Scholars Journal of Medical Case Reports
Abbreviated Key Title: Sch J Med Case Rep
ISSN 2347-9507 (Print) | ISSN 2347-6559 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Fixed Prosthodontics

CAD/CAM Customized Metal Post and Core with Digital Intraoral Impression: A Case Report

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DOI: 10.36347/sjmcr.2023.v11i10.011 | **Received:** 25.08.2023 | **Accepted:** 03.10.2023 | **Published:** 09.10.2023

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Abstract **Case Report**

Background: Following endodontic treatment, it is crucial to utilize a suitable restorative technique to secure the coronal seal as well as shield remaining dental structure. When two or more walls of a tooth are lost, it becomes necessary to restore it with posts in order to enhance retention and stability of the final restoration. These posts can be categorized as either prefabricated or customized, and can be produced via the CAD-CAM. ***Purpose:*** The development of digital dentistry has been aimed at augmenting the accuracy of workflow and expediting the production process. The focus of this case report is the restoration of undamaged teeth that have undergone endodontic treatment. This was done with the assistance of a CAD-CAM post and core system that was milled through digital impression. ***Patients and Methods:*** For this particular case, the method employed involved utilizing an intraoral scan for the fabrication of a post and core restoration for inferior premolars that had undergone endodontic treatment. This approach was derived from in vitro experiments which validated the intraoral scanner's capacity to accurately discern post-space up to a depth of 12 mm with the assistance of the scan post. ***Results:*** The digital technique allows us to convert the concave surface of the root canal into the convex surface of the post, and realize an anatomical post and core that improves the biomechanics of the endodontically treated tooth reducing the possibility of root fractures. ***Conclusion:*** The use of an intraoral digital scanner represents an opportunity for the clinician as it speeds up the production of an anatomical post and core restorations.

Keywords: Digital dentistry, post-space, digital intraoral impression, metal, post and core, CAD-CAM.

INTRODUCTION

Endodontically treated teeth are well known to be more susceptible to fracture [1]. This is due to the loss of hard tissues coming from the initial carious pathology, the endodontic access cavity and instrumentation and finally, for a minimal part, for the biochemical and structural changes in nonvital dentin [2]. Restoring these teeth is highly problematic without residual hard tooth tissues and destruction at the gingiva level -no ferrule effect. Studies by various authors show that the placement of the post and core construction of the destroyed teeth does not strengthen them but weakens the tissues [3]. The results are expressed in fractures of the treated roots. Post and core restoration is a challenging and complex clinical procedure. It requires consideration of many factors, such as the thickness of the root of the tooth, root length, and the presence of remaining dental and enamel walls above the gingiva, to ensure the strength of the construction through the ferrule effect and others. In addition, taking a standard impression is complicated, as it is necessary to print the intracanal features of the tooth and others accurately [3]. Several materials have been proposed to build posts; metallic posts, fiber, ceramic, zirconium oxide and PEEK. For making post and core restorations, there are different options. A restoration method indicated direct constructions with different types of posts and core build-up with composite materials [3]. Indirect post and core restorations are conventional and also by digital methods [4].

Conventional indirect restorations are labor-intensive and complex laboratory artistry, which is why the result is not always predictable. On the other hand, digital posts and core restorations are relatively new, with facilitated methodology and excellent results [5]. It remains an open question of which method of restoration and type of materials is to be applied to protect the remaining tissues and restore affected tooth structures in the long term [6]. Digital dentistry has been developed to increase workflow precision and to accelerate the production process; generally, use of CAD-CAM to realize customized posts was limited to scanning plaster

models obtained from traditional impressions. [7] Other authors purposed a different digital workflow in which a traditional silicon impression is scanned to mill a personalized CAD-CAM post and core. Differently, in the reported case an intraoral scan of post-space was performed; this operative protocol is the outcome of in vitro experiments about the capacity of the intra oral scanner to read post-space in order to obtain a full digital workflow. In the presented case report two customized post and core obtained using intra oral scanner were cemented with adhesive technique and the teeth restored with monolithic zirconia crown also realized by CAD-CAM.

CASE REPORT

A 30-years-old M.L patient reported to the Department of Prosthodontics at CHU Farhat Hached of Sousse (Tunisia) in July 2023 with a chief complaint of prosthetic rehabilitation of the right inferior premolars. (#44; #45). The patient provided a written informed consent to publish details and any images about this case report. Clinical and radiographic examination revealed that (Figure 1):

- The first premolar (#44) was decayed with a defective composite resin filling. It was discolored and the vitality test was negative.
- The second premolar (#45) was endodontically treated without any apical complications.

Figure 1: Intra oral views of initial situation

Taking into account the age of the patient, low masticatory forces, the residual root dentinal thickness and the height of the clinical crown related to total length of root; the selected treatment plan was: crown restoration by customized metallic post and core and monolithic zirconia crown. Firstly, we started by carrying out an endodontic treatment at the level of the 45. Next, the preparation of a zirconia -based all ceramic restoration were done, we had to respect the guidelines of preparation design (no sharp angles, smooth margins ....). The preparation was achieved using flat and tapered diamond bur. Then, post-space was prepared using Largo post-file, which removes effectively guttapercha from the canal with minor modifications of the shaped root canal, allowing an anatomical conservative approach. The post-space was prepared 12 mm in depth, ensuring maintenance of a 5–6mm gutta-percha apical seal. The intraoral scan included post-scan and crown preparation of 4.5 in a full lower and upper arches digital imprint then the scan with two scan posts (3Shape, Copenhagen, Denmark) for post restoration which were fitted with dimensions 1.7 mm thick and 12 mm long.

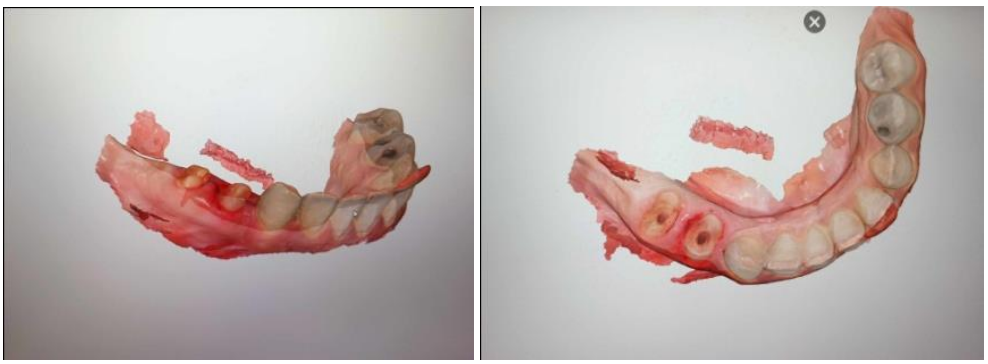

Figure 2-3: The intraoral scan without post-scan

Figure 4-5: The intraoral scan included post-scan

Finally a left and right bite scan were taken and submitted to a laboratory to fabricate post and core restoration from chromium-cobalt alloy by CAD CAM (figure 6).

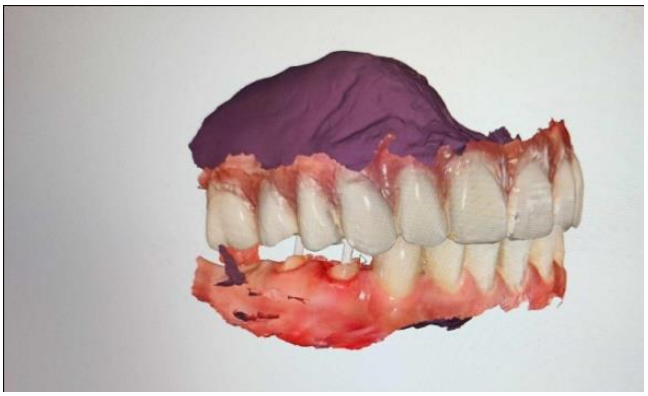

Figure 6: The bite scan

In laboratory, the digital post and core were fabricated (figure 7-8). After receiving the finished post and core (Figure 7-8), it was adjusted. It required a try-in step to confirm fit, insertion, retention, marginal integrity and mostly the space left for ceramic crown (figure 9-10).

Figure 7-8: digital post and core conception

Figure9-10: The customized metal post and core

Once validated, it were cemented and a second scan was performed after luting of post and core in order to elaborate the zirconia -based all ceramic restoration.

DISCUSSION

Direct digital technology significantly reduces the clinical time for the fabrication of chromium-cobalt alloy post and core. Inaccuracies are avoided due to volumetric changes in impression materials and plaster for models and volume changes in wax and composite models [1, 2]. The fully digital method simplifies and shortens clinical and laboratory procedures. Post and core restorations with aesthetic materials have been studied in the literature [4, 5]. As a result, the accuracy of the fitment to the walls of the root canal and the endurance to chewing forces by various stimulators have been established. Still, the studies with chromium cobalt alloy for CAD-CAM post and core are insufficient, as are the long-term clinical studies. The digital technique allows us to convert the concave surface of the root canal into the convex surface of the post, and realize, as reported in the literature, an anatomical post and core that improves the biomechanics of the endodontically treated tooth reducing the possibility of root fractures. Digital procedures allow to create prosthetic products post and cores, in direct or semi-direct technique; it is possible to scan a polyvinylsiloxane (PVS) impression of a post-space, or scan the Duralay imprint, but these techniques require more working steps which lead to a risk of procedural errors. The direct technique is considered more accurate, in terms of trueness and precision (ISO), to produce prosthetic products through the digital work-flow. The digital workflow allows the use of industrially precured fiber reinforced composite resins with superior mechanical properties. The precision of the CAD/CAM post and core restoration allows for a minimal amount of cementing composite resin and can result in a better adhesion to the dentinal walls. The use of this type of alloy without a nickel in its composition is favorable, as it has been proven that nickel is one of the main allergenic components in alloys used for dental restorations [6]. According to research by Moustapha and co-authors, the mechanical properties of CAD-CAM post and core restoration are more favorable [7]. Studies by Leven R and co-authors on the accuracy of different types of scanners prove that there is no significant difference in the accuracy of the studied intraoral scanners regarding the fabrication of CAD/CAM zirconia posts and cores [8].

CONCLUSIONS

The use of an intraoral digital scanner represents an opportunity for the clinician as it speeds up the production of an anatomical post and core restorations. Three clinical visits were required for the fully digital production of computer-assisted posts and cores of chromium cobalt and a ceramic crown. The accuracy of the recovery is acceptable. Further case series and in vitro research are needed to standardize the technique as many new CAD-CAM materials will be available in the future giving the clinicians many new treatment opportunities

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