Prefabricated Zirconia Crowns – A Solution to Treat Hypomineralized Permanent Molars: Report of a Case

Jorge Casián-Adem*/ Lizette Cobos ** / William F Waggoner ***/ Anna B Fuks ****

The presence of carious lesions in children associated with developmental defects of enamel is frequently observed. Restoring these affected teeth can be a challenge for the clinician. Teeth with enamel defects may have poor or limited resin adhesion and some may require repeated restoration. Prefabricated zirconia permanent molar crowns were recently introduced as an option for restoring severely decayed and broken down young permanent molars. These new restorations offer an efficient, esthetic, and economic option to restore severely broken down carious permanent molars that may be associated with enamel defects in partially or fully erupted molars.

A clinical case of a 13-year-old female patient is presented. She had a mandibular second permanent molar that demonstrated significant caries and loss of much of the clinical crown, which was treated with a vital pulpotomy and restored with a prefabricated zirconia crown.

Keywords*: Molar Incisor Hypomineralization, Enamel defects, prefabricated zirconia crown, Mineral Trioxide Aggregate.*

INTRODUCTION

Molar Incisor Hypomineralization (MIH) is the term used to describe a clinical condition that is reported as increasing in frequency and whose prevalence ranges between 2.8 and 40.2% of the population[1,2]. It is estimated that this condition affects, on average, one in six children worldwide[1]. The term Molar Incisor Hypomineralization was first introduced by Weerheijm in 2001[3,4]. These authors defined this entity as hypomineralization of systemic origin, presenting with defects in tooth enamel, in at least one and in up to four permanent first molars and is frequently associated with similarly affected incisors[4,5].

Clinically, MIH is considered an opacity in the enamel, whose color could range from shades of white to cream to brown[4,6]. It is usually found in at least one of the first permanent molars, although MIH can also be detected in both primary and permanent second molars[4,5,7]. It is noteworthy that the presence of hypomineralized second primary molars increases the possibility of MIH in the permanent dentition; however, the absence of hypomineralized second primary molars does not eliminate the possibility of presenting MIH[7,8]. In MIH, the permanent molars may show rapid caries progression starting shortly after the eruption of the tooth.

Patients presenting with visible enamel defects may report dental sensitivity to heat, cold, certain foods and, sometimes also to toothpastes and tooth brushing. The breakdown and roughness of the hypomineralized enamel can favor the accumulation of biofilm and the consequent development of tooth decay.[1,2,9].

*Jorge Casián-Adem, DDS, Private practice Pediatric Dentistry and Orthodontics, Veracruz, Mexico.
** Lizette Cobos, DDS, Privatepractice Orthodontics, Veracruz, Mexico.
***William F. Waggoner, DDS, MS, Privatepractice Pediatric Dentistry, Las Vegas NV, USA.
****Anna B. Fuks, DDS, Professor Emeritus, Hebrew University, Hadassah School of Dental Medicine, Jerusalem, Israel.

Send all correspondence to:
Jorge Casián-Adem, Calle 20 301, Colonia Cazones, 93230, Poza Rica, Veracruz, México.
Phone: (+52) (782) 822 1412
E-mail: jfcasian@prodigy.net.mx

Presented here is a report of a 13-year-old female patient with enamel defects in the maxillary central incisors and significant defects and breakdown of a mandibular second permanent molar. She reported frequent episodes of dental sensitivity. The permanent molar was restored with a prefabricated zirconia crown. Prior to placement of the crown, a vital pulpotomy was performed by the placement of Mineral Trioxide Aggregate (MTA), a bioactive material. After 40 months the tooth demonstrated very good clinical and radiographic results.

Case Report

A 13-year-old female patient presented to the office of the principal author(JC) with the chief complaint of an extremely sensitive mandibular right second permanent molar (Figure 1). The patient reported pain caused by temperature changes, particularly cold, which prevented her from chewing any food on the right side of her mouth. Toothbrushing with toothpaste also caused some discomfort; thus, the patient avoided toothbrushing.

The tooth had previously been restored using composite resin restorations, but those restorations had failed and been lost. Clinically, the affected molar exhibited a large, extensive carious lesion and had lost much of the clinical crown.

Due to the extensive carious lesion associated with the MIH and the lack of sound enamel capable of being etched and bonded, a resin restoration was contraindicated. It was decided that full coverage restoration was needed. Historically, preformed metal crowns have been used to restore young, badly broken down permanent molars, but in this instance there was a desire for a more esthetic restoration. It was decided to restore the tooth with a prefabricated zirconia crown (NuSmile ZR Permanent Molar Crown; NuSmile, Ltd., Houston, TX, USA).

The child was anesthetized with the administration of a single 1.8-ml cartridge of Articaine 4% with epinephrine 1/200,000 (Medicaine 1/200,000; Septodont, Saint-Maur-des-Fossés Cedex, France). A rubber dam was placed, isolating the affected tooth. With a low-speed #6 carbide round bur, the carious tooth structure was carefully excavated. This, however, lead to a carious exposure of the pulp, which was found to be vital. As this was a young, permanent molar it was decided to treat the pulp with an MTA vital pulpotomy. (Figure 2).

Figure 1. Initial image of a hypomineralized and carious right mandibular second permanent molar with a very extensive occlusal lesion associated with developmental defects of the enamel.

The coronal pulp was removed and a wet cotton pellet moistened with a 1.25% solution of sodium hypochlorite was placed on the pulp stumps for approximately 1 min. The pulp chamber was then rinsed with sterile saline solution. A portion of Mineral Trioxide Aggregate cement (NeoMTA; NuSmile, Ltd, Houston, TX. USA) was mixed following the manufacturer's instructions to a putty-like consistency. The MTA was placed into the pulp chamber with an amalgam carrier and was gently condensed with a wet cotton pellet. The MTA was then covered with a 2-3mm layer of resin-modified glass ionomer cement (BioCem; NuSmile, Ltd, Houston,TX. USA) to protect the MTA during the subsequent process of tooth preparation and crown placement.

Preparation for the zirconia crown was done as conservatively as possible. This consisted of occlusal reduction of approximately 1.5 mm; and circumferential reduction of 1-1.5mm, removing all surface convexity, with a gingival feather-edge margin extending approximately 1.5 mm subgingivally. (Figure 3) As this was a molar in an active process of eruption it was desired to place the gingival margin at a depth that would remain subgingival at the completion of eruption.

Figure 2. Occlusal view of the pulpotomy.

Figure 3. Preparation performed on the mandibular second molar.

After fitting the crown to a passive fit, the occlusion was checked, and the crown was deemed ready to cement. Adhesion of resin modified glass ionomer cements to zirconia contaminated by saliva has been shown to be poorer than to non-contaminated zirconia, so prior to cementation the crown was thoroughly rinsed and its inner surface was cleaned with a cleaning solution containing zirconium oxide particles (Ivoclean; Ivoclar Vivadent, Schaan, Liechtenstein) to remove traces of phosphates contained in the saliva that contaminated the crown during try-in. (It should noted that the NuSmile Permanent Crown kits now come equipped with pink "try-in" crowns which can be used to trial fit the prefabricated zirconia crowns, avoiding the contamination of the zirconia crowns to be cemented.) The crown was then cemented with resin-modified glass ionomer cement (BioCem; NuSmile, Ltd, Houston, TX. USA) following the manufacturer's instructions. A post-operative radiograph was taken to evaluate the final fit and cementation. Excess retained cement was noted on the radiograph and removed. The fit of the crown and evaluation of the pulpal treatment was found to be very satisfactory. (Figure 4).

One week later the tooth was reassessed. Tooth sensitivity had completely disappeared, the gum around the crown was healthy, and the patient was very pleased with the treatment, reporting that she was able to eat, chew, and brush her teeth in a normal manner (Figure 5).

Figure 4. X-ray of the cemented crown. Some excess of cement can be noted on the mesial of the crown.

Fourteen months later, the patient initiated orthodontic treatment in the same dental office, allowing for continued follow-up of the tooth. At 40 months post-operatively the crown had retained its esthetics and function and the tooth had remained vital and asymptomatic. (Figures 6 and 7)

Figure 5. Photograph of the crown 1 week after cementation. The crown appears clean, the gingival tissue is healthy, and tooth sensitivity has disappeared.

Figure 6. Follow-up at 40 months after crown placement. The tooth is asymptomatic and the gingival tissue appears healthy.

Figure 7. Periapical control x-ray 40 months post-op.

DISCUSSION

MIH has been classified into three severity levels. Mild MIH shows demarcated opacities located at non-stress bearing area, with no caries associated with the affected enamel. Moderate MIH demonstrates demarcated opacities present on molars and incisors, with post-eruptive enamel breakdown limited to one or 2 surfaces without cuspal involvement. Severe MIH (as seen in the present case) demonstrates post-eruptive enamel breakdown, crown destruction, caries associated with affected enamel, and a history of dental sensitivity[10].

Hypomineralized molars often present a restorative challenge for the dentist, particularly due to the difficulty of restoring them with adhesive systems such as composite resins[11]. This is due to the poor or inadequate etching of the defective enamel obtained after the application of phosphoric acid[11-14]. This inadequate etching a result of higher than normal organic/protein content of the affected enamel and significantly lower mineralization than is found in sound, unaffected enamel. Another common problem lies in the difficulty in determining where affected enamel ends, and normal, strong enamel begins. This is important for creating an adequate finish line for the restoration, especially in partially erupted molars. Occasionally glass ionomers, or resin modified glass ionomers may be used to restore MIH teeth, but these are usually considered intermediate restorations. Preformed metal crowns have been used to restore severely damaged MIH teeth with high long-term survival rates [2,14]. While durable and economical, these crowns lack esthetic appeal. Full coronal custom coverage with laboratory fabricated crowns can also be done, particularly in older children, but is time-consuming, technique-sensitive and expensive.

In the present case, there had been previous attempts to restore the tooth with resin, but failure of those restorations left the patient's parents seeking another restorative option; one that would solve dental sensitivity and that was esthetically pleasing, as well as durable.

The pulp exposure of an immature permanent molar during caries excavation required the decision of either performing a full root canal treatment or a pulpotomy. While the root apices were nearly closed, it was decided that a vital pulpotomy would be the best treatment to maintain vitality and allow for completion of root end closure[15-17].

Yet another treatment option to pulpal therapy and placement of a crown was the removal of the affected molar and allowing the permanent third molar to erupt as a replacement a few years later. After discussing the pros and cons of both treatment alternatives with the patient's parents, it was decided to restore the affected second molar.

Due to the age of the patient, the second molar was still in active eruption. The crown margin was placed approximately 1.5 mm subgingivally in order to compensate for the subsequent eruption of the tooth, yet still maintain a subgingival margin

Forty months after restoration the molar was asymptomatic; and clinically and radiographically sound with an esthetic appearance. Both clinical and radiographic monitoring is ongoing to evaluate the continued vitality and clinical function of the crown. Zirconia is extremely durable and biocompatible, and the post-operative radiographs show good marginal adaptation of the crown. Replacement of this pre-fabricated crown with a custom crown may be necessary in the future, but that decision will be dictated only if failure of the present treatment occurs.

CONCLUSION

Use of a prefabricated zirconia crown to restore a severely destroyed permanent second molar was shown to have excellent results in this case. Advantages of this treatment include the ability to provide an esthetic, durable restoration at a low cost that can be placed in a single appointment with no impressions or laboratory costs. In partially erupted molars, it is possible to place this type of crown since a precise finish line is not required as is necessary with a laboratory processed crown. Additionally, It is not necessary to refer the patient to another specialist because the crowns can be placed by a pediatric dentist.

Prefabricated zirconia crowns hold promise as a clinically and economically viable alternative for restoring permanent molars affected by enamel defects, tooth decay, and molar incisor hypomineralization.

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