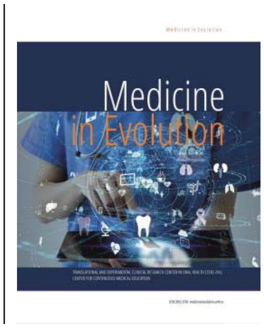
Digital workflow of immediate CAD/CAM restoration with hybrid ceramic resins, an aesthetic treatment approach for pediatric patients



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Abstract

Preserving primary teeth is crucial for ensuring the right circumstances for the eruption of their permanent successors. Prosthetic treatment can be the only option for restoring the function, aesthetics and longevity of endodontically treated primary teeth as well as, fractured teeth, multi surface caries or extensive wear. The case report below presents the complete digital workflow and clinical use of a CAD/CAM resin nano ceramic restoration of two endodontically treated primary second molars on a six-year-old patient.

Keywords: CAD/CAM, deciduous teeth, digital impression

INTRODUCTION

Loss of tooth structure may be caused by a number of factors which can include carious lesions due to poor oral hygiene, traumatic injuries or non-carious lesions such as erosion and abrasion (1,2). Excluding traumatic injuries which can lead to an immediate opening of the pulpal chamber, both carious and non-carious lesions if left untreated, will eventually lead to pulpal lesions. In extreme cases, due to severe enamel and dentin loss, teeth may become untreatable leading to extraction (3,4).

Preserving primary teeth is crucial for ensuring the right circumstances for the eruption of their permanent homologues. Premature loss of primary teeth, when left untreated, usually evolves to a space deficit with various consequences on the position and eruption time of the permanent teeth (5-7). In the early stages, the loss of tooth structure can be treated using conventional restorations such as compomers, glass ionomers or even composite resins (8,9). However, in cases of extensive tooth structure loss these restorations may not provide sufficient strength; additionally, primary teeth with endodontic treatment become more brittle, therefore other treatments are required such as coverage crowns (10,11).

Prosthetic treatment can be the only option for preserving and/or restoring the function, aesthetics and longevity of endodontically treated primary teeth as well as, fractured teeth, multi surface caries or extensive wear (12). Over the years, the materials used for the fabrication of pediatric crowns varied from stainless steel (with increased durability but poor aesthetics) to prefabricated zirconia crowns with good aesthetics but impossible to adjust (13,14). The main disadvantage of prefabricated pediatric crowns is the lack of marginal, occlusal and internal fit which can lead to microleakage, wear of the antagonists, consequence of abrasion (improper polishing of occlusal surface) and descementation (15,16).

The use of CAD/CAM technologies in the field of prosthetic dentistry has revolutionized the approach of teeth rehabilitation regarding the accuracy, speed, the patient’s comfort and predictability of the treatments (17). Conventional impression methods are difficult to implement even on adult patients, therefore in the case of children, conventional prosthodontics steps may be considered as an impossible task. However, with the CAD/CAM technologies, this may be an issue of the past. Digital impressions take less time to complete and also remove the taste and sensation of the conventional impression materials. The main advantage of these technologies are the high accuracy of the prosthetic milled restorations in regards to all clinical parameters (18,19).

Aim and objectives

The aim of this paper was to present a complete digital workflow and the clinical use of a CAD/CAM resin nano ceramic restoration of two endodontically treated primary second molars on a young growing patient.

CASE REPORT

A 6-year-old male patient presented at the Department of Pedodontics, Faculty of Dentistry, University of Medicine and Pharmacy “Victor Babes”, Timisoara, with chief complain of pain in 7.4. The patient's medical history indicated that two weeks earlier he had received a root canal treatment on 7.4 at his local dentist but his mother wanted a second opinion of a pediatric dentist. Clinical examination showed deep dentinal caries on 5.5, 5.4, 6.4, 6.5, 2.6, 3.6, 7.5, 7.4, 8.4, 8.5, 4.6 associated with anterior crossbite.

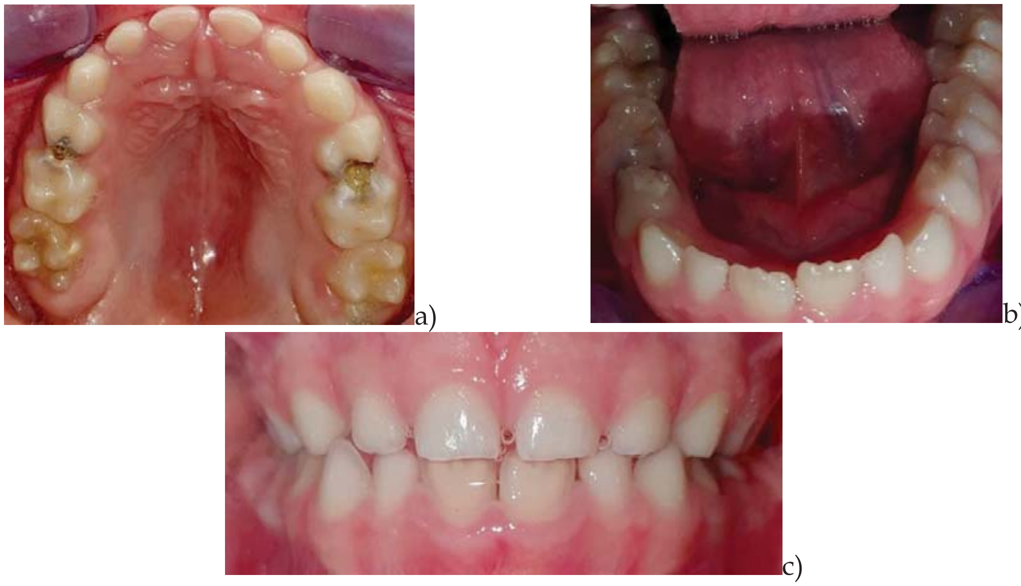


Figure 1. Intraoral clinical exam: a) upper arch; b) lower arch; c) frontal view of occlusion

Radiographic examination showed loss of tooth structure on the before mentioned teeth. Additionally, deep caries with pulp damage was shown on 7.5 and on the first quadrant, on 5.5 and 5.4.

Figure 2. Orthopantomography

Pulpectomy was performed as described below. Inferior alveolar nerve block was administered (2% lidocaine with 1:100.000 adrenaline), the tooth was isolated with a rubber dam, the pulp chamber was accessed, and the working length was determined using a Size 15 sterile K-file to 2 mm short of the radiographic apex. Intracanal tissue was extirpated using a barbed broach (Medin Barbed Broach, Vlachovice, Czech Republic), and the canals were filed with Vitapex. Canals were irrigated with 2% Gluco-Chex between instruments and with 5 ml of sterile saline as a final irrigation. Canals were dried with premeasured paper points up to 2 mm from the root apices. Canals were filled with Vitapex a premixed calcium hydroxide with iodoform solution using a endodontic intercanal tip. After radiographic control of the root-canal filling, a cotton pellet was applied to the pulp chamber, and the access cavity was sealed with glass ionomer cement (GC Equia Forte HT FIL capsules).

Due to extensive tooth structure loss on both 5.5 and 7.5, a digital prosthodontic treatment approach was chosen in order to ensure the protection of the teeth and to restore the aesthetic and function. Approval and written consent was obtained for the CAD/CAM treatment.

The treatment involved the preparation of the deciduous teeth 5.5 and 7.5 according to standardized preparation techniques: 1.2 mm of occlusal reduction, 1 mm of axial reduction and a chamfer finish line positioned equigingivally.

a) b) c)

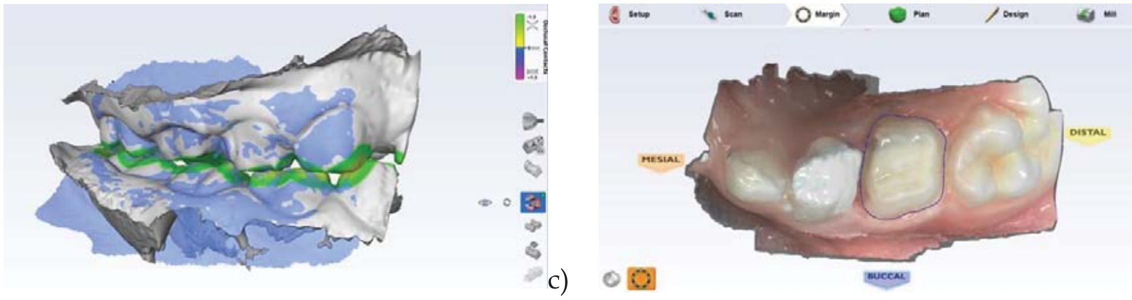
Figure 3. dental burs used, b) intraoral aspect of the preparation of 5.5, c) preparation of 7.5

Both abutments were scanned using an intraoral scanner (Planmeca Planscan, Finland), obtaining the digital models.

Figure 4. Digital impression

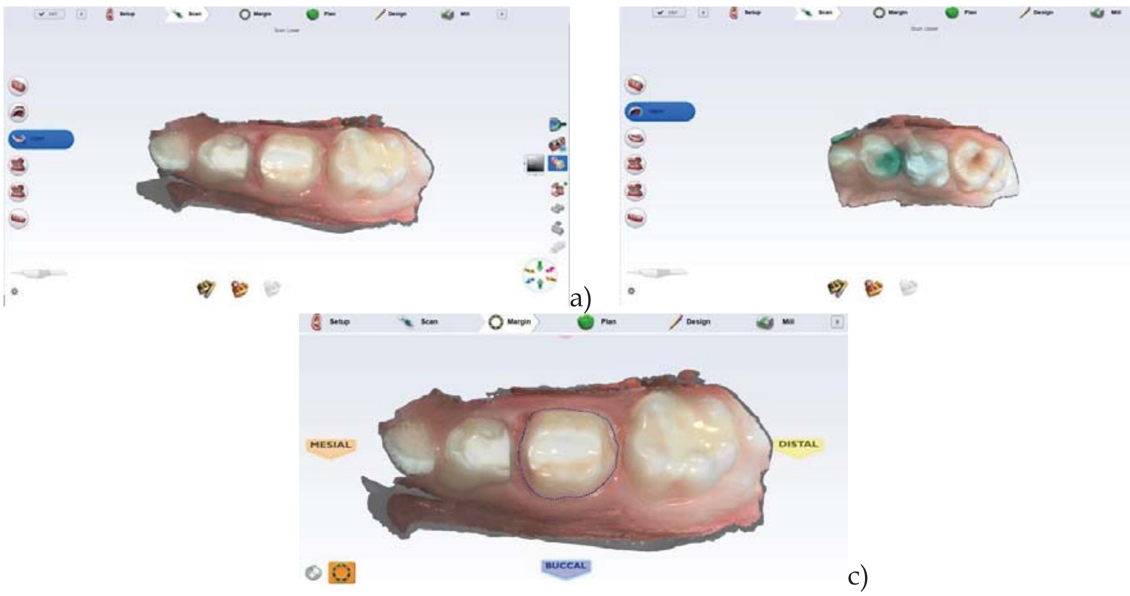
a)

b)



c) d)

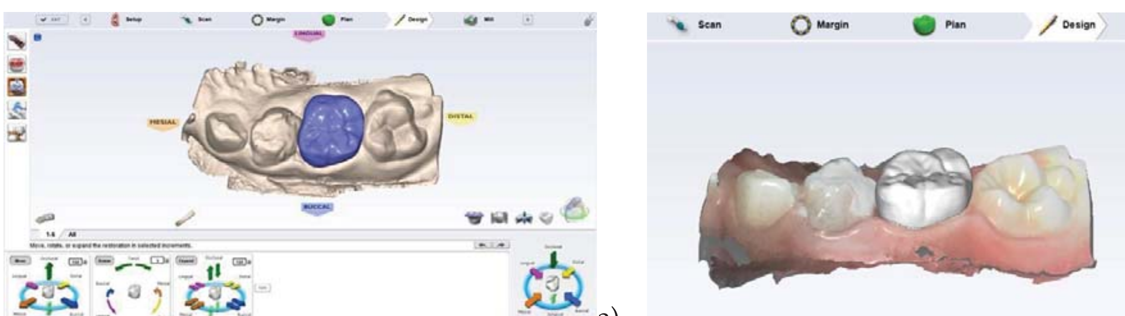
Figure 5. dental scanning - a) 5.5 scanned abutment, b) lower antagonist, c) occlusion, d) tooth preparation margin line



a) b) c)

Figure 6. dental scanning – a) 7.5 scanned abutment, b) lower antagonist, c) preparation margin line

The next steps included the design of the crowns (Romexis Software) followed by the milling of the final restorations from hybrid ceramic resin blocks (Tetric CAD, Zurich).



a) b)

c)

Figure 7. a,b) establishing the dental crown design, c) default crown milling parameters

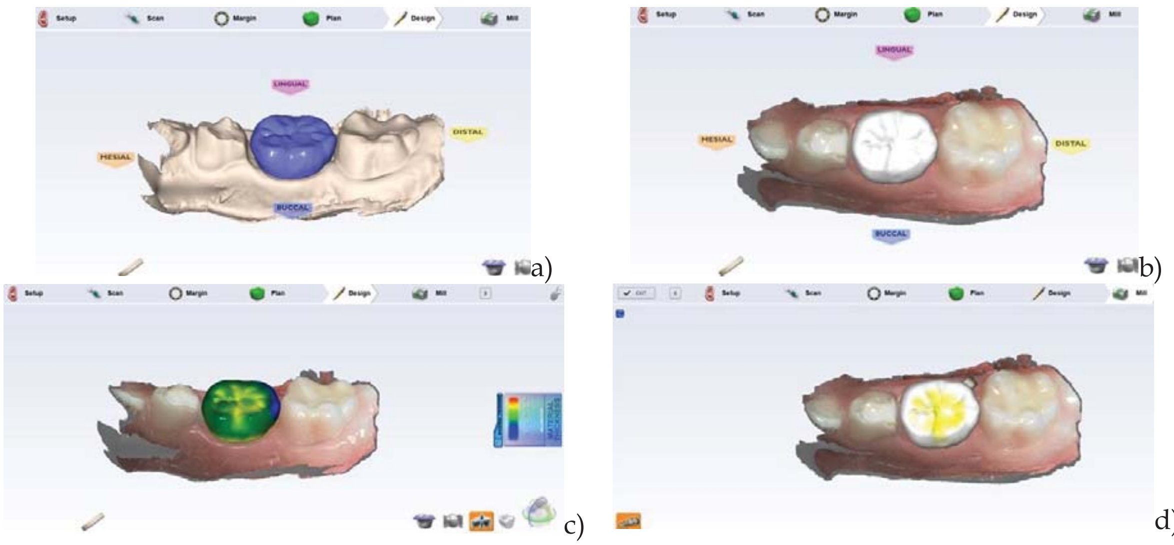


Figure 8. a,b) establishing the dental crown design, c) setting up the material thickness, d) default crown milling parameters

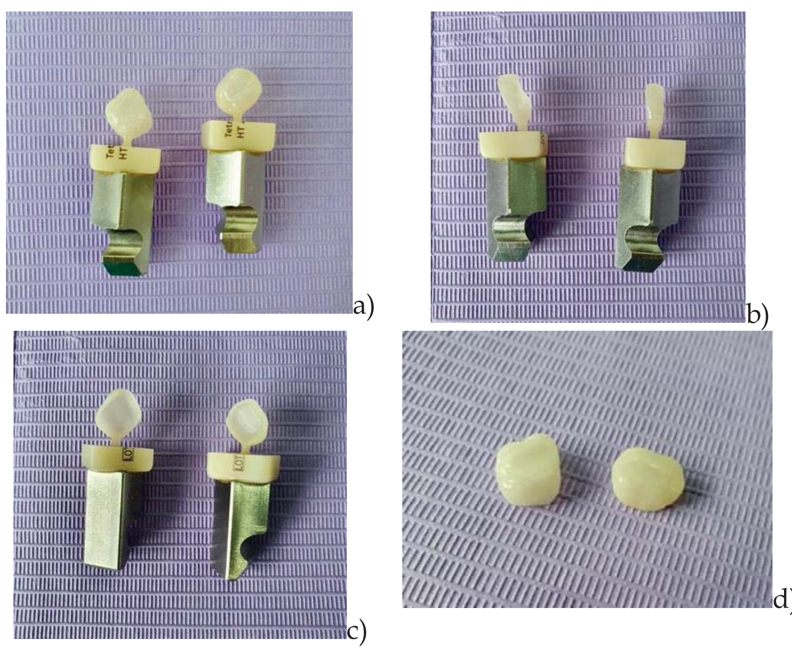


Figure 9. a,b,c) Tetric CAD hybrid ceramic resin crowns, d) final restorations

After the milling procedure, the restorations were assessed intraorally for marginal and internal fit. Teflon strips were placed on the adjacent teeth to prevent any excess cement from bonding to them. Adhesive cementation protocol was implemented: etching with orthofosforic acid (37%), bonding (Adhese Universal) and light curing. Next, the crowns were filled with cement (Variolink Esthetic DC) and seated on the abutments.

Figure 10. Adhesive cementation protocol

All excess cement was removed after an initial 2 seconds polymerization followed by final light curing of the cement. Last step involved the occlusal adjustments and polishing of the crowns.

 a)  b)

Figure 11. a,b) Final aspect of fixed prosthodontic restorations

DISCUSSIONS

The prevalence of endodontically treated primary teeth associated with extensive tooth structure loss is a common situation in the field of pediatric dentistry. Depending on the extension of the tooth destruction, conventional conservative methods (compomers, glass ionomers) may not provide viable treatment options, leading to a complete coronal loss and eventually the premature extraction of the primary teeth with negative consequences on the evolution of the permanent homologues (20).

Preformed stainless-steel crowns were frequently used in the management of severely destroyed primary teeth due to their cheap fabrication process and fast clinical procedure of adjustment and cementation. However, stainless steel crowns come with a number of disadvantages including improper marginal adaptation (with negative impact on the adjacent gingival tissue), lack of aesthetics and also the potential allergenic reactions caused by low biocompatibility (21,22). As a biocompatible and aesthetic alternative, prefabricated zirconia crowns were introduced, providing superior aesthetics but at the cost of increased tooth reduction and less possibilities for marginal adaptation (23).

CAD/CAM technologies provide both requirements of aesthetics (ceramics, resin ceramics) and clinical fit eliminating at the same time the disadvantages of conventional prosthodontics generated by the impression procedure. Another advantage provided by these technologies is the real time evaluation of the abutment geometry, therefore any adjustments can be performed during the digital impression procedure without the need of an additional appointment. Additionally, the same day milling of the final prosthetic restoration is another advantage that promotes the use of CAD/CAM technology in the field of pediatric dentistry (18).

This case report presents the workflow in the fabrication of two CAD/CAM nanoceramic crowns for the rehabilitation of endodontically treated primary molars. When compared to other treatment options such as preformed crowns, the digital approach may be more time consuming, more expensive for both the clinician and the patient and also the cementation procedure is more sensitive. However, the advantages that these systems provide regarding the precise fit, marginal adaptation and excellent aesthetics, combined with the same day milling of the final restorations far outweigh the presented disadvantages.

CONCLUSIONS

In regards to the present case report, the following conclusions can be drawn:

- CAD/CAM technologies provide and ideal alternative to conventional treatment approaches implemented in pediatric dentistry;
- When compared to preformed crowns, CAD/CAM fabricated crowns provide excellent clinical results of internal, and marginal fit and occlusal adaptation;
- In case of long-term functionality of primary teeth, CAD/CAM restorations may be the best alternative treatment;

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