A simplified technique for the restoration of severely mutilated primary anterior teeth

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The restoration of severely carious primary anterior teeth is a challenge to the pediatric dentist. The introduction of new materials and technologies makes re-evaluation of existing treatment philosophies necessary. A technique involving the placement of an omega shaped stainless steel wire extension into the entrance of the root canal prior to restoring the crown with a compomer material is described. 96 restorations were placed in 25 children. After 18 months 81.2% of the 96 restorations, which were available for evaluation, 60 (79.9%) were intact. The technique for restoring primary anterior teeth was simple, quick and effective.

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INTRODUCTION

Maintenance of the primary dentition in a non-pathologic and healthy condition is important for the well being of the child as well as for proper mastication, aesthetics, phonetics, space maintenance and prevention of aberrant habits such as tongue thrust.

The esthetic restoration of severely mutilated primary anterior teeth has for a long time been a challenge to the pediatric dentist, not only because of the available materials and techniques, but also because the children, who require these restorations are usually among the youngest and least manageable group of patients. The technological advances in dental materials for use on children, that have occurred in the past few decades, make constant re-evaluation of our treatment philosophies and techniques a necessity; because what was an acceptable treatment approach in the past may not necessarily be the best treatment option for our young patients today.

In addition to management problems there are a number of technical problems with respect to the restoring of the primary incisor teeth. They have short and narrow crowns, only a small surface for bonding, a pulp chamber that is large relative to the crown size and enamel that is inheritantly difficult to acid etch due to its aprismatic nature.[1,2] In many cases, the destruction of the tooth structure involves the entire crown, leaving just the root and hence, only dentine for bonding of the restorative materials. Not surprisingly, in the past, and often even now, many of these teeth are extracted.

Clinicians, who treat young children, are always faced with a challenge to find the most effective material and technique to successfully restore the primary anterior teeth. Conventional glass ionomers cements have demonstrated high failure rates in the long-term when used in the primary dentition.[3,4] While composites are highly technique-sensitive and lack the benefits of fluoride release. However, the new generation of single paste, polyacid-modified resins known as compomers such as Compoglass (Ivoclar/Vivadent, Amherst, NY.) and Dyract (DeTrey, Dentsply, Konstanz, Germany) are gaining popularity among the dental profession. Compomers, although essentially a resin composite, are different in that the composite resin monomers are modified so as to contain acidic functional groups, which are the same as in a glass ionomer cement and so the compomer sets via an acid/base reaction after polymerization of the resin phase has occurred.

Several case reports have demonstrated good results when these materials were used to restore primary teeth; however, the long term durability is still in some doubt when used to restore severely broken down primary teeth.[5-11]

The Prompt L-Pop (ESPE) bonding system simplifies the bonding technique because it is a self-etching priming adhesive system that can be used to bond compomer to tooth structure in a single step.[12,13]

The aims of this study were to develop, a simple technique to increase the potential surface area for attachment

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Figure 1. Periapical radiograph of the maxillary anterior teeth showing carious destruction of the crowns and intact roots of the anterior teeth.

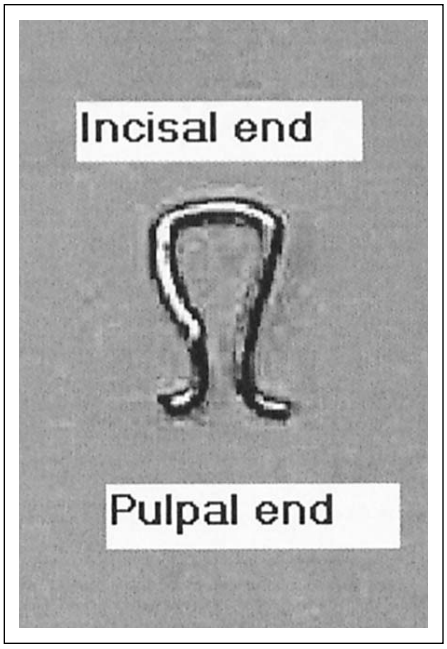

Figure 2. Magnified photograph showing the shape of the "omega wire extension".

of restorative material and consequently to increase the long-term stability of an aesthetic restoration for primary anterior teeth. Then to evaluate the clinical performance of these restorations over an 18 month period.

MATERIALS AND METHODS

Mutilated primary anterior teeth in children with early childhood caries (ECC) were treated by using a combination of Dyract (DeTrey, Dentsply, Konstanz, Germany) and a stainless steel wire extension inserted into the root canal for mechanical support of the restorative material.

Twenty-five healthy children (16 males and 9 females) with a mean age of 38 months with grossly carious primary anterior teeth, both maxillary and mandibular, were selected for inclusion in this study.

Criteria for selection of the children

Only those children, who satisfied the following criteria, were eligible for inclusion in the study:

- healthy children with no mental or medical disorders,
- primary anterior teeth, which were unrestorable using conventional techniques,
- a deep overbite,
- normal root formation with at least of one third of the root present,
- no bad oral habits, and
- parental consent for treatment rather than extraction.

Full medical and dental histories were taken for each child. In addition, periapical radiographs were taken to detect any abnormal root resorption of, or calcification within the root canals (Figure 1).

Uncooperative children, and those who required treatment of numerous teeth other than the anterior teeth, were treated under general anesthesia, while the cooperative children were treated under local anesthesia.

Treatment protocol

The following treatment protocol was followed to restore the anterior teeth:

- caries removal,
- pulpectomy,
- placement of the omega wire extension and
- restoration of the crown with compomer.

Construction of the stainless steel wire extension

The wire extension, used for ancillary retention and support, was made from a 1.5cm length of 0.5mm round orthodontic stainless steel wire which was bent, using No.130 orthodontic pliers, into an omega shaped loop, so creating an "omega wire extension" as shown in Figure 2.

During construction of the pulpal ends of the wire extension, the wire was bent in such a way as to allow the ends to be hooked in the entrance of the root canal. The pulpal ends extended approximately 3mm into the root canal so as to increase the overall retention of the wire. The incisal end or loop of the wire projected 2-3mm above the remaining root structure. This provided better mechanical retention and support for the restorative material.

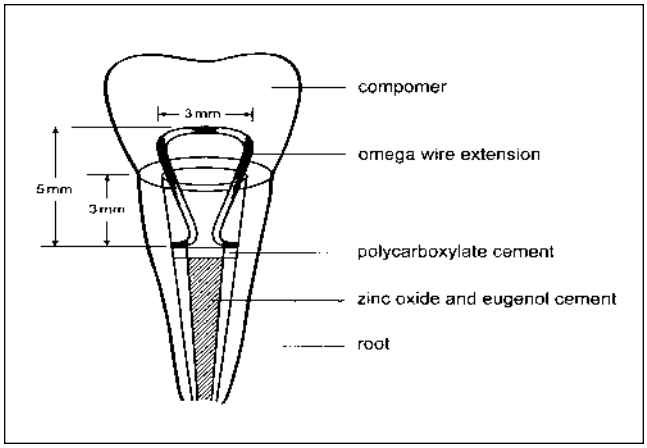

Figure 3. Diagram showing the dimensions of the omega wire extension and technique for placement in the tooth.

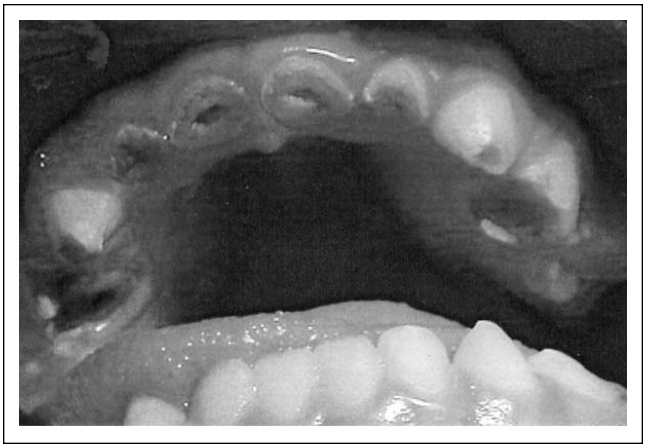

Figure 4a. Intraoral photograph demonstrating the extent of the teeth destruction preoperatively.

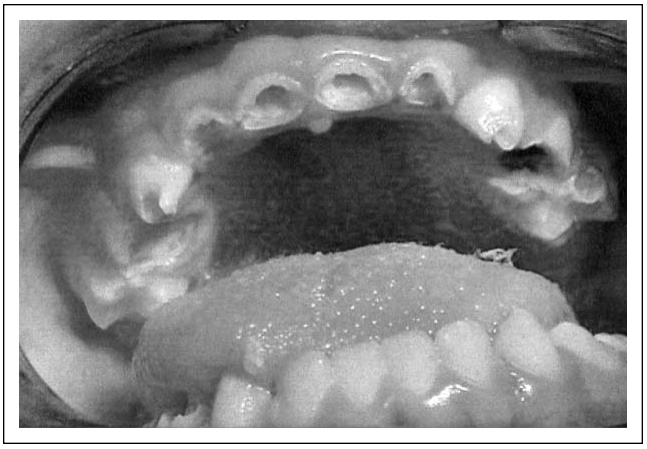

Figure 4b. Intraoral photograph demonstrating the remaining teeth structure after caries removal.

Technique

After caries removal with a spoon excavator and a No. 332 bur (unsupported enamel was not removed so as to preserve as much sound tooth structure as possible), the pulp chamber was opened and the pulp tissue was extirpated. After irrigation with copious amounts of 2.5% sodium hypochlorite the root canal was dried with paper points and a thick mix of zinc oxide and eugenol paste was vertically condensed with root canal pluggers into the root canal. After completion of the pulpectomy, to a suitable depth, a 4mm length of the coronal portion of the root filling was removed (one mm longer than the cutting surface of the fissure bur). A thin layer of fast-setting polycarboxylate cement was then condensed over the zinc oxide and eugenol to act as a barrier between the zinc oxide eugenol and the resin restoration to prevent inference with the setting process of the composite resin component of the compomer (Figure 3). The clinical appearance of a tooth prior to and after preparation can be seen in the Figures 4a and 4b.

After complete setting of the cement, the tooth structure and the pulp chamber were cleaned of excess polycarboxylate cement to the full depth of the fissure bur (approximately 3mm).

The enamel and dentine surfaces were then washed with water and dried with oil-free compressed air. The walls of the pulp chamber and the remaining coronal structures were conditioned according to the manufacturers' instructions with Prompt L-Pop 2 (ESPE, Germany).

Then Dyract (DeTrey, Dentsply, Konstanz, Germany) was injected and condensed into the entrance to the root canal and over the remaining parts of the sound coronal tooth structure. The pulpal ends of the wire extension were compressed together using a pair of needle holders, and then inserted in the Dyract before releasing the needle holders. The compomer was subsequently light cured according to the manufacturers' instructions for 40sec (Figure 4c).

Reconstruction and shaping of the crown over the incisal loop of the wire was carried out with additional compomer, which was cured layer by layer (less than 2mm per layer) until the final reconstruction was achieved. After checking the occlusion, and the removal of any interferences, final finishing and polishing of the restorations was performed with diamond finishing burs (Figure 4d).

Patients were recalled at 3, 6, 12 and 18 months intervals, so that the teeth and restorations could be systematically evaluated both, clinically and radiographically for retention of the restorations, recurrent

Figure 4c. Intraoral photograph demonstrating the placement of the "omega wire extensions" in the condensed compomer material in the root canals.

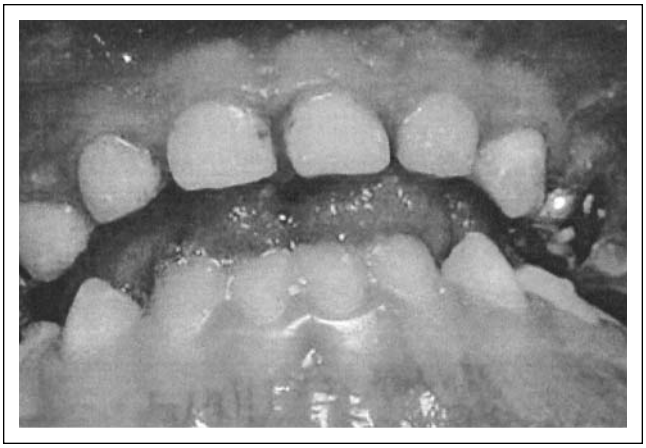

Figure 4d. Intraoral photograph showing the rebuilt anterior teeth crowns over the "omega wire extensions".

caries and the presence of any periapical radiolucency. All post-operative assessments were conducted by the same examiner.

RESULTS

A group of 25 children, who received at least two, and some as many as 9 "omega wire extension" supported crowns giving a total of 96 treated teeth. Using the above-mentioned technique, the anterior primary teeth were restored to normal coronal dimensions, appearance, spacing and occlusion.

Post-operative results

The 96 restored teeth were followed post-operatively for a period ranging from 3 to 18 months. At no time was there any evidence of recurrent caries in any of the treated teeth. The number and percentage of restorations demonstrating complete and/or partial loss at the various follow-up periods are shown in Table 1 and Figure 5. After 3 months, 89 (92.7%) of the 96 restored teeth were available for evaluation, of which 85 (95.5%) of the 89 teeth exhibited complete retention of the restorations.

The number of the restorations exhibiting partial loss of the restorative material was highest at the 12 month recall when it was 20 teeth. Partial loss of the restorations presented as separation of some of the restorative material from within the pulp chamber or root canal; this was reported in six teeth; trauma was reported in respect of eight teeth; and partial loss of the restorations at the incisal angle was observed in six teeth. In two patients although the restorations were intact, the endodontic procedure was considered to have failed. One tooth was mobile and the other, developed a fistula, which was indicative of pulpal degeneration, consequently both of these teeth were extracted.

By the 18 month recall, 78 (81.2%) of the original 96 teeth were available for examination and of these there was complete retention of the restorations on 60 (79.9%) of the teeth.

DISCUSSION

The successful restoration of badly mutilated primary anterior teeth in preschool children is a challenging task. The failure rate of restorations is high due to the absence of sufficient tooth structure to support the restoration, in addition the poor adhesion of the bonding agents to the enamel and dentine of the primary teeth compared to permanent teeth[4,14,15] can compromise the final restoration.

A simple yet effective technique to overcome these failures has been described in which a custom-made "omega wire extension" was placed in the space of the pulp chamber and entrance of the root canal with the projecting portion of the loop being used for retention of the coronal restoration. The wire did not appear to cause any internal stresses in the root probably because it was engaged in the build-up material. As the teeth were pulpally treated, it was possible to inject the build-p material 3 to 4mm into the remaining part of the pulp chamber and in the cervical region of the root canal where it supported the coronal restoration.

The placement of simple wire posts in primary teeth as described by Rifkin[16] has not been widely accepted in pediatric dentistry possibly because of the perceived potential for interference with normal physiologic root resorption if the wire extends a long way into the root canal. In addition, if the wire is forcibly fitted into a narrow root canal it can increase the internal stresses within the root, and so may lead to fracture.

Dyract and the other compomers have been well received in pediatric dentistry because of their composite-like esthetics, lack of a need for mixing (single component), command-cure (light polymerization) and the user-friendly handling characteristics. It is claimed by some clinicians that the physical properties

Table 1. The status of the original 96 restored teeth, expressed as numbers and percentages, at 3, 6, 12, and 18 months

Recall period in months	Number of restorations evaluated		Complete retention		Partial retention	
	number	%	number	%	number	%
3	89	92.7	85	95.5	4	4.5
6	82	85.4	66	80.5	16	19.5
12	82	85.4	62	75.6	20	24.4
18	78	81.2	60	76.9	18	23.1

of compomers approach those of resin composites.[9,17,13] Nevertheless, as with any material, early success is not always followed by long-term success as the materials are subjected to prolongued function in the mouth and more critical evaluation.

The use of the single step adhesive system (Prompt L-Pop 2) to bond the compomer to tooth structure eliminated several steps, because no separate acid etching and priming of the enamel and dentine is required; so reducing the treatment time for the child. The adhesive which is an aqueous phosphoric ester solution removes the smear layer and also etches the enamel, and demineralize dentine in such a way that a hybridized layer is formed for bonding to the dentine. Simultaneously, micro-mechanical bonding occurs in the enamel.[11,18-20]

The bond strength between tooth substance and compomer produced by Prompt L-Pop 2 appears to be adequate, thus the restorative procedure does not require a separate bonding step. This is particularly important because compomers were originally marketed on the premise of not requiring the acid etching for bonding to tooth substance.[17,12]

Among the restorations that were placed there were two false failures because of pulp degeneration; however, it is noteworthy that recurrent caries was not reported in any of the cases. Dyract contains fluoride-containing compounds such as strontium difluoride (5% by weight), it is widely recognized that this release of fluoride can be expected to impart an effect on the surrounding tooth structure as the fluoride is incorporated into the tooth structure; thus, protecting it against plaque formation and recurrent caries.[21,22]

Despite the high overall success rate of this technique, some cases showed partial loss of the restorations because of trauma (40% of the 20 failures) and biting on hard foods such as carrots and sugar cane which resulted in the loss of material from six of the 20 teeth (30%). According to Judd,[23] particular attention must be paid to mandibular lateral incisor and canine interferences during parafunctional mandibular movements, or physiological forward mandibular shift. This problem can be overcome by making the restored crowns slightly shorter than the original natural crown and by placing the crown former over the short post with a slight labial proclination to ensure adequate

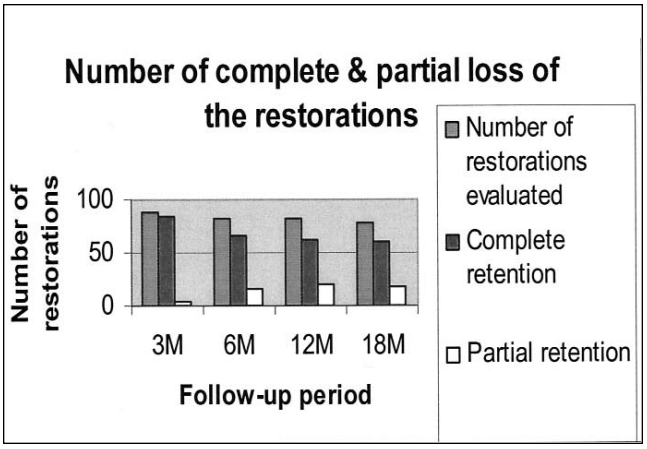

Figure 5. The number of restorations that were complete and exhibited partial loss at the various follow-up examinations after 3 to 18 months.

bulk of the composite resin material on the surface at the same time as reducing the occlusal loading.[23] This approach was not adopted in the reported cases, but the principles can could be incorporated into the technique to enhance the success rate if appropriate.

Pinkham,[24] stressed the importance of preserving tooth structure for the retention of composite resin crown restorations, even so, these full coverage coronal restorations can be dislodged fairly easily when traumatized. Webber and co-workers,[25] described a technique for the restoration of carious or fractured primary incisors using a celluloid crown with composite material which was forced into the entrance of the root canal. Although their results were good, they did not report the actual number of teeth that were restored, nor did they indicate the percentage success rate, nor the extent of tooth destruction prior to restoration; hence, a direct comparison between the techniques cannot be easily made. Nevertheless, post-operative results for the "omega wire extension" technique are presented after 18 months of follow-up. Only long-term follow-up of the presented cases will provide a definitive answer about the durability of the "omega wire extension" and compomer for the restoration of carious primary anterior teeth.

The described technique achieved excellent cosmetic results. Furthermore, it was simple, and quick to execute.

However, it was relatively technique sensitive in that it required a degree of patient cooperation. As the average age of patients who suffer from ECC is usually less than four years it could still be advisable to perform this treatment under general anesthesia in order to achieve optimum results. Almost all of the parents of the children, who were treated, reported an improvement in psychological behavior of the children and felt that the lifestyle of the children had been improved by the restoration of their anterior teeth in the manner described.

CONCLUSIONS

1. This "omega wire extension", increased the retentive properties of the remaining tooth structure.
2. This technique achieved excellent cosmetic results.
3. The restored teeth did not develop recurrent caries.
4. The technique was easy to master.
5. Periodic reviews are necessary for the detection and repair of minor fractures.

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