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An in vivo study to evaluate four different post systems in restoring primary anterior teeth

[1]Dr. Shiminder Bhangoo, Professor & Head, Department of Paediatric and Preventive Dentistry, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

[2]Dr. Tanya Goyal, Reader, Department of Paediatric and Preventive Dentistry, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

[3]Dr. Ruchika Goyal, Reader, Department of Paediatric and Preventive Dentistry, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

Corresponding Author: Dr. Shiminder Bhangoo, Professor & Head, Department of Paediatric and Preventive Dentistry, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

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Introduction

Early childhood caries(ECC) is a complex disease involving maxillary primary incisors within a month after eruption and spreads rapidly to involve other primary teeth(Davies GN 1998).It is a serious socio-behavioural and dental problemthat afflicts infants and toddlers(Jose B and King NM 2003).American Academy of Paediatric Dentistry (AAPD) in 2003 defined ECC as the presence of one or more decayed(Non- cavitated or cavitated), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger.The Academy also specifies that, in children younger than 3 years , any sign of smooth surface caries is indicative of severe early childhood caries(S-ECC). From ages 3 to 5 , 1 or more cavitated, missing (Due to Caries) or filled smooth surface in primary maxillary anterior teeth or a decayed, missing ,or filled score of >or equal to 4 (age 3 years), > or equal to 5 (age 4 years), or > or equal to 6 (age 5 years) surfaces constitutes severe early childhood caries (S-ECC).(American Academy of Paediatric Dentistry Reference Manual 2002-2003.

These patients usually approach the dentist only when the teeth are grossly broken down and only the root stumps are left. In the past the severity of this condition had prompted the extraction of teeth due to inadequate aesthetic treatment options. However, many parents these days are demanding aesthetic restoration of primary anterior teeth and extraction is not an option for them and the importance of preserving the integrity of primary dentition until the appropriate exfoliation time is well recognized nowadays . The various restorative

materials used in the past to restore these teeth failed to withstand occlusal forces, in severely damaged teeth with loss of crown structure. Hence, post and core systems were introduced to provide additional support to the restorations. Some of the post and core systems being used are modified Omega shaped orthodontic wires, biological posts, fibre core posts, and glass reinforced fibre composites (GFRC) [10–12]. This study was designed to evaluate and compare four different intracanal post systems for various parameters such as post retention, vertical/horizontal root fracture, secondary caries, marginal adaptation and marginal integrity at baseline, one, three and six months follow up.

Materials And Methods

For this prospective study ,which was carried out in the Department of Pedodontics and Preventive Dentistry, Genesis Institute of Dental Sciences and Research, Ferozepur(Punjab),15 patients aged 3-5 years , presenting with ECC who fulfilled the following inclusion criterias were selected

Inclusion Criteria

- Patients aged between 3- 5 years
- Grossly decayed four deciduous maxillary incisors indicated for pulpectomy
- Sound root structure with no root caries
- Presence of at least 2\3rd root structure radiographically
- Presence of at least 1\3rd crown structure
- Sufficient overjet between deciduous maxillary and mandibular incisors
- No mobility
- No medical or mental health problems

Methodology

Each patient ,received all the four post respectively:
Glass fibre post with respect to 52
Polyethylene fibre post with respect to 62
Omega wire loop with respect to 61
Composite post with respect to 51

The teeth were isolated with cotton rolls and a high volume saliva ejector. Grossly carious lesions were removed using a no. 8 carbide bur, and pulp tissue was extirpated. The canal was prepared using a sequence of 3 consecutive endodontic files (nos. 25 to 35; K-File, Mani Inc, Tochici, Japan) under constant irrigation with physiologic saline solution and dried with paper points. The coronal two thirds of the canal was obturated with calcium hydroxide-iodoform paste (Metapex, Meta Biomed Co, Cheongiu City, Korea), and a layer of zinc phosphate base (Harward Cement, Harward Dental International GmbH, Honow, Germany) was placed inside the canal to isolate the filling material, seal the canal, and make it ready for post placement.

In group 1 (glass fiber post with respect to 52), the initial 3 mm of the canal was prepared and a glass fiber post of corresponding size (Fibre Post Plus ProduitsDentaires , Switzerland.) was tried for proper fitting and inserted in the canal using a selfetch/self-adhesive resin cement (Flowable Composite, 3M) according to the manufacturer's instructions. The crown was reconstructed with the same composite resin using appropriate celluloid strip crowns (Pedoform Strip Crowns, 3M ESPE, St. Paul, Minn., USA).

In group 2 the tooth surfaces were prepared as in group 1. A tape-shaped Ultra High Molecular Weight Polyethylene fibre (Ribbond, Seattle, WA, USA Triaxial) 3 mm in diameter was selected and manipulated according to the manufacturer's instructions. The fibre post was immersed in a dental adhesive (Scotch Bond, 3M) to increase adhesion between the fibre post and composite, and to facilitate handling. The prepared cavity was acid etched for 20

seconds with a 37% phosphoric acid gel, rinsed, dried and two coats of a dentin adhesive single bond (3M) were applied. Dual cure luting cement(Rely X 3M) was placed 2 to 3 mm apical to CEJ. Ribbond fibre was inserted into the canal with the help of a plugger. The tip of fibre was folded back into the canal so as to form a double thickness fibre for better reinforcement. The loop emerging out from the canal was used to build a core. It was light cured (40 sec) according to the manufacturer's instructions. Reconstruction and shaping of the crown over the polyethylene was carried with composite by using strip crowns.

For group 3, a 0.7mm stainless steel orthodontic wire was manipulated by using no. 130 orthodontic plie into omega –shaped to hold restorative material for core build. The incisal end of the loop was projected 2 to 3 mm above the remaining tooth structure. The space created for the post was etched with 37% phosphoric acid for 20 sec. Dual cure luting cement (Rely X 3M ESPE) was placed 2 to 3 mm apical to the CEJ with omega loop and light cured.

In group 4, canal was filled with flowable composite (3M ESPE) only without the application of any post .Composite was placed in several steps into the root canal and cured in increments. Crown was then built up with composite.

All the teeth were treated by one well-experienced operator. Follow-up appointments were scheduled after 1, 3 and 6 months to evaluate the retention, marginal discoloration, marginal adaptation. Secondary caries, gingival inflammation post stability, root fracture and periapical status using modified USPHS criteria.

Modified USPHS criteria used for direct clinical evaluation of the restoration (extended for direct fibre post restoration) (J Adhes Dent 2008)

Table 1

Score	Alpha	Bravo	Charlie	Delta
Surface texture	Sound	Rough	-	-
Anatomical form	Sound	Slightly loss of material (chipping, clefts) superficial	Strong loss of material(chipping, clefts)	Total or partial loss of the bulk
Marginal integrity (enamel)	Sound	Positive step, removable by finishing	Slightly negative step not removable, localized	Strong negative step in major parts of the margin, not removable
Marginal discoloration (enamel)	None	Slightly discoloration, removable by finishing	Discoloration, localized not removable	Strong discoloration in major parts of the margin, not removable
Secondary caries	None	Caries present	-	-
Gingival inflammation	None	Slightly	Moderate	Severe
Restoration color stability	No change	Change of color comparing to baseline condition	-	-

Post	In situ with no gap between post & cavity wall	Gap between post & cavity Wall	Post displacement or detachment	Post fracture
Root	No clinical or radiographic sign of root fracture	Root fracture with bone loss next to the root surface and pain on biting	_	_
Periapicalstatus	Normal: good	Widening of the periodontal ligament (PL) not exceeding twice the width of the lateral PL	Periapicalradiolucency in connection with apical part of root, exceeding at least twice the width of the lateral PL	_

Results

Table 2: Surface Texture

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	5	10	-	-
Polyethlene	15	-	-	-	4	11	-	-	-	15	-	-
Omega loop	15	-	-	-	11	4	-	-	1	14	-	-
Composite	9	6	-	-	4	11	-	-	-	15	-	-

From the statistical analysis, it was observed that surface texture in group 1 (Glass fibre post) was better than the other groups viz Polyethylene post, omega post and composite post after 1, 3 and 6 months.

Table 3: Anatomical Form

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	14	1	-	-
Poly	15	-	-	-	5	10	-	-	-		14	1
Omega	15	-	-	-	12	3	-	-	5	10	-	-
Composite	11	4	-	-	1	14	-	-	-		-	15

The polyethylene fibre, omega loop and composite post showed an increase in bravo score which indicated loss of anatomical form. Moreover maximum alpha score were noticed for glass fibre post at the end of 6 months.

Table 4: Marginal Integrity

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	15		-	-
Poly	15	-	-	-	11	4	-	-	-	2	12	1
Omega	15	-	-	-	15		-	-	4	11	-	-
Composite	15		-	-	6	8	1	-	1	2	-	12

At the end of the first month, the marginal integrity was compared and there was no change noticed from the base line in all four posts. After 3 months, polyethylene fibre and composite post showed increased destruction of marginal integrity. Composite post showed maximum delta (destruction of marginal integrity) score as compared to glass fibre posts (having maximum alpha score).

Table 5: Marginal Discoloration

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	13	1	-	1
Poly	15	-	-	-	9	6	-	-	-	3	11	1
Omega	15	-	-	-	13	2	-	-	6	9	-	-
Composite	15		-	-	6	6	3	-	-		3	12

No marginal discolouration was noticed at the end of 1 month in all the groups. At 3 months follow up, there was no change in glass fibre post, but other three posts show increased bravo scores indicating increased marginal discolouration. At the end of 6 months, glass fibre post had shown the maximum alpha score while the composite post had maximum delta score indicating increased marginal discolouration of the post.

From the statistical analysis, it was observed that color matching in group I glass fibre restorations) was better than other groups. At the end of 3 months polyethylene fibre, omega post and composite group showed marginal discolouration.

Table 6: Secondary Caries

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	15		-	-
Poly	15	-	-	-	15		-	-	15		-	-
Omega	15	-	-	-	15		-	-	15		-	-
Composite	15		-	-	15		-	-	15		-	-

When the secondary caries was observed at the end of 1, 3 and 6 months follow up, all the four posts had shown no change from the base line.

Table 7: Gingival Inflammation

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	15		-	-
Poly	15	-	-	-	15		-	-	13	2	-	-
Omega	15	-	-	-	15		-	-	15		-	-
Composite	15		-	-	15		-	-	10	4	-	1

At the end of 1 and 3 months follow up for gingival inflammation, all the four posts did not show any change from the base line. At the end of 6 months, polyethylene fibre post and composite post showed increase in bravo score indicating increased gingival inflammation.

Table 8: Restoration Color Stability

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	14	1	-	-	9	6	-	-		15	-	-
Poly	13	2	-	-		15	-	-	-	15	-	-
Omega	13	2	-	-	1	14	-	-		15	-	-
Composite	8	7	-	-		15	-	-	-	15	-	-

When the restoration color stability was observed at the end of 1 month, glass fibre posts showed maximum alpha score followed by polyethylene fibre, omega loop and composite post. At the end of 6 months, all the four posts showed bravo score indicating change in colour of the restoration.

Table 9: Post

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	15		-	-
Poly	15	-	-	-	15		-	-	11	3	-	1
Omega	15	-	-	-	15		-	-	15		-	-
Composite	15		-	-	15		-	-	10		4	1

Glass fibre post and omega loop showed maximum alpha score followed by polyethylene fibre and composite post.

Table 10: Root

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-		15	-	-	-	15		-	-
Poly	15	-	-	-	15		-	-	15		-	-
Omega	15	-	-	-	15		-	-	15		-	-
Composite	15		-	-	15		-	-	15		-	-

When the roots of the teeth were observed at the end of 1, 3 and 6 months, glass fibre post, polyethylene fibre, omega loop and composite posts did not show any change.

Table 11: Periapical Status

Material	At 1 M				At 3 M				At 6 M			
	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta	Alpha	Bravo	Charlie	Delta
Glass	15	-	-	-	15	-	-	-	15		-	-
Poly	15	-	-	-	15		-	-	15		-	-
Omega	15	-	-	-	15		-	-	15		-	-
Composite	15		-	-	15		-	-	15		-	-

When the periapical status was observed at the end of 1, 3 and 6 months, glass fibre post, polyethylene fibre, omega loop and composite posts did not show any change from base line.

Discussion

The successful restoration of badly mutilated primary anterior teeth in preschool children is a challenging task. The high failure rate of such restorations is due to the insufficient tooth structure available to support them. Different resin materials and techniques have been used for reinforcing the root canals. The use of intracanal posts in endodontically treated teeth improves the retention of a definitive restoration. The results of our study indicate that after 6 months, on applying the USPHS criteria for surface texture, glass fibre showed minimum distortion followed by polyethylene and omega loop. Maximum distortion was observed with the composite post.

While applying the USPHS criteria for anatomical form the higher success rate was observed with glass fibre

posts followed by omega loop wire and composite posts. This may be explained by the fact that fibre posts are serrated, which might help in mechanical retention. Polyethylene fibre is found to be better than composite post as ribbond fibres have greater strength and improved flexural characteristics, which provide high fatigue resistance, preserve the architectural shape, and maintain fibre orientation during application[3].

Marginal integrity

On applying the USPHS criteria for marginal integrity glass fiber post showed best result which could be attributed to the fact that it combines chemically with the flowable composite and the composite used for the core build-up. **(MuradMuradov et al 2004).**

Using the USPHS criteria for marginal discoloration, Glass fibre showed the least marginal discoloration as it provides a homogenous mechanical and chemical bonding of all components. During manufacturing process, glass fibre posts obtain a microporous surface. The resulting indentations serve as micro retentions when filled up with cement, hence it showed the least discoloration.

Glass fibre showed best result on using USPHS criteria for restoration color stability which could be due to better bonding of posts to cementing media, good adaptability to the root canal, posts offering better light transmission which enhances the polymerization of the resin cement at the apical region during the cementation procedure **(Pegoretti A et al 2002)**

In primary teeth, glass fiber posts were more retentive when compared to the composite posts. This could be due to the additional mechanical retention from the serrations present on the post surface **(Pegoretti A et al 2002).**

The high failure rate of polyethylene fiber post could be due to inadequate bonding between the composite and the fibre and degradation of the composite resin due to repeated mechanical loading under moist intraoral conditions. This reduces the modulus of elasticity and increases the risk of debonding[4].

The statistically insignificant differences were found at the end of 1, 3 and 6 months for periapical status, root, and secondary caries among all the four groups**.** The results of our study inferred that though there was deterioration in all the parameters studied in all the posts used, composite posts showed maximum failure rates .Glass fibre showed maximum success followed by omega loop and polyethylene fibres. Thus ,from the results of our study, the overall clinical performance (in terms of surface texture, anatomical form, marginal integrity, marginal discoloration, secondary caries, restoration color stability, post, root and periapical status can be rated as Glass post> Omega loop>Polyethylene post > Composite post.

Conclusions

Early childhood caries (ECC) requires treatment to restore the dentition to its original mesio-distal and vertical dimension, rectification of altered masticatory apparatus, improvement in phonetics, a break from any para-functional habits that might have set in as a result of mutilated dentition and prevention of psychological problems affecting the self- esteem of the child .Even though many post systems have been used in the past ,our study recommends the use of Glass fibre post and strip crowns for restoring primary anterior teeth affected by ECC .

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