

RESTORATION OF AN ENDODONTICALLY TREATED FIRST PERMANENT MOLAR IN A NINE-YEAR OLD CHILD USING DIGITAL WORKFLOW: A CASE REPORT

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ABSTRACT

BACKGROUND Until recently, stainless steel crowns are the most widely used restorations for permanent molars following endodontic treatment in children. This is due to their feasibility and cost-effectiveness. However, these restorations are not esthetically acceptable and serve only as long term temporary restorations that have to be replaced after several years . With the new era of digital dentistry and adhesive restorations , the use of intraoral scanners (IOSs) and computer-aided design/computer-assisted manufacturing (CAD/CAM) indirect restorations using overlays serve as an innovative, esthetic and durable substitute for stainless steel crowns.

OBJECTIVES This case report aims to highlight a new, durable and esthetic approach for restoring an endodontically treated first permanent molar in a nine-year old child using the digital workflow.

KEYWORDS CAD/CAM , scanners , Digital workflow, first permanent molar, intraoral scanners

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INTRODUCTION

Various treatment approaches are available for restoring endodontically treated teeth using different materials and techniques⁽¹⁾. Full coverage restorations have been recommended following endodontic treatment in posterior teeth in order to provide adequate coronal seal and reduce risk of fracture under the influence of masticatory forces^(2,3). As stated by the American Academy of Pediatric Dentistry (AAPD)⁽⁴⁾ , Stainless Steel Crowns (SSCs) are indicated for restoring young permanent molars with extensive caries, developmental defects and endodontically treated teeth in children. Full coverage with SSCs aids in preventing cuspal fracture and maintaining proximal contacts and occlusal height⁽⁵⁾. They are cost-effective, easy to prepare and less technique sensitive. Despite all their advantages, SSCs are still esthetically unacceptable and don't meet the raised parental demand for tooth-colored restorations⁽⁶⁾. They are still interim restorations that have to be replaced later on after adolescence when cast restorations are feasible. With the evolution of adhesive dentistry, innovative , aesthetically appealing restorative options are now available for restoring endodontically treated molars in children⁽⁶⁾.

Indirect ceramic restorations are long-term treatment options that lie between direct restorations and full coverage crowns⁽⁷⁾. They require more conservative preparation compared to SSCs, protect from further loss of tooth structure, and preserve periodontal integrity due to their to supragingival margins. Additionally overlay restorations are considered more definitive therapeutic options when compared to SSCs⁽⁷⁾. Decision making when restoring endodontically treated teeth in children depends on several factors and should incorporate a short and long-term treatment plan. Those factors include child's dental age, level of child's cooperation, parental demands, financial cost, the dentist expertise and the availability of the material and equipment⁽⁸⁾.

In children and adolescents, restoring endodontically-treated posterior teeth with indirect ceramic restorations is extremely challenging. This is primarily due to the impression-taking procedure, which is highly technique sensitive and requires patient's cooperation. The traditional impression techniques induce great discomfort for patients especially those with gag reflex⁽⁹⁻¹¹⁾. The new era of digital dentistry with the wide use of Computer-Aided Design/Computer-Assisted Manufacturing (CAD/CAM) and intraoral scanners (IOSs) has paved a way for pediatric dentists who treat young

permanent molars in their routine practice⁽¹²⁾. The IOSs facilitate taking impressions in children easily, quickly and accurately with no materials or trays needed. The IOSs are better tolerated than conventional impression techniques^(13,14).

This article aims to present a recent treatment modality for restoring permanent molars in children using digital workflow. This line of treatment will be explained through a clinical case of an endodontically treated first permanent molar restored with an indirect ceramic overlay in a nine-year old child.

Case report

A nine-year-old girl presented to the Pediatric Dentistry and Dental Public Health Department, Faculty of Dentistry, Alexandria University, Egypt with severe pain with hot and cold in the upper left quadrant. The patient was medically free. Dental history was recorded and careful clinical and radiographic examinations were done. The upper left first permanent molar had a cavitated carious lesion with exposed dentin (Figure 1a). Thermal test was performed and the patient responded with severe pain that lasted for a while after removal of the cold stimulus. The patient had no pain on percussion. The preoperative periapical x-ray showed frank cavitation involving the pulp. (Figure 3a) Finally the upper first permanent molar was diagnosed as a case of irreversible pulpitis and root canal treatment was the treatment of choice. The child's behavior ranked 3 according to Frankle behavioral rating scale⁽¹⁵⁾. The treatment plans short and long were discussed with the parents. The parents accepted the treatment but their main concern was esthetics and durability of the restoration.

Intervention

The child was cooperative and compliant with the dental treatment after performing the behavior management techniques of tell-show and do, positive reinforcement and voice control. Regarding the pain control, topical anesthesia containing benzocaine 30 mL 20% (Pharma Research, Inc, 5220 NW 72nd Ave, Miami, FL 33166, USA) was applied for 60 seconds according to the manufacturer's instructions, to decrease discomfort during local anesthesia, after drying the tissues using gauze to increase its absorption. Local maxillary infiltration anaesthesia containing 4% Articaine hydrochloride with adrenaline 1:100,000 (ARTINIBSA, Inibsa Dental S.L.U, 08185 Lliçà de Vall, Barcelona, Spain) was administered.

Root canal treatment was done following the principles of endodontic treatment with access opening, cleaning, filing, shaping and finally obturation⁽¹⁶⁾. A postoperative periapical x-ray was taken to confirm the success of the endodontic filling (Figure 3b) followed by build up with composite resin and the patient was scheduled one week later for tooth preparation and scanning.

Digital workflow

The tooth was prepared to receive an overlay restoration. Cavity preparation was performed in harmony with contemporary rules for all ceramic restorations including absence of undercuts together with rounding off all line angles and internal angles. There are many designs for indirect ceramic restorations according to the clinical situations. In this case the butt joint preparation was chosen (Figure 1b,2). It requires minimal preparation; occlusal reduction following the cusps so that the preparation is considered flat with inclined surfaces⁽¹⁷⁾. The tooth preparation, opposing arch and bite registration were scanned in the same session (Figure 2) using the intraoral scanner (CEREC Omnicam®, Dentsply Sirona Inc, York, Pa, USA). Finally the tooth was temporized using a light-cured material (Clip, Voco GmbH, Germany) and the patient was scheduled one week later for try in and cementation of the Lithium disilicate glass-ceramic CAD-CAM restoration (IPS e.max® CAD, Ivoclar Vivadent, Schaan, Liechtenstein).

At the cementation session, local anesthesia and a rubber dam were used. The tooth surface was cleaned to eliminate any material debris used for fabricating the temporary restoration (Figure 1b).

The fitting surface of the restoration was etched with hydrofluoric acid (porcelain etchant (HF 9.5%), Bisco Inc., Schaumburg, Illinois, USA) for 60 seconds and then thoroughly rinsed with water and cleansed with air/water spray then dried. Afterward the silane (Porcelain Primer/Bis-Silane™, Bisco Inc., Schaumburg, Illinois, USA) was applied for 60 seconds over the entire fitting surface then dried with a gentle jet of air. Over the prepared tooth, 37% phosphoric acid (Meta Etchant, Meta Biomed, Republic of Korea) was applied for 30 seconds then rinsed and excess moisture was removed. A coat of adhesive system (Prime&Bond universal™, Dentsply Sirona Inc, York, Pa, USA) was applied over the etched tooth surface and light cured. A dual-cured cement (Calibra® Universal Self-Adhesive Resin Cement, Dentsply Sirona Inc, York, Pa, USA) was applied over the entire tooth surface and the overlay was placed into its position and pressed gently. Initial light curing or "tack curing" was done for 5 seconds to create a semi-gel state in the luting cement for easier excess material removal along the margins then complete curing was performed^(18,19). Finally finishing and polishing was done using abrasive strips and rubbers (Figure 1c).

Follow up

One week later, at the follow-up appointment, the restoration was inspected clinically for integrity of marginal fit and occlusion. The patient was scheduled for follow up appointments at 1, 6, 12 months and then annually until 3 years follow up.

After 3 years, no cracks, chipping, bulk fracture, loose restoration (debonding), nor complete loss of the restoration were encountered which are common material-dependent failures⁽²⁰⁾. The crown surface was lustrous maintaining the color match and translucency with no surface or marginal staining. Upon clinical examination, no gaps or line of demarcation between the tooth and the restoration. The second premolar and second permanent molar erupted properly with established contact as it was checked by a dental floss. The tooth structure was entirely integrated with no breakdown or secondary caries. Gingival health was excellent with no plaque accumulation (Figure 1d).

Periapical x-ray (Figure 3c) showed excellent adaptation of the restoration with no gap or secondary caries and no evidence of periapical pathosis was found. The patient was entirely satisfied with the restoration esthetically and functionally.

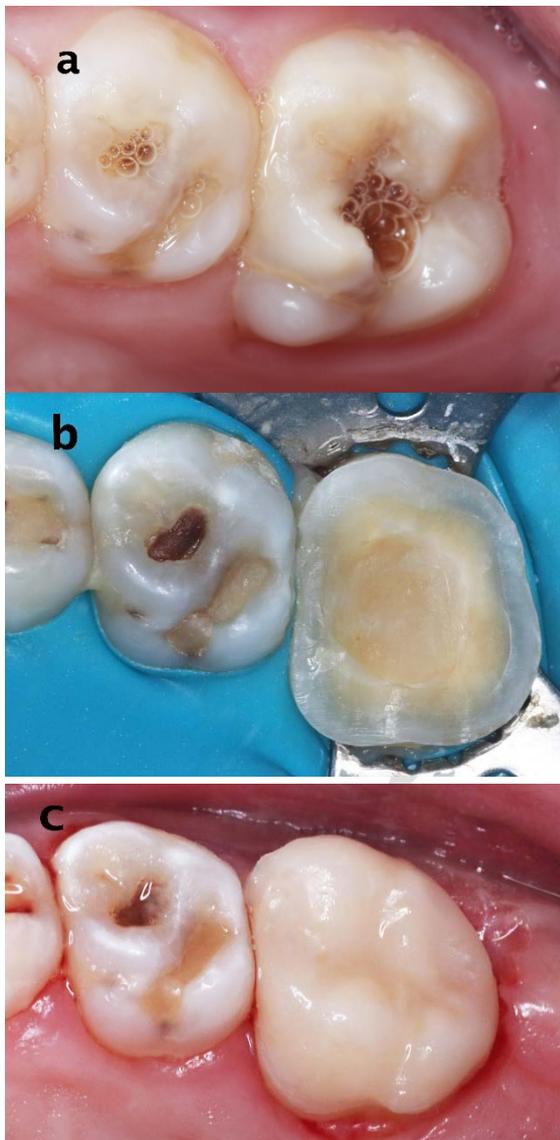


Fig. 1 (a) preoperative photograph showing the tooth #26 with cavitated carious lesion with exposed dentin (b) occlusal view of the prepared tooth #26 under rubber dam isolation (c) The cemented overlay directly after cementation (d) 3 years follow up of the indirect ceramic restoration

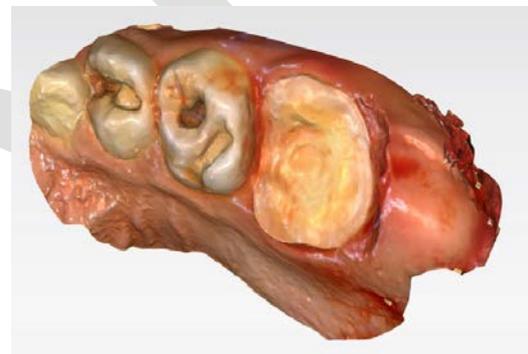


Fig. 2 Intraoral scanning of the prepared tooth # 26



Fig. 3 (a) preoperative x-ray of tooth # 26 showing deep carious lesion involving the pulp (b) postoperative x-ray of tooth # 26 following endodontic treatment (c) periapical x-ray of tooth # 26 after 3 years follow up showing no evidence of periapical or peri-radicular pathosis

DISCUSSION

Stainless steel crowns are the most widely used restorations when restoring endodontically treated permanent molars in children. SSCs prevent further tooth breakdown, restore proximal contact and occlusal height. They are easy to prepare and fit requiring short chairside time with low technique sensitivity. Moreover, they are cost-effective compared to other restorative techniques. Despite all these advantages, there are still some drawbacks. Their appearance is not acceptable to many parents and children. They are not definitive restorations, and they need to be replaced later after adolescence. Moreover, the preparation involves considerable amount of tooth material loss. ⁽²¹⁻²³⁾ With the

evolution of digital dentistry, the use of CAD/CAMS and IOSs allow the placement of more esthetic, long term and conservative restorations in pediatric children. Indirect ceramic restorations have gained acceptance in clinical practice and can be used with children. The IOSs facilitated the impression taking procedure making it more accurate and tolerable by children. This is in accordance with a previous case report used the same approach for restoring endodontically treated molar in an 11-year old child⁽²⁴⁾. A well prepared tooth with highly accurate impression together with high quality lab guarantee an accurate ceramic restoration. In this case, however the intraoral scanning was time consuming, it was well tolerated by the child and the procedure went smoothly without interruption.

When compared to SSCs, indirect overlays require more conservative preparation with minimum tooth loss, maintain gingival health owing to their supragingival margins, and are esthetically appealing to parents and children⁽²³⁾. For proper decision-making, several factors were taken into consideration for choosing between direct and indirect restorations. As mentioned before, the parents were concerned about esthetics together with durability to avoid repeated treatment in the future. As long as the SSC is not esthetically appealing and has to be replaced later on, so it was excluded as a treatment option, the parent preferred to go with indirect ceramic restorations.

Finally, when it comes to restore endodontically treated molars in children, the clinician should consider several factors including the patient's short and long-term needs, the child's and parents' cooperation, treatment costs, the clinician's skills and the materials available.

CONCLUSION

With the evolution of digital dentistry, indirect ceramic restorations can serve as an esthetic, long term, conservative therapeutic substitute when restoring endodontically treated molars in children.

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