The application of fiber core posts in restoring badly destroyed primary incisors

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Early childhood caries (ECC) represents a challenge to pediatric dentists especially, when teeth are badly destroyed. ECC involves the upper anterior teeth early in life and by the time the dentist sees the child, most of the coronal structure is lost. Dentally, this is a very devastating situation for both the dentist and parents, as in many cases, extraction of these teeth is the only option.

With the introduction of new adhesive systems and restorative materials, a new approach for treating these teeth is explained and documented by clinical cases, where fiber core posts are introduced into the root canals of primary incisors for a distance of 2 to 3 mm. It is retained in place by flowable composite, then the coronal part is reconstructed by a strip crown to restore the crown form. After a follow up period of one year, only 2 teeth out of 30 had to be extracted. The failure was attributed to failure in pulpal therapy rather than failure in the restorations, which were totally intact. A laboratory testing of the fracture load resistance of the restored teeth proved that this technique significantly improved the fracture load resistance of composite celluloid crowns, making it a valuable procedure to consider when the coronal tooth structure is not enough to support and retain a composite celluloid strip crown.

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INTRODUCTION

Early childhood caries (ECC) is a serious public health problem in disadvantaged communities in both developing and industrialized countries where under nutrition is common. ECC involves the maxillary primary incisors within months after their eruption and spreads rapidly to involve other primary teeth.[1]

The restoration of primary incisors with extensive caries lesions is a clinical challenge of severe dimensions. Not only are these teeth difficult to restore, but the behavior of the patient can affect treatment negatively.[2] The severity of this condition in maxillary teeth has prompted the extraction of teeth due to inadequate esthetic options. However, many parents are demanding the esthetic restoration of teeth and are not satisfied with extraction.[3]

An acceptable restoration for maxillary anterior incisors should have matching material color, durability, adhesive cementation that is biocompatible with the pulp, easily and rapidly placed and requiring only one treatment visit.[2]

Esthetic restorations of anterior primary teeth can be in several forms as stainless steel crowns with or without composite facing, composite strip crowns and ceramo-based metal crowns. In extreme forms, extractions followed by fixed or removable appliances can be another alternative.[4]

Composite strip crowns have been used and recommended by many clinicians and proved to perform well.[5-7] These crowns have limitations due to type of material and size of lesion, which may affect stability, retention and marginal adaptation[8] and again in grossly decayed teeth, factors as poor marginal adaptation, secondary caries, gingivitis and pain may cause their failure.[9] Therefore, some clinicians preferred the application of stainless steel crowns with composite facings and reported better performance.[10-12] Others recommended indirect composite resin crowns[13] or even described a technique of using mini pins with celluloid crowns.[3]

The problem with anterior primary incisors that are grossly decayed is the lack of coronal structure to support and provide adhesion for a composite crown. Therefore, the use of resin based composite post reinforced with metallic pins was suggested[14] and a technique referred to as "short post" technique was proposed.[15] This technique required root canal treatment and short composite post. Another variation of treatment was suggested, where complete endodontic therapy and stress relieved posts were inserted to gain adhesion from intra-pulpal tooth structure.[3]

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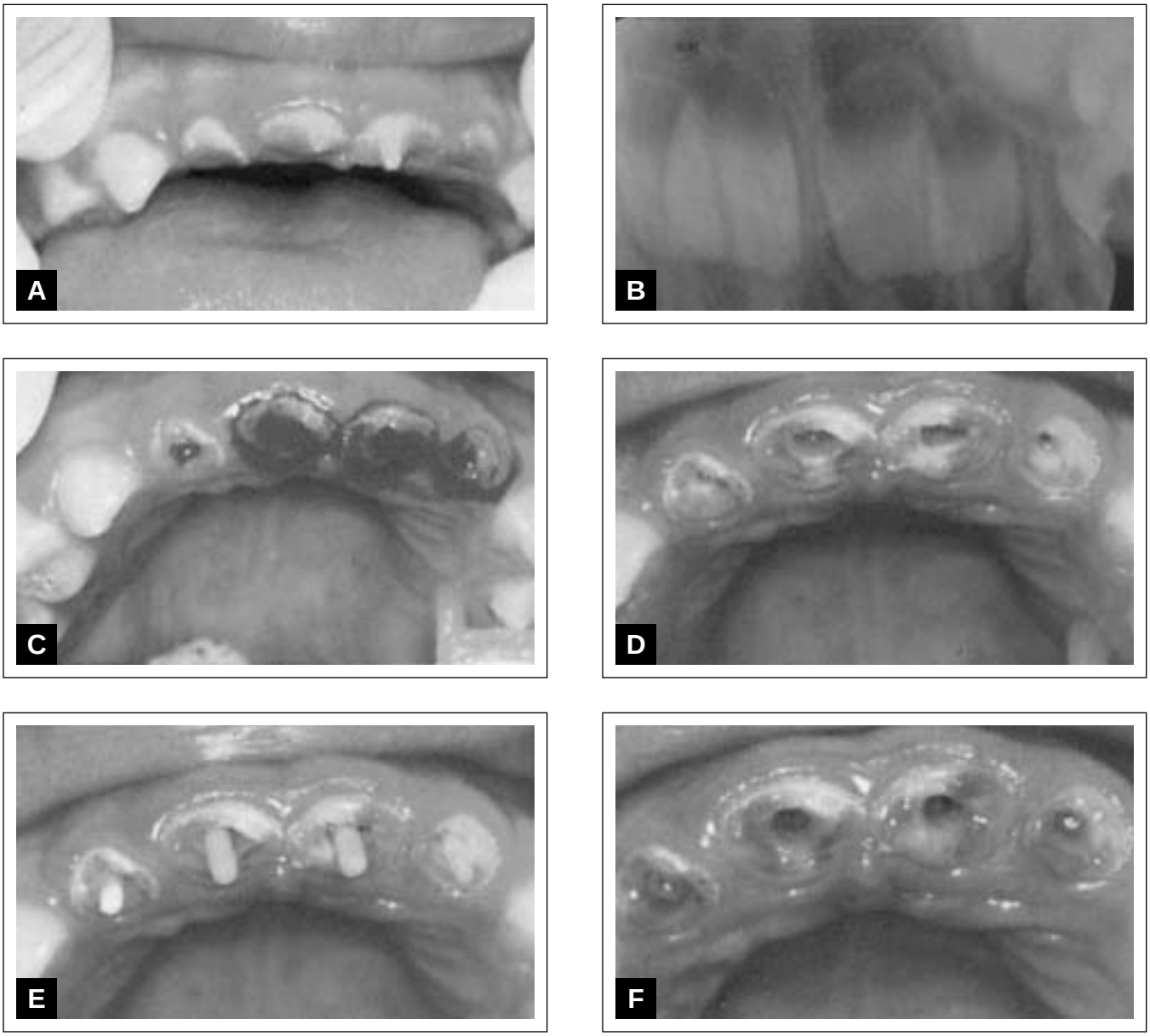

Figure 1. A. preoperative view **B.** preoperative radiograph **C, D.** pulp treatment, caries removal and drilled canals **E.** trial fitting of the post **F**. acid etching of the tooth and canals.

The aim of the present article was to evaluate a new approach of placing composite strip crowns on badly destroyed anterior primary incisors where glass fiber core posts are inserted for some distance (2 to 3mm) intra-radicular to give more support and retention to the crown.

MATERIALS AND METHODS

In our present study the following materials were used. Fiber core post system (Jeneric/Pentron, USA). This system comes in 3 diameters, combined with special drills. Bond 1 adhesive (Jeneric/Pentron, USA) which is a self priming self adhesive, Flowit flowable composite (Jeneric/Pentron, USA), Z 100 dental composite (3M, USA) and celluloid strip crowns (3M, USA).

A total of 12 patients were treated using the new technique with a total of 30 restored teeth. The mean age of patients was 4 years and 2 months. Nine patients were treated under general anesthesia and only 3 patients, who were cooperative and required one or two teeth to be restored had their teeth treated under local anesthesia on the dental chair. For each patient a radiographic evaluation of the treated teeth was made before starting treatment, as any treated tooth should have intact and preserved root structure.

Then treatment was divided into two phases: phase one was the treatment of the pulp, which was different in each case varying from pulpotomies, partial pulpectomies or even pulpectomies and were all determined by the state of

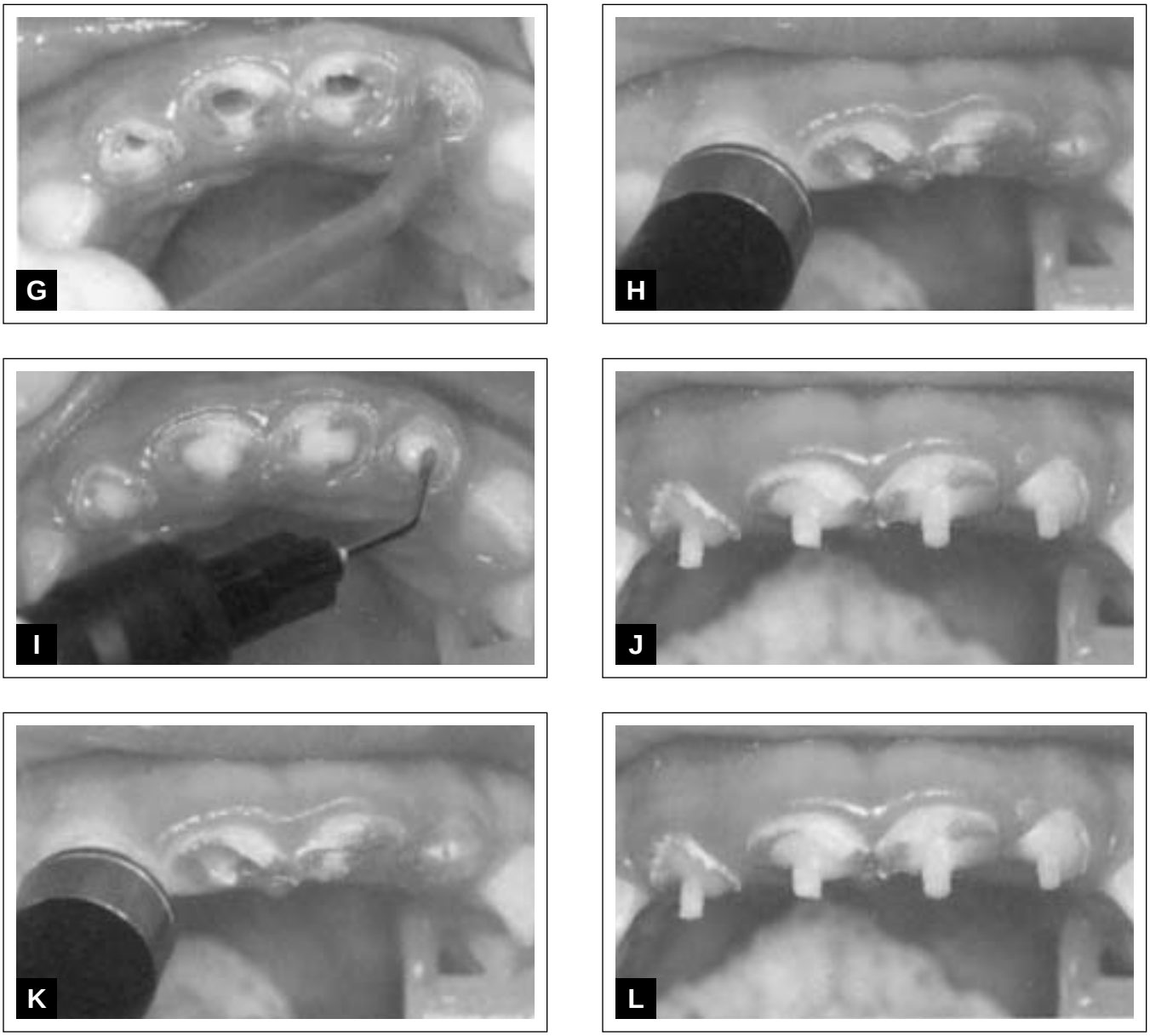

Figure 1 (continued). G, H. applying bond and curing **I, J.** applying flowable composite and placing the post in the uncured compostie followed by **K.** light curing **L.** adjusting length of core.

the pulp, whether it was vital or non vital. Pulpal management and treatment materials also varied, which is not discussed here as this is not the aim of this article. Phase two was the construction of the restoration. The clinical procedure is shown in Figures 1 to 3 and it was as follows:

Caries removal, pulpal treatment and drilling the radicular pulp

Caries removal has to be done carefully being as conservative as possible, keeping intact hard dentin.

As mentioned before pulp treatment will not be discussed, but after completion of pulpal treatment, the radicular pulp has to be drilled to a distance of no more than 2-3 mm into the canal. This could be done with the same bur that removes pulp tissue or with the special drill that comes in the fiber core kit.

Trial fit the posts

For each canal a post of corresponding size is trial fit for proper fitting and proper length. The posts can be cut with a diamond bur under water cooling to a desired length of 2 to 3 mm into the canals.

- Acid etch the tooth structure and the canals.
- Place the bonding agent and cure.
- Place flowable composite followed by inserting the post to the desired length then cure both units together.

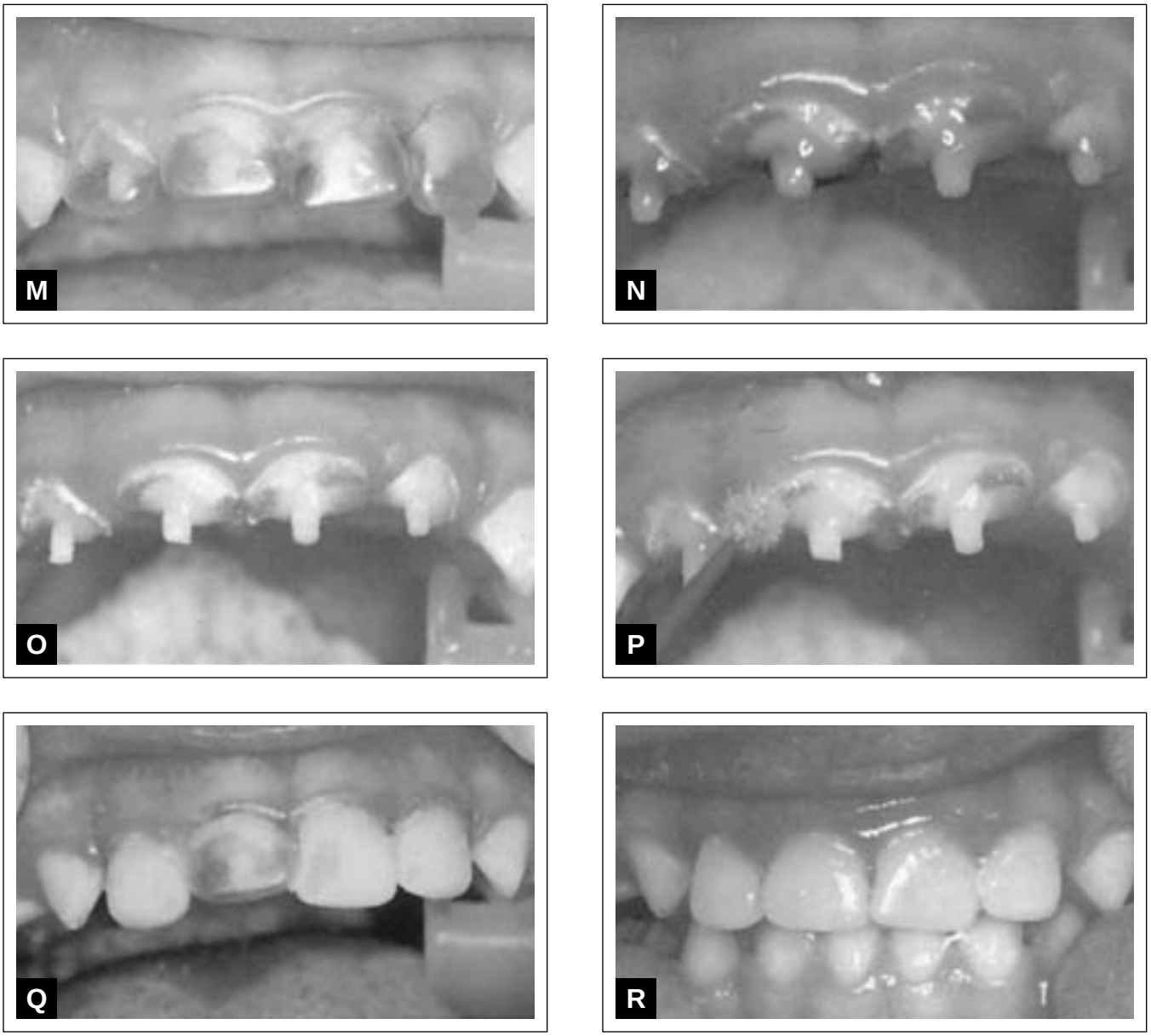

Figure 1 (continued). M. trial fit strip crowns **N.** acid etching **O, P.** apply bond and light cure **Q.** applying composite crowns **R.** post-operative view.

- The length of the core can be adjusted at this stage and occlusion is checked. Any adjustments can be done at this stage and retention of the core is checked with finger pressure.
- Trial fit strip crowns.
- Another etching may be performed to refresh tooth structure or in case moisture contamination occurred.
- Another coat of bond is applied then cured followed by composite strip crowns application.
- The strip crown is removed from the restoration and, although very rare, final finishing of the restoration is done and occlusion is checked.

A post-operative radiograph was done to check the length of the post. The follow up of the restorations was performed every 3 months for a period of one year to examine whether there was or was not a change in the following criteria:[9] color match, marginal adaptation, marginal discoloration, anatomic form, secondary caries, gingival condition, pain, temperature sensitivity and periapical condition.

Laboratory investigation

The *in vitro* testing sample consisted of 30 primary canines that were recently extracted for orthodontic treatment and which the roots were still intact. The crown portion was cut flat leaving only about 2mm

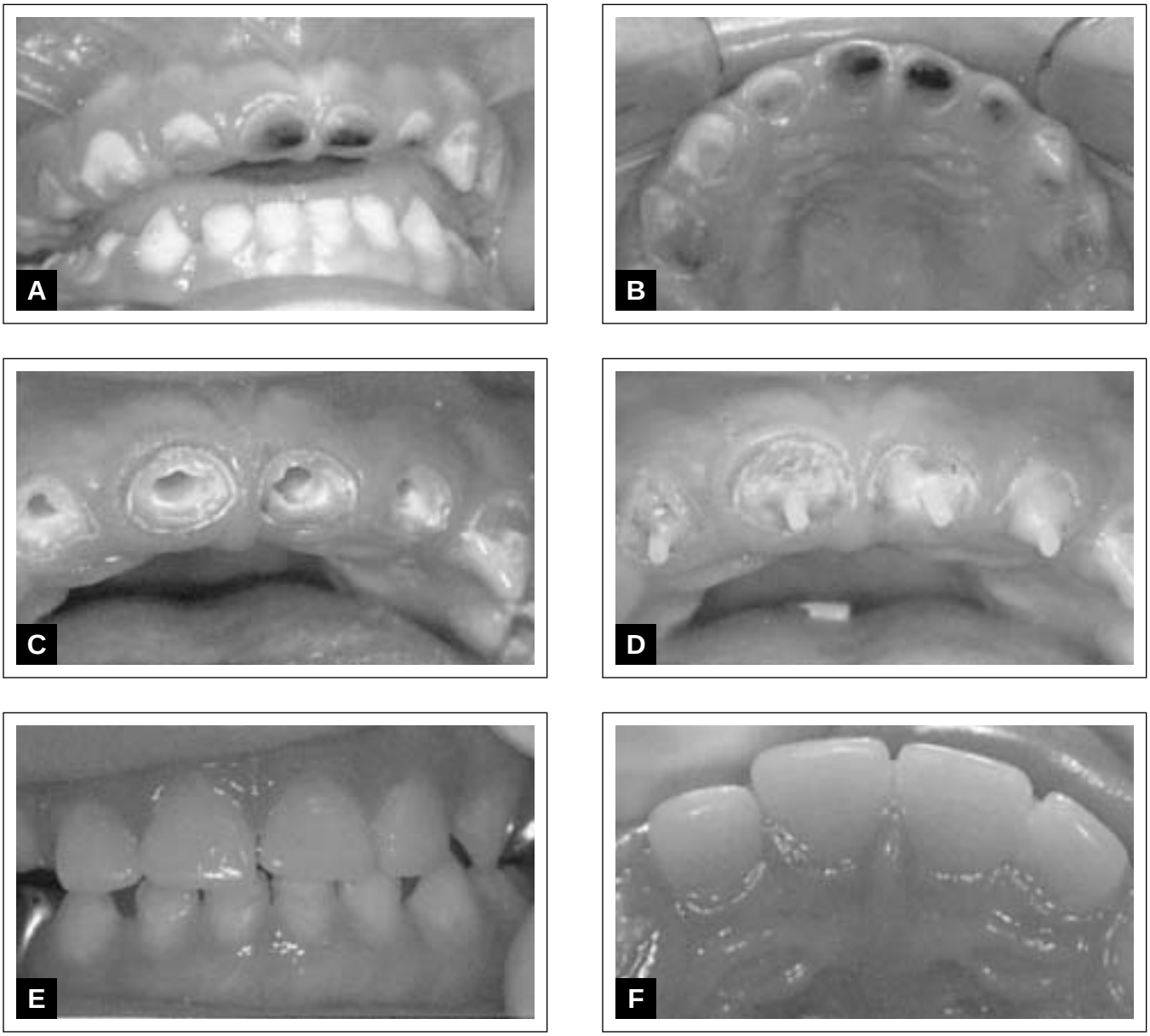

Figure 2. A, B. preoperative view **C.** canals after caries removal, pulp treatment and drilling radicular pulp **D.** post and core inserted and cured **E, F.** postoperative view.

of the crown portion above the cemento-enamel junction. The contra-lateral teeth were used for different restoring techniques to provide almost equal teeth size for comparison. The restored groups were as follows:

Group I: Ten teeth restored with composite only without entering the pulpal space.

Group II: Ten teeth restored after drilling the radicular pulp as in the clinical cases, but the pulpal portion was filled with flowable composite only without the application of the post.

Group III: Ten teeth restored exactly in the same sequence as the clinical cases using glass fiber core posts.

After cutting the coronal tooth structure, each tooth was embedded in an acrylic cylinder that is mounted to a metallic ring to be attached to the test machine.

In all groups the composite was applied using standardized cylindrical tubes that encircled the cervical portion of the crown. Materials were applied according to the instructions of the manufacturer. Each tooth was stored in water at room temperature for 72 hours after which the teeth were ready to be tested for the fracture load resistance on a testing machine (Instron universal testing machine).

Each tooth in the acrylic cylinder was fitted to the metallic ring and mounted on the test machine. There

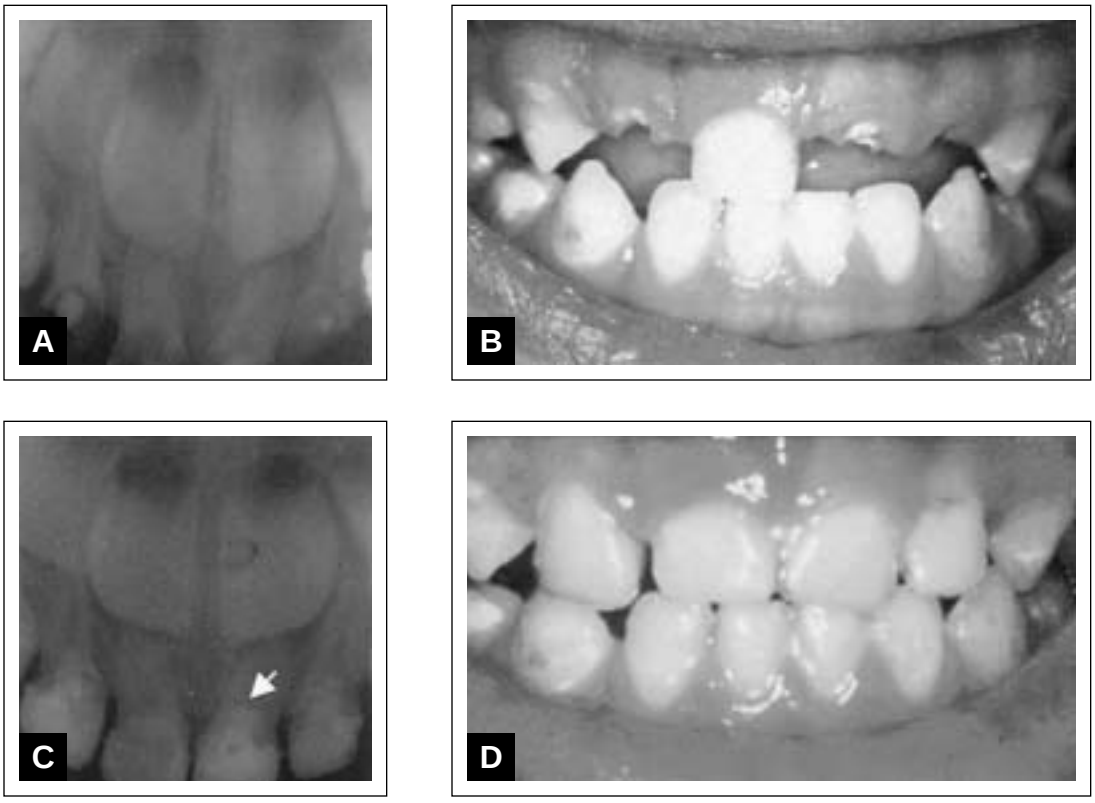

Figure 3. A. preoperative radiograph **B.** preoprative view after strip crown was placed on tooth 51 **C.** post operative radiograph notice the arrow pointing at the level of the post at or below the level of bone **D.** post operative view teeth 52, 61 & 62 having a fibre post and crown while tooth 51 having a strip crown.

the test knife fell perpendicular to the sample vertically on the composite at a level of 2 to 3mm away from the tooth margins at a cross head speed of 0.5mm/min and fracture load was recorded in Kg. Values were then statistically analyzed using the student t-test at 5% level of significance.

RESULTS

After a follow up period of 12 months, 28 out of 30 restored teeth performed well as evident by the assessment criteria. In one patient one tooth became loose and in another a fistula developed periapically, which indicated pulpal degeneration and these teeth had to be extracted, while the restorations were still intact. Although the treatment failed, the failure was attributed to failure in pulp treatment rather than failure of the restoration itself.

Table 1 shows the results of the laboratory testing. There was a significant difference between all three groups. The weakest restoration was the composite alone (GI). The fracture resistance was improved significantly when a composite core was placed. This improvement was even more significant when the fiber core post was introduced. An interesting finding was noticed in cases where fiber core posts were used. When fracture occurred, it was in the form of a crack and the fractured portion remained intact, whereas, in GI and II the fracture resulted in separation of the crown.(Figure 4)

Table 1. The load needed to fracture composite crowns (Kg)

	GI	GII	GIII
Mean SD	15.26 2.675	23.54 3.38	28.36 2.26
t	6.09*		
		3.75*	
	11.8**		

* Significant ** Highly significant

* Instron universal testing machine, Comten industries inc. JSM 25 S11 JEOL, Japan.

DISCUSSION

It was shown from the clinical part of this study that the application of fiber core posts to support composite strip crowns on badly destroyed primary incisors is a valuable clinical procedure. This technique increases the surface area of tooth structure i.e. intra-radicularly where adhesion of the bonding agent to tooth structure is enhanced. Again, the use of fiber core post together with flowable composite and the bonding agent offers an alternative where all components are bonded together

Figure 4. Specimens after applying the fracture load. A complete fracture is evident in groups I & II where no fibre post was inserted. Cracking and incomplete separation of the crown occurred in samples where a fibre core was inserted.

to form a firmly attached restoration unit. Cohen *et al*.[16] stated that post retention was an important factor for a successful restoration where little or no coronal dentin is present. Therefore, many articles in the literature described techniques and methods to offer high post retention with minimal insertional stresses.[17,18] Again this technique utilizes the coronal portion of the root, which is the strongest part of the root to transmit any functional stresses and may add to success.[19-22]

The introduced technique would have the following advantages that agree with Sidoli *et al*.:[23]

1. Homogeneous mechanical and chemical bonding of all components, which serves to reinforce the tooth.
2. The fiber core content have a Young's modulus of elasticity approximating that of the tooth, hence decreasing stress concentration and therefore, increasing longevity of the restoration.

After a test period of one year, only 2 teeth were extracted one due to mobility and the other due to development of a periapical lesion. In both instances the restorations were intact. The failure was attributed to pulpal therapy failure and not to the technique used. Another factor that adds to the success of this technique would be the use of a bonding agent, which was proven by Cohen *et al*.[24] to increase the resistance of the core to torsional forces. The laboratory study confirmed the clinical behavior. The interesting finding was that the addition of composite core without a fiber core still significantly improved the fracture resistance of the composite crowns. This could be considered an alternative procedure in cases where the post core is not available.

Braem *et al.*[25] stated that hybrid composites have better fatigue resistance and higher modulus of elasticity, which can add to the longevity of the restorations. However, size and nature of the lesion causes limitations of composite resin affecting stability, retention and marginal adaptation.[8] It was noticed that when fracture of the samples occurred in both groups I and II where no posts were inserted, the fracture was complete.

Whereas, when a post was inserted, not only the fracture resistance significantly improved, but also the fracture was not complete leading to only cracking in the specimens with the portions still attached (Figure 4). This could be attributed to the elasticity of the post material, which makes it yield to pressure without complete separation. This may have the advantage of better retention of the restoration, however, in case where the post is placed deep in the radicular pulp space, root fracture might result. Therefore, radiographic evaluation of cases after post placement is very important to check the level of the post. It should always be at or above the level of bone.(Figure 3) Citron[4] described a technique where a post was placed through the length of the canal, however, it needed close monitoring during tooth shedding.

The described method is technique sensitive and requires patient cooperation and as the average age of patients, who suffer from ECC is usually less than 4 years, hence, in many occasions this kind of treatment is best done under general anesthesia. Team work and organization is very important to finish post and crown placement as quickly and efficiently as possible.

CONCLUSIONS

1. Using fiber core posts to support composite strip crowns on badly destroyed primary anterior teeth is a valuable clinical procedure.
2. After 12 months, only two treated teeth out of thirty teeth failed. The failure was attributed to pulpal therapy failure rather than failure of the technique of restoration.
3. The laboratory findings proved that placing intraradicular composite cores significantly improved the resistance of composite strip crowns to fracture.
4. This improvement was highly significant when a fiber core post was applied to reinforce the composite strip crown.

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