Successful Restoration of Severely Mutilated Primary Incisors Using a Novel Method to Retain Zirconia Crowns – Two Year Results

Osama Ibrahim El Shahawy */ Anne C O'Connell**

Aim: *This manuscript describes a simple reliable technique for restoring severely mutilated primary anterior teeth. A rigid glass ionomer post is created over which zirconia crowns can be fitted to achieve a long-term stable esthetic restoration for primary anterior teeth.* ***Study design:*** *Children aged 2-5 years with two up to six extensively decayed upper primary incisors were included. Fuji IX was condensed into an intracanal space created to a depth of 3mm, to provide a core which also extended 3mm supragingivally. Crown preparations were completed upon these cores. Zirconia crowns (Nusmile, Houston Texas USA) were fitted and cemented over the prepared cores. All patients were recalled at regular intervals.* ***Results:*** *Twenty-three healthy children with 86 restorations participated in the study. The overall survival of the restorations was 95.3% after 12 months and 80.2% after 24 months. According to Kaplan-Meier survival analysis, the median survival time was not reached while the estimated mean survival time was 22.9 months.* ***Conclusions:*** *This newly described clinical technique is simple and reliable to use for restoration of extensively decayed primary incisors. Use of zirconia crowns retained using this technique offers superior esthetic, durable restorations with remarkable gingival response up to 24 months.*

Key words: *Primary teeth, zirconia, esthetics.*

INTRODUCTION

Early childhood caries can cause extensive destruction of upper primary incisors. Until recently, the treatment of choice for such primary teeth was extraction. Many parents now are requesting that these teeth be restored rather than extracted .[1] Restoration of upper primary incisors may improve mastication and avoid alterations in speech, para-functional habits and psychological problems associated with extracted upper anterior teeth. The challenge for the clinician is to provide a durable and esthetic restoration in cases where the decay had destroyed most of the coronal tooth structure.

Direct restorative procedures do not always give satisfactory results with a reduced survival rate of anterior strip crowns when more than three surfaces are carious.[2] Restoration of structure and shape of the missing coronal surfaces using post and core designs from prosthodontic principles has been reported. In vitro studies report significant differences in retention when comparing different post systems in bovine [3] and primary teeth [4,5] however no difference was reported by Pinheiro *et al* . [6] A recent systematic review identified only 2 studies where intracanal reinforcement for restoring grossly broken down primary anterior teeth after pulpectomy for 1 year or longer follow-up period was assessed, highlighting the lack of data on this clinical problem .[7]

Many types of intracanal post systems have been described previously in the primary dentition, usually as case reports. These vary in the design and material used eg. direct resin composite post; [8,9] glass fiber reinforced resin post;[10-12] polyethylene fiber tape;[13,14] an "inverted mushroom shaped" retentive undercut prior to resin post;[9] alpha- or omega-shaped orthodontic wire; [5,15] metal prefabricated or cast posts with macroretentive elements ,[16] use of natural teeth from a tooth. [17,18]

The aim of this study was to describe and clinically evaluate a simple reliable technique for restoring severely mutilated primary anterior teeth using a glass ionomer post and zirconia crowns over time. The clinical success and durability of restorations placed in children using this method over 24 months is reported.

MATERIALS AND METHOD

Ethical approval was taken from Cairo University, Faculty of Oral and Dental Medicine, Research Ethics Committee. Children were selected if they were aged 2-5 years with no relevant medical history and presented with primary anterior teeth, evaluated as non-restorable using conventional techniques. Further

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inclusion criteria included parental request for treatment rather than extraction, remaining coronal tooth structure at the gum margin and pre-operative radiograph showing normal root formation and sufficient amount of root structure present. Periapical pathology was noted if present or absent. Informed consent was obtained from all parents/caregivers.

Dental treatment was provided under local or general anesthesia depending on the age and anticipated cooperation of the child and the number of affected teeth requiring treatment. One operator provided the treatment using the same sequence for each tooth: caries removal, pulpectomy, preparation of the intra-canal space, placement of the core material, preparation for the zirconia crown and cementation of the crown.

Preoperative photographs (Fig. 1A) and radiographs were obtained for each child. Occlusion was checked to determine occlusal reference points on which final occlusion will be checked. Caries was removed using a spoon excavator and a large round bur on high speed hand piece under copious amount of coolant (Fig. 1B) (remaining caries near the gingival margin was not removed until completion of the root canal treatment to avoid gingival bleeding). The pulp chamber was opened and the canals were debrided and cleaned using endodontic H-files. After irrigation with copious amounts of 2.5% sodium hypochlorite, the root canal was dried with paper points and a mix of calcium hydroxide and iodoform paste (Metapex, Meta Biomed Co. Ltd, South Korea) was injected to fill the root canal. After completion of the pulpectomy, the remaining caries at the gingival margin was removed, then a 3mm length of the coronal portion of the root filling was removed to provide space for the core material (Fig. 2). The core material (Fuji IX, GC Inc., Japan) was injected and condensed into the 3mm intra canal space extending 3mm supragingivally and the material was allowed to set according to the manufacturer's instructions (Fig. 3). The supragingival core was prepared using a high speed diamond bur and the crown preparation extended to provide a finish line within sound tooth structure subgingival to the core material (Fig. 4). The crown preparation was finalized using the NuSmile zirconia Try In crown system (Nusmile ZR Pediatric Crowns, Houston, Texas). This allowed assessment of each individual tooth preparation as well as the three-dimensional alignment of adjacent crowns without contamination of the final zirconia crown (Fig. 5). The uncontaminated Nusmile ZR crowns were filled with Fuji IX and fitted on the prepared cores. Before the material set, seating and alignment of the crowns were checked (Fig. 6). Figure 7 shows the same patient after 24 months demonstrating excellent gingival response. The upper left central incisor crown had dislodged due to traumatic incident 2 weeks previously.

Patients were recalled at 3, 6, 12, 18, and 24 months so that the teeth and crowns could be evaluated both clinically and radiographically for retention of the crowns and gingival health.

Statistical Analysis

Data is presented as frequencies (n) and percentages (%). Kaplan-Meier survival curve was constructed for survival analysis to calculate the survival estimates of the restorations. [19] Statistical analysis was performed with IBM (IBM Corporation, NY, USA) SPSS Statistics Version 20 for Windows (SPSS Inc., an IBM Company).

Figure 1A: Preoperative photograph

Figure 1B: Caries removal and pulp extirpation

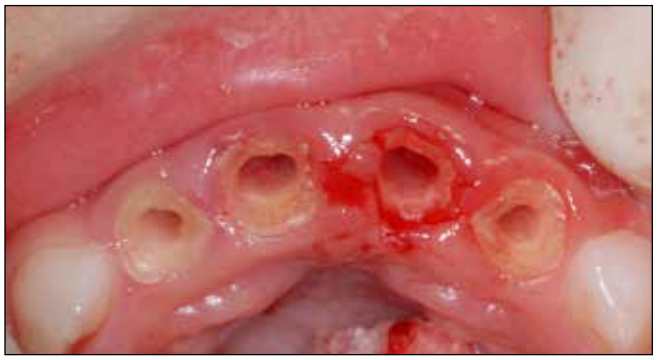

Figure 2A: Illustration of creation of 3mm intra-canal space

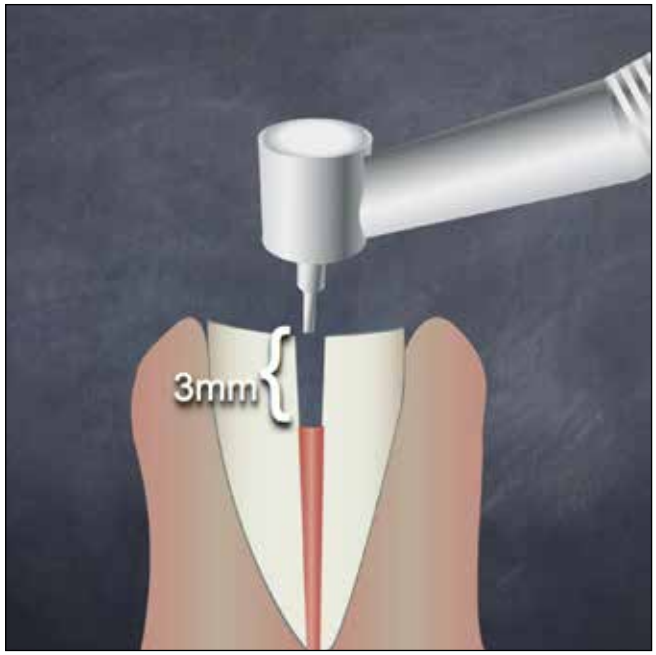

Figure 2B: Clinical example of post space

Figure 3A: Illustration of the glass ionomer core material condensed into post space and extruded extracoronally

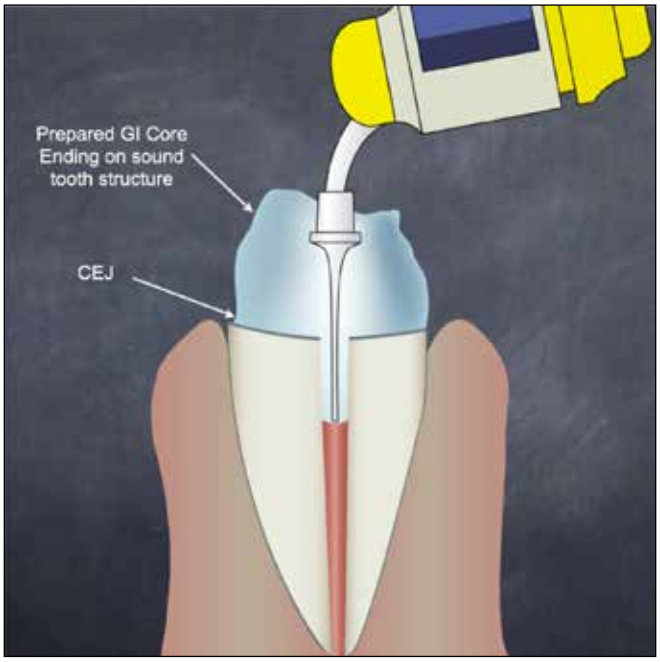

Figure 3B: Clinical demonstration of the use of glass ionomer for post and core

Figure 4A: Schematic of preparation of the GIC core for a zirconia crown with subgingival finish line extending beneath the core margin

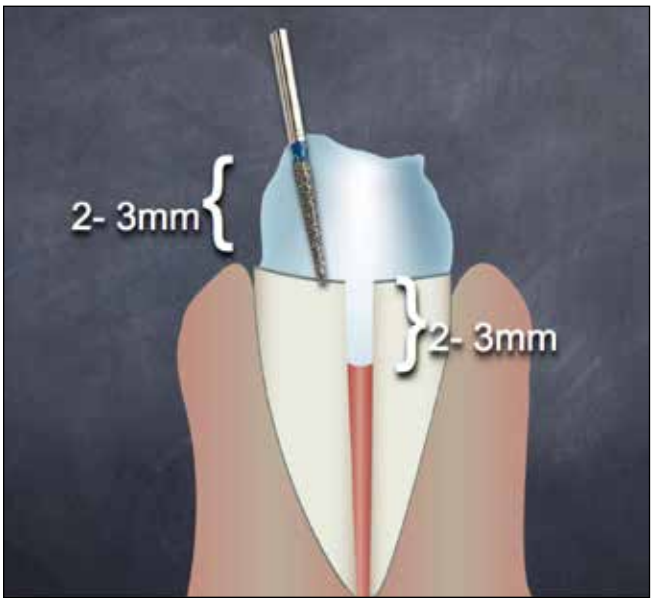

Figure 4B: Preparation of the core structure with a subgingival finish line on intact tooth

Figure 5: Schematic of the use of the Nusmile zirconia Try in crowns

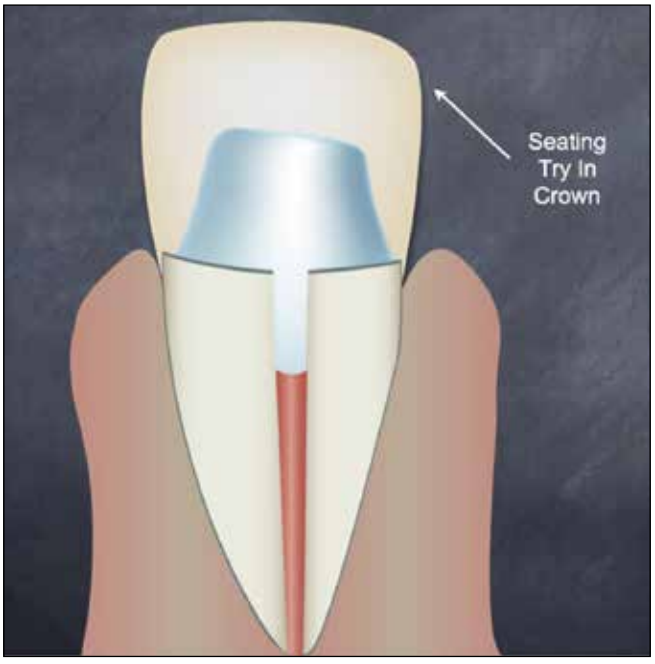

Figure 6A: Illustration of the completed crown with subgingival finish line that extends below the level of the core material

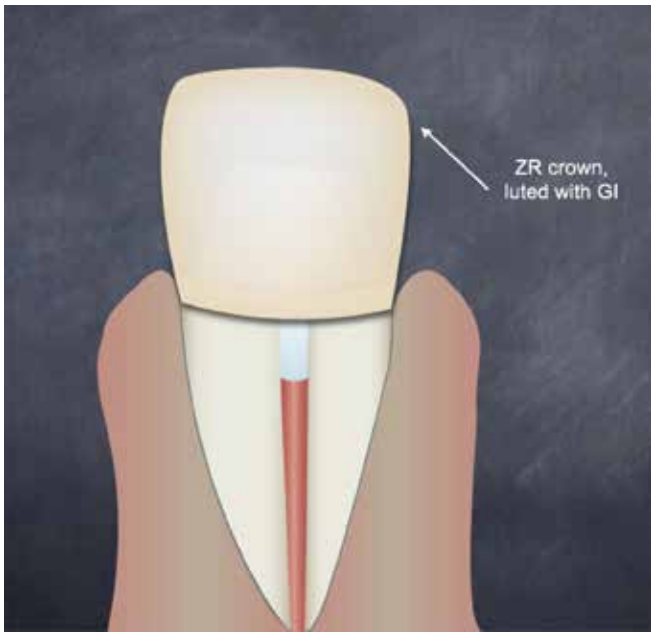

Figure 6B: Clinical photograph immediately after cementation of the zirconia crowns

Figure 7: Clinical photograph at review visit after 24 months. Upper left central incisor crown dislodged due to trauma 2 weeks previously.

RESULTS

Twenty three children participated in the study and received between two to six intra-canal core supported zirconia crowns after pulpectomy, providing a total of 86 treated teeth. The 86 restored teeth were followed post-operatively at 3, 6, 12, 18 and 24 months intervals. There were no failures of the pulp therapy and no crown fractures. Table 1 describes the prevalence and causes of failure of crowns over time. Restorations were lost to follow up either because the patient failed to attend or the tooth in question had exfoliated. All restorations were retained at 3 months, and one restoration had been lost by the six months review, representing 1.2% of the evaluated restorations. The cause of crown dislodgement was unknown by the parent. At one year three restorations had been lost (3.8%) in two children. The reasons reported were trauma in two cases and unknown cause for one crown. After 18 months, six restorations showed dislodgement (8.1% of the evaluated restorations) with the reported cause for the crown loss being trauma (3 crowns), biting on hard object (one crown) and unknown (2 crowns). Evaluation at 24 months showed six restorations had been dislodged representing 9.0% of the evaluated restorations due to trauma (4 restorations, Fig. 7) and biting on hard object (2 restorations). In every case the dislodged crown had fractured within the GIC with the post being retained in the root structure, and the zirconia crown containing GIC core. None of the lost crowns were recemented.

The total number of crowns placed was 86 and the total number of crowns dislodged was 16. According to Kaplan-Meier survival analysis, the overall survival was 95.3% at 12 months and 80.2% after 24 months. The median survival time was not reached while the estimated mean survival time was 22.9 months (Figure 8).

DISCUSSION

Restorations of extensively damaged primary teeth should provide excellent esthetics and mechanical resistance to fracture or loss of the restoration.[5,14,20] When there is severe loss of coronal tooth structure, the use of intra-canal post after endodontic treatment has been used extensively to provide retention for and stability to the subsequent restoration.[11,13] Many case reports have shown success of various systems as already mentioned. In this clinical study, we demonstrate a simple, effective method for restoration of severely mutilated primary incisors using glass ionomer post and core and also glass ionomer as a luting agent for zirconia crowns. In addition, the success of the technique is supported by the clinical performance over 24 months in young children reporting a success rate of 80% for GIC retained zirconia crowns.

Posts prepared with composite resin present a satisfactory esthetic result, but risk loss of retention due to polymerization contraction. [14,21] The omega wire/composite resin technique described by Mortada and King [15] does not provide an adequate adaptation to the canal wall, is dependent on the luting cement and risks metal showing through as a dark colour.[20] The use of 'biological' posts made from extracted primary teeth is highly controversial due to the use of tooth banks and biological contamination.[18,21] Glass fiber posts provide an alternative approach with improved esthetic properties and a modulus of elasticity very close to that of dentin but their use is both time and technique sensitive.[12] All the described post systems rely on an adhesive material to secure the post within the canal, however clinically maintaining a dry field clinically is a

challenge when multiple primary incisors are being restored due to extensive caries.

In the technique described here, glass ionomer cement is used as both the post and core and luting agent for the final zirconia crown. Glass ionomers are not very sensitive to moisture contamination and bonds directly to the tooth.[22] Injection of the material into the prepared root is a fast, reliable method to produce a bulk filling in contact with the dentin surface and provides a solid supragingival structure. Ideal crown preparation is possible within minutes. The extension of the finish line onto intact tooth structure subgingival to the prepared core allows for additional length of the preparation to enhance retention and stability of the crown thereby reducing the risk of dislodgment or fracture. The post, core and luting cement are the same material which should consolidate the reinforcement of the tooth. The failures noted in this study occurred within the GIC at the junction of the core and post, indicating a cohesive failure of the GIC.[22] Neither the zirconia crowns nor the remaining tooth structure fractured in any patient. Dislodgement due to trauma is not unexpected due to the prevalence of trauma to the primary dentition in this young age group.

Previous case reports have used strip crowns as a final restoration rather than using zirconia crowns.[10,12] Resin restorations are affected by moisture contamination and may not be appropriate when the margins are subgingival. Success rates of these restorations decreases when there is less tooth structure for adhesion.[2] The use of zirconia crowns as the final restoration is becoming more widespread and seem to provide superior and stable esthetics over time. Walia *et al* reported 100% retention rate for zirconia crowns at 6 months compared to 78% retention of strip crowns. [23] His study however excluded primary incisors that were pulp treated.[23]

Our study is the first study to report 2 year clinical performance data on anterior zirconia crowns on severely mutilated teeth demonstration the high success rate in these compromised teeth (95% success at one year and 80% at two years).

CONCLUSION

Clinicians can now use this simple technique to offer restorative options to parents of young children with severely mutilated teeth which previously would have been extracted. Use of the glass ionomer retained zirconia crown offers superior esthetics and a durable restoration with remarkable gingival integration for the treatment of severely mutilated primary anterior teeth.

Figure 8: Kaplan-Meier survival curve in months.

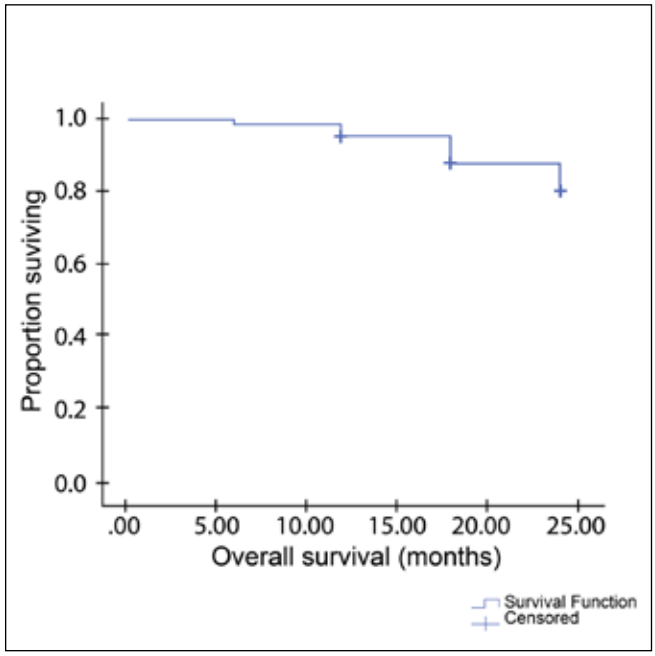

Table 1: Frequencies (n) and percentages (%) of the prevalence and causes of failure

Recall period	Evaluated restorations	Retained restorations	Loss follow up	Dislodged	Causes of dislodgement		
					Trauma	Biting on hard object	Unknown
3 months	86 (100.0)	86 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
6 months	86 (100.0)	85 (98.8)	0 (0.0)	1 (1.2)	0 (0.0)	0 (0.0)	1 (100.0)
12 months	80 (93.0)	77 (96.3)	5 (5.9)	3 (3.8)	2 (66.7)	0 (0.0)	1 (33.3)
18 months	74 (86.0)	68 (91.9)	3 (3.9)	6 (8.1)	3 (50.0)	1 (16.7)	2 (33.3)
24 months	67 (77.9)	61 (91.0)	1 (1.5)	6 (9.0)	4 (66.7)	2 (33.3)	0 (0.0)

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