of oral fluid and bacteria into the periradicular area[2]. Ideal permanent restoration should be able to improve dental aesthetics and function and protect structurally weakened teeth after the endodontic treatment[2].

Treatment plans for restoring endodontically treated teeth are varied. They may include direct simple restoration or complex restoration that require posts and cores. The choice of restoration is influenced by various factors such as the remaining crown structure in the post endodontic treatment, the necessity for good aesthetics and prosthetics[4].

Corresponding author:
Setyabudi
Department of Conservative Dentistry,
Faculty of Dental Medicine, Universitas Airlangga,
Surabaya, Jawa Timur, Indonesia
E-mail: setyabudi@fkg.unair.ac.id

Excessive loss of dental structure requires fibre posts to strengthen the core and replace the loss of dental structure. The remaining dental structure also determine the restorative stability[2].

This case report will discuss the E-max restoration of endodontically treated maxillary lateral incisors using an intraoral digital scanner.

Case Report

The vitality test (-), percussion test (-), and palpation test (-) showed no mobility, and the surrounding tissue was normal. The radiographic examination of tooth 22 showed distal dilacerations of a root canal and radiopaque image along the root canal, indicating hermetic root canal obturation (Figure 2).

Figure 1. Preoperatif clinical picture.

Figure 2. A pre-operative radiograph image.

A 21-year-old female patient visited the Department of Conservative Dentistry, RSGM FKG UNPAD. She wanted her fractured lateral incisor to get crown restoration and had endodontic treatment one week ago. She did not have a history of systemic disease and wanted to have her teeth repaired due to displeasing dental appearance. The examination on 22 revealed that a middle-third coronal fracture (Figure 1).

Figure 3. Guttapercha removal with the drill strength of 1.375 (luxapost, DMG).

Figure 4. A fiber post trial.

The diagnosis of 22 was previously treated tooth. The planned treatment for this case was an all-ceramic IPS e-max crown with a glass fibre-reinforced composite post (Luxapost, DMG).

At the first visit, a clinical examination was performed, and an oral and written informed consent was obtained. Then, the upper and lower jaws were molded with alginate to obtain a diagnostic model and a template for making a temporary crown.

At the second visit, a rubber dam was placed, and 2/3 of the guttapercha was removed coronally. Afterwards, 6 mm of the guttapercha remained in the root canal as an apical seal (Figure 3).

A fibre post trial of was performed until the post fitted along the root canal (Figure 4).

The root canal was etched for 5 seconds, and tooth bonding was applied. The fibre post then was cemented into the root canal, and the core was built using luxacore (LuxaCore, DMG) on the crown (Figure 5).

Figure 5. Core build-up using LuxaCore (LuxaCore, DMG).

A radiographic photo was performed to confirm the fibre post placement (Figure 6).

Figure 6. A radiographic photo after the fibre post cementation.

At the third visit, tooth 22 was prepared for an all-ceramic crown. The axial surface was prepared using a round tip bur by making guidelines on the labial surface at about 1.5 mm until half. About 1.5 mm of the incisal surface was reduced with the same bur. Proximal surface reduction was performed using a thin diamond taper bur. The palatal surface was reduced using a round diamond bur parallelly positioned to the tooth axis. Finish line of the preparation was chamfer.

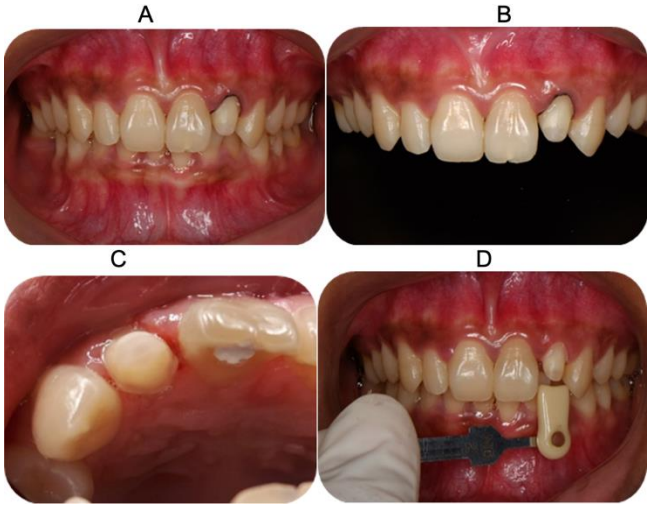

Figure 7. A. Crown preparation of 22 in occlusion with a retraction cord, B. Crown preparation of 22, C. Incical surface area, D. Determination of base color.

Figure 8. Virtual intraoral scanning/printing with a digital intra-oral scanner.

After the entire tooth surface was prepared (Figure 7A-C), an intra-oral scan was performed with a digital intra-oral scanner (3shape, TRIOS) for making the all-ceramic e-max using the cad/cam method. The base color was determined

after tooth preparation, and the final color determination for the crown of tooth 22 was finalized through the VITA Classic A2 shade guide (Figures 7D and 8).

Figure 9. Digital intra-oral scanner (3-shape, TRIOS).

Imaging results were obtained from the use of intra-oral digital scanner (Figure 8)

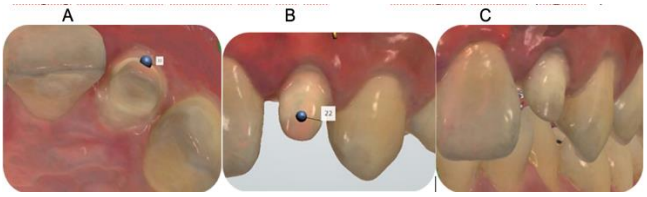

Figure 10. A. Digital intra-oral scanner on the insisal surface, B. Digital intra-oral scanner on the labial Surface, C. Digital intra-oral scanner on the occlusion.

The CAD/CAM was obtained after the digital intra-oral scanning (Figure 10 and 11).

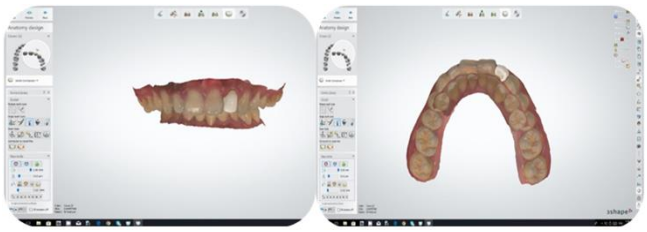

Figure 11. The CAD/CAM from the digital intra-oral scan.

The provisoris on tooth 22 was made. The patient should maintain good oral hygiene until the next visit for the IPS all-ceramic crown. e-max. cementation.

At the fourth visit, the e-max was cemented using dual-cure resin cement (RelyXTMU200, 3MESPE) (Figure 12).

Figure 12. Post e-max crown insertion into tooth 22.

Discussion

In this case, the root canal treatment caused a traumatic injury as it reached the dental pulp and impaired half of clinical crown of the tooth. The remaining tooth structure also determines the restorative stability[2]. According to Hargreaves (2016), the excessive loss of tooth structures occurs due to caries, restoration procedures and endodontics. A full coverage crown could be a restoration option. Otherwise, minimal loss of dental structures after the root canal treatment could be restored by direct composite restoration[3].

Hargreaves et al. (2016) state that the resistance to tooth fracture after the root canal treatment was reduced by 69% for cases with MOD cavities, and thus direct composite restoration was not appropriate to prevent tooth fracture and root canal reinfection[3].

All-ceramic crown restoration with the fibre post after the root canal treatment in tooth 22 was performed due to the excessive loss of tooth structure. It is suggested that the use of all-ceramic restoration with fibre posts has been shown as an excellent aesthetic method and has also proved retention results over the years[5].

The remaining crown structure and the functional requirements determine the needs for intra-radicular post and core crown. Root canal posts mainly can maintain and support the final tooth restoration, obtain retention of core crown, support the final restoration, and replace dental structure. Built-up core was placed to replace the damaged dental structure. The crown restoration covers the core crown and also restores dental aesthetics and functions[2,3,4,5,6].

Forces on anterior and posterior teeth are different because the posterior teeth are subjected to vertical pressures, while the anterior teeth must maintain lateral and shear stress, that a post distributes to the crown and root to prevent fracture[2,6,7]. Increasing post length is beneficial, but 5 mm of guttapercha as an apical seal is still required. Over length post is disadvantageous due to the apical dentin is susceptible resulting into root perforation and fracture[2].

Several factors considered in selecting a post to restore teeth after the root canal treatment involve remaining dental structure, ferrules, the retention and resistance, dental aesthetics and functions, and post material[1,3,7,8].

The importance of post materials of elastic modulus for delivering stress towards dental structures. Post materials that have higher elasticity than dentin can be harmful since they deliver stress to dental roots and result in root fractures[2].

The best treatment in maintaining the restoration of root integrity, posts and cores uses fibre posts, especially those at 8-10 mm. Such fibre posts have elasticity that resembles dentin in delivering stress from the roots to normal teeth. However, the length of fibre posts less than 5mm results in the reduced pressure absorption in the post system. This can result force delivery to the dentin in the cervical area and create cervical fracture[2].

In this study, fibre posts were chosen because they have similar elasticity to dentin and aesthetic appearance. Moreover, they are stainless to the gingival edges and translucent. Its translucency allows fibre posts to be penetrated by light during cementation using dual-cure cement materials. Posts and cores are cemented by an adhesive and biocompatible technique[1,2,3,4,5,6,7].

Hargreavest et al. (2016) state that posts in root canals require core and coronal restoration. They should provide as many clinical properties as possible, such as to what extent they can prevent the roots against fractures, retain and repair the roots, core and crown, and protect crown edges from leakage. Thus, these posts result in dental aesthetics and serve high radiographic visibility and biocompatibility[3].

In this case, restoration using the e-max gave very satisfying results. Previous research conducted by shows similar findings that after a-year post-endodontic restoration, it counted 80-95% success for crown restoration with violation of biological width, reinfection of periapical lesions and secondary caries. However, only e-max and zircon showed better efficacy than PFM and composite restorations in terms of free gingival discoloration and inflammation[5].

All-ceramic crowns after root canal treatment provided good translucency and vitality without opacity as in PFM restoration. E-max crowns show better clinical and radiographic results due to their physical and mechanical properties such as biocompatibility, durability, radioactivity, flexure strength, and safety to patients, dentists and technicians[5,9].

Impression is the first step in the dental crown creating process. Printing inaccuracies will result in errors during the process. The crown can overcontour or deform at the edges and thus may result in gingivitis and worse periodontal problems[8,11].

The restoration materials used in this case are lithium disilicate reinforced ceramic glass and e-max cad/cam crown. The impression method begins with scanning with an intra-oral scanner. The scan result was sent to the laboratory using e-max cad/cam restorations known as the integrated chairside-laboratory cad/cam technique. In this technique, an intraoral digital scanner can obtain a virtual cast that allows a dentist to remove impression materials, identify finish lines of the preparation, evaluate the interocclusal space and design prosthetics[8].

The virtual intra-oral digital scanning technique can produce accuracy and precision casts compared to the impression technique. The research conducted by Sason GK. et al. (2018) supports this finding by stating that intraoral scanners showed less deviation but higher precision than extra-oral scanners. Ng Jonathan (2014) states the crown creating technique with the intra-oral digital scanner provides more accurate finish lines than the conventional impression[8].

A conventional impression technique used today is physical impression with elastomer/alginate impression materials and impression tray. The disadvantages of this technique include improper selection of materials and impression tray, requirement of disinfection, distortion before casting, cast storage and die making. Digital impression using a scanner can be an option to improve the accuracy of dental

restorations and naturally eliminate errors caused by conventional impression and gypsum model casts[8,11].

On the three-dimensional digital impression, the anatomical structures were recorded using an optical camera. The digital data obtained improve treatment plan, provide high efficiency and reproducibility in data storage facilities, as well as maintain documentation, cost and time effectiveness, and good communication between operators and laboratory technicians[10,12].

An intra-oral digital scanner can give comfort to patients, especially those with anxiety and high gag reflex. Furthermore, the scan results can be transferred directly to a laboratory and can provide high precision and better finish-line accuracy than conventional impression methods. Digital impression helps practicians to describe treatment plans for patients and can become medical records and reproduced[8,10,11,12].

Moreover, an intraoral digital scanner also can produce details of prepared teeth and dry working areas from saliva and blood, as well as require high costs[8,10,11,12].

Conclusions

The e-max restoration on the endodontically treated maxillary lateral incisor with an intra-oral digital scanner showed satisfying results and excellent dental aesthetics.

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Declaration of Interest

The authors report no conflict of interest.

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