

Original Article

Clinical comparison of various esthetic restorative options for coronal build-up of primary anterior teeth

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ABSTRACT

Background: This study was designed to compare the clinical performance of composite, strip crowns, biological restoration, and composite with stainless steel band when used for the coronal build-up of anterior teeth.

Materials and Methods: A total of 20 patients aged 3-6 years presenting with mutilated primary anterior teeth due to caries or trauma were selected for the study using randomized simple sampling. A total of 52 primary anterior teeth were randomly divided into four equal groups having 13 teeth in each group. Teeth in Group I were restored with composite, in Group II with strip crowns, in Group III with biologic restoration and with stainless steel band reinforced composite in group IV. The restorations were evaluated for color match, retention, surface texture, and anatomic form according to Ryge's Direct (US Public Health Service) evaluation criteria at baseline (immediate postoperative), after 48 h, 3, 6, and 9 months. The data obtained were statistically analyzed using Chi-square test, and level of significance, that is, *P* value was determined.

Results: At baseline, none of the groups showed any color changes. Other than Group III all other groups showed highly significant changes ($P < 0.05$) in color after 3 months. Loss of retention was seen in both Groups I and IV after 3 months. After 6 months, retention loss was seen in all the groups except Group II, in which loss was seen after 9 months ($P > 0.05$). Deterioration in surface texture was exhibited maximum by restorations in Group IV followed by Group I at 3 months. Whereas, no surface changes were seen in Group II and III. Only Group I and IV showed discontinuity in anatomic form after 3 months. After 6 months, except in Group II, discontinuity in anatomic form was observed in all the groups. Discontinuity in anatomic form was seen in all the 4 groups after 9 months although the difference was not significant ($P > 0.05$).

Conclusion: Biological restoration was found to be most satisfying esthetically owing to color compatibility with the patient's tooth. Thus, it has a great potential to be used as esthetic restorative option in primary anteriors.

Key Words: Composite resin, crown, deciduous, dental, dental caries, dental restoration, esthetics

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INTRODUCTION

In the modern civilized cosmetically conscious world, well-contoured and well-aligned white teeth set the standard for beauty.^[1] Hence, other than the pain, esthetic concerns today, has become one of the main reasons for seeking dental care.^[2] In daily clinical practice, it is common to come across patients with mutilated primary anterior teeth due to problems such as nursing bottle caries, malformation and discoloration, hypoplastic defects, tooth fractures, and bruxism.^[1] The most cases of mutilated primary anterior teeth among children are observed with nursing bottle caries.^[3] Early childhood caries is a major public health problem being the most common chronic infectious childhood disease and is difficult to control.^[4,5]

Primary maxillary anterior teeth dominate the physical appearance^[5] and their destruction apart from a compromise in esthetics may also lead to development of parafunctional habits such as tongue thrusting, speech problems, psychological problems, reduced masticatory efficiency, and loss of vertical dimension of occlusion.^[1] Hence, it is important to restore crowns destroyed by caries or trauma to preserve the integrity of primary dentition until its exfoliation and eruption of permanent teeth.^[1]

The esthetic restoration of severely mutilated primary anterior teeth has for long been a challenge for the pediatric dentist and one of the most difficult goals to achieve,^[6] not only because of the lack of available materials and techniques, but also because the children who require such restorations are usually among the youngest and least manageable group of patients.^[1,3] Other reasons, which may make the treatment more challenging includes small sized teeth, the proximity of pulp to the tooth surface, relatively thin enamel and lesser surface area for bonding.^[2]

In the past, due to these reasons the most commonly followed treatment for such mutilated teeth was extraction because the restoration of primary teeth was a challenging and a cumbersome task.^[5] However, with the advancements in materials and techniques coupled with growing awareness among patients and parents, it becomes prudent to restore a carious tooth to its form and function as soon as detected.^[7]

Recent developments in restorative materials such as band reinforced composite,^[8] composite resins,^[7] strip crowns,^[9] and biological restoration with

natural tooth^[1,10,11] along with placement techniques, preparation designs, and adhesive protocols have provided clinicians with an alternative to extraction and facilitated restoration of mutilated primary anterior teeth to quite an extent.^[5]

However, the outcome for the long lasting and successful management of these modalities to restore esthetics, form and function are lacking.^[12] There is insufficient controlled, clinical data to suggest the one type of restoration, which is superior to another.^[12,13] Therefore, it was prudent to evaluate and compare the clinical performance of various esthetic restorations for primary anterior teeth.

MATERIALS AND METHODS

Randomized clinical trial was carried out after obtaining the ethical approval from the concerned authorities in the outpatient Department of Paedodontics and Preventive Dentistry. A total of 52 primary anterior teeth in 20 patients aged between 3 and 6 years presenting with mutilated primary anterior teeth due to caries or trauma were selected. They were randomly divided into four equal groups namely — composite (Group I), strip crowns (Group II), biological restoration (Group III), and composite with stainless steel band (Group IV) having 13 teeth in each group [Figure 1].

Before selection, all the patients were screened using following exclusion and inclusion criteria for either of the maxillary or mandibular primary anterior teeth. The variable number of teeth was included in each patient depending upon the teeth affected. Written informed consent from the parent/guardian was obtained.

Inclusion criteria

- Only the children in the age group of 3-6 years.

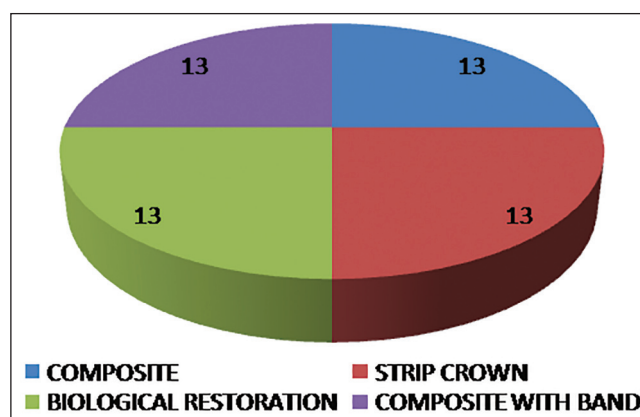


Figure 1: Distribution of samples.

- Teeth affected due to caries or trauma with more than 1/3rd crown structure remaining.

Exclusion criteria

- Any tooth nearing exfoliation or not fit for restoration
- Patients with systemic problems
- Teeth with excessive pathologic mobility.

Methodology

The procedure involved removal of carious tooth structure in carious teeth and nonretentive tooth preparation in case of teeth, which were traumatically involved. Appropriate endodontic treatment was performed in teeth, which were pulpally involved without any signs of periapical involvement. The teeth were obturated with Endoflas FS (Sanlor and Cia.S. en, Columbia, USA), and the coronal seal was obtained with Glass Ionomer Cement (GIC) (Fuji II, GC Corp., Japan). After 1 week, the treated tooth was restored with either of the restorative options mentioned in the study.

Composite restoration

Following the tooth preparation, the shade was selected using Vitapan classical shade (GmbH & Co. KG, Germany) guide under natural light. Tooth surface was then air dried and self-etch adhesive system (Optibond All-in-One, Kerr Comp., USA) was applied and cured for 15 s. Incremental build-up for reconstructing^[14,15] and shaping with nanoparticle hybrid composite (Premise, Kerr Comp., USA) was carried out. After checking the occlusion, and the removal of any interference, final polishing of the restorations was performed with polishing disks and polishing strips (Shank FG, Shofu Inc., Japan) [Figure 2].

Strip crowns

Strip crown of suitable size approximating the mesiodistal width of the tooth to be restored was selected and pierced with a sharp explorer at the mesial or distal incisal angle to create a core vent

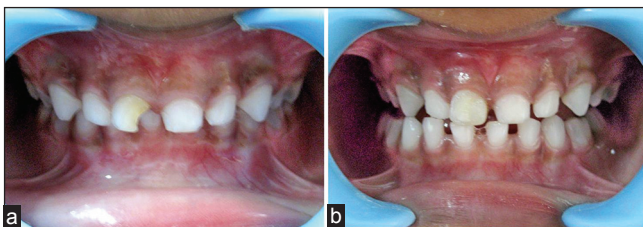


Figure 2: Group I — (a) preoperative (b) composite restoration in 51.

taking care of not to damage it. The gingival margin of the crown were trimmed to an approximate level using sharp, curved scissors and was tried on the tooth requiring coronal build-up. The prepared tooth surface was dried, and the self-etch adhesive system was applied and cured. The rubber dam was removed before the placement of the crown. The trimmed strip crown was filled with nanoparticle hybrid composite (Premise, Kerr Comp., USA) and placed on the prepared tooth and then cured. The strip crown shell was then peeled off with the help of an explorer. This procedure was done in accordance with the review given by Kupietzky, 2002.^[16]

Little, if needed, polishing of the restoration was done using composite finishing disks and strips preserving the luster of the labial crown surface [Figure 3].

Biological restoration

The collected samples of extracted teeth were thoroughly scaled, polished, freed of soft tissues, and periodontal remnants. The pulp was removed from the root canal and teeth were then stored in Hanks Balanced Salt Solution. A tooth which best fitted the mesiodistal, cervicoocclusal and buccolingual dimension of the tooth to be restored was selected from the storage medium. The extracted tooth's shade was also matched with the patient's tooth. Selected tooth was decoronated and autoclaved at 120°C and 15 lbs for 30 min.

Tooth to be restored was minimally prepared on all the surfaces using crown preparation kit (Shofu Inc., Kyoto, Japan) and nonretentive preparations were made, ending in chamfer shoulder-type margin with rounded corners.^[5,17,18] The coronal fragment of the

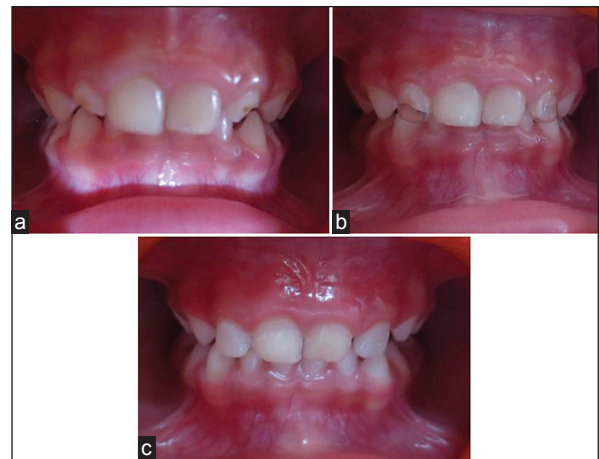


Figure 3: Group II — (a) preoperative (b) strip crown placed in 52, 62 (c) postoperative.

extracted tooth was then tried for fit, and adjustments were done until it fitted to the prepared tooth. The tooth fragment was then cemented to the prepared tooth structure with Glass Ionomer Luting Cement (Fuji I, GC Corp., Japan), and cervical regions of the restorations were polished with both rotary instruments and resin composite polishing disks [Figure 4].

Composite with stainless steel band

The stainless steel band was adapted on the tooth surface, and a labial portion of the band was trimmed away leaving a narrow portion of 1½ –2 mm of the band gingivally. The stainless steel band was preferred over stainless steel crown as extensive tooth preparation is required. Moreover, the technique of placement is time-consuming, and clinicians face problem to control hemorrhage during application of composite facing.^[1] According to Magneville and Dejou1996, the substructure of band provide support to the composite and increases the longevity of the restoration.^[19] The trimmed band was then cemented on the prepared tooth using GIC luting cement (Fuji I,

GC Corp., Japan). Any of the remaining cement was cleaned off from the proximal areas. Subsequently, the labial portion was restored with nanoparticle hybrid composite resin (Premise, Kerr Comp., USA) in increments and cured. Final composite resin restoration was then finished using composite finishing burs and disks [Figure 5].

The restorations were evaluated by an observer who was blind to the study to avoid biasing.

The data obtained were statistically analyzed using Chi-square test and level of significance, that is, *P* value was determined.

RESULTS

All patients were recalled, and restorations were evaluated for anatomic form, surface texture, color match, and retention in accordance with Ryge’s Direct (US Public Health Service) evaluation criteria^[5,20] at baseline (immediate postoperative), after 48 h, 3, 6, and 9 months [Table 1].

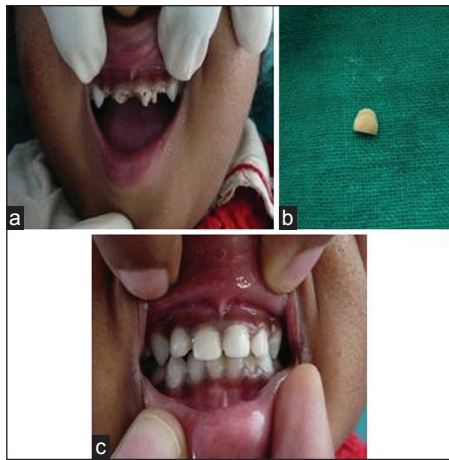


Figure 4: Group III — (a) preoperative (b) decoronated crown (c) biologic laminate in 51, 61.



Figure 5: Group IV — (a) preoperative (b) band cementation in 51, 61 (c) postoperative.

Table 1: Ryge’s direct (USPHS) evaluation criteria

| Clinical characteristics | Color match | Retention | Surface texture | Anatomic form |
|--------------------------|--|-----------------------------|---|--|
| Alfa (A) | The restoration matches the adjacent tooth structure color and translucency | Restoration present | Restoration surface is as smooth as the surrounding enamel | Restoration is continuous with existing form |
| Bravo (B) | Slight mismatch in color, shade, or translucency between the restoration and the adjacent tooth | Partial loss of restoration | Restoration surface is rougher than the surrounding enamel | Restoration is discontinuous with existing form, but missing material is insufficient to expose dentin or base |
| Charlie (C) | The mismatch in color and translucency is outside the acceptable range of tooth color and translucency | Restoration absent | There is a crevice and fracture on the surface of the restoration | Sufficient restorative material is missing to partially or totally expose dentin or base |

USPHS: United states public health service.

Statistical analysis revealed no color changes at baseline in all the groups. At 48 h, 7.7% of the sample in Group IV (composite with stainless steel band) only showed degradation in color. Thereafter, changes in color match after 3, 6, and 9 months were shown by all the three groups: composite, strip crowns, and composite with stainless steel band except Group III (biological restoration); and the difference was highly significant at 6 and 9 months ($P < 0.01$) [Table 2]. When intergroup comparisons were made at baseline, 48 h and 3 months using nonparametric Chi-square test, nonsignificant differences ($P > 0.05$) were obtained among all groups. It was observed that as compared to other group; group III had a significantly higher proportion of score A at 6 and 9 months. At 6 months, significant differences ($P < 0.05$) were obtained when Group III was compared with any other group. At 9 months highly significant differences ($P < 0.01$) were found, when Group I was compared with Group III. Significant differences ($P < 0.05$) were obtained when Group III was compared with Group II and IV. While nonsignificant results ($P > 0.05$) were obtained at 6 and 9 months for all other intergroup comparisons that compared Group I, II, IV [Table 3].

Table 2: Intergroup and intragroup comparison of color match, retention, surface texture and anatomic form of various restorative options at different time intervals using Chi-square test

| Variable | Test | 48 h | 3 months (M3) | 6 months (M6) | 9 months (M9) |
|-----------------|------------|------------|---------------|---------------|---------------|
| Color match | Chi-square | 3.053 | 6.438 | 17.357 | 16.587 |
| | <i>P</i> | 0.383 (NS) | 0.092 (NS) | 0.008 (HS) | 0.011 (S) |
| Retention | Chi-square | 0 | 2.080 | 9.404 | 10.044 |
| | <i>P</i> | 1 (NS) | 0.556 (NS) | 0.152 (NS) | 0.123 (NS) |
| Surface texture | Chi-square | 0 | 3.891 | 5.909 | 1.816 |
| | <i>P</i> | 1 (NS) | 0.273 (NS) | 0.116 (NS) | 0.611 (NS) |
| Anatomic form | Chi-square | 0 | 2.080 | 6.933 | 4.828 |
| | <i>P</i> | 1 (NS) | 0.556 (NS) | 0.327 (NS) | 0.566 (NS) |

*NS: Nonsignificant; S: Significant; HS: Highly significant.

The loss of retention was seen in both Group I and IV after 3 months. After 6 months, retention loss was seen in all the groups except Group II (strip crowns), in which loss was seen after 9 months. However, the difference was not significant [Table 2].

At baseline and after 48 h none of the group showed any surface roughness in any of the samples. Deterioration in surface texture was exhibited maximum by restorations in Group IV (composite with stainless steel band) followed by Group I (composite) at 3 months. Whereas, no surface changes were seen in Group II (strip crowns) and III (biological restoration). At 6 months, all the groups except strip crowns showed deterioration in surface texture. Changes in surface texture in Group II (strip crowns) were recorded only at 9 months [Table 2].

At baseline and after 48 h no change in anatomic form was shown by any group. Only 7.7% of samples, Group I (composite) and IV (composite with band) showed discontinuity in anatomic form after 3 months. At 6 months except for Group II (strip crown), discontinuity in anatomic form was observed in all the groups with maximum discontinuity in Group I. Thereafter, at 9 months 15.4% sample in Group I and II exhibited worst score for anatomic form exposing the dentin or base. Discontinuity in anatomic form was seen in all the groups at 9 months although the difference was not significant. However, on inter- and intra-group comparison no significant differences ($P > 0.05$) existed between the various groups at different time intervals [Table 2].

DISCUSSION

Esthetics, by definition, is the science of beauty: that particular detail of an animate or inanimate object that makes it appealing to the eye.^[1] Primary maxillary anterior teeth dominate the physical appearance,^[5] hence, it is important to restore crowns

Table 3: Intergroup comparison of color match of various restorative options at different time intervals using Chi-square test

| Inter group comparison | Group I versus II | | Group I versus III | | Group I versus IV | | Group II versus III | | Group II versus IV | | Group III versus IV | |
|------------------------|-------------------------|----------|--------------------|----------|-------------------|----------|---------------------|----------|--------------------|----------|---------------------|----------|
| | χ^2 | <i>P</i> | χ^2 | <i>P</i> | χ^2 | <i>P</i> | χ^2 | <i>P</i> | χ^2 | <i>P</i> | χ^2 | <i>P</i> |
| | Immediate postoperative | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 48 h | 0 | 1 | 0 | 1 | 1.040 | 0.308 | 0 | 1 | 1.040 | 0.308 | 1.040 | 0.308 |
| 3 months | 1.759 | 0.185 | 0 | 1 | 0.722 | 0.395 | 2.167 | 0.141 | 0.248 | 0.619 | 3.391 | 0.066 |
| 6 months | 2.476 | 0.116 | 6.190 | 0.013 | 3.667 | 0.160 | 4.396 | 0.036 | 2.550 | 0.325 | 7.287 | 0.026 |
| 9 months | 2.476 | 0.116 | 10.860 | 0.001 | 3.667 | 0.160 | 4.062 | 0.044 | 2.550 | 0.325 | 6.769 | 0.034 |

destroyed by caries or trauma to preserve the integrity of primary dentition until its exfoliation and eruption of permanent teeth.^[1] Thus, the present study was conducted to evaluate and compare the clinical performance of various esthetic restorations for primary anterior teeth.

Color match

When assessed for the color match in the present study, all the groups except biological restoration showed some degree of discoloration over a period of time. Color changes in Group I, II, and IV could be attributed to changes in composite restoration, which may be caused by the formation of colored degradation products, changes in surface morphology because of wear and by extrinsic staining.^[21,22] Secondly, intrinsic color changes in teeth, especially those, which were endodontically treated may contribute to change in color.^[23,24] Furthermore, due to the transparent characteristic of resin composites used in Group I, II, and IV; the brown hue (affected dentin) of the excavated lesion could be seen through the restoration.^[19,20]

Retention

When assessed for retention in the present study, the maximum retention was seen in Group II (strip crown) followed by Group I (composite) and Group IV (composite with stainless steel band). Furthermore, it is not statistically significant. The greater loss of restoration was seen in Group III (biological restoration), and this retention loss may be attributed to the tooth fragment not fitting precisely to the prepared tooth.^[5] Kupietzky *et al.* 2003, in an 18 months retrospective study found full retention rate of strip crown to be 88%.^[22] Similar results were shown by Ram and Fuks 2006.^[8] According to Anderson, retention or survival rate of reattached fragment was low in relation to the survival rate of composites.^[25]

Surface texture

Considering the surface texture, clinically detectable roughness was seen in every group after 3 months interval. The maximum change was seen in Group IV (composite with stainless steel band) followed by Group III (biological restoration) and I (composite). Furthermore, it is not statistically significant. The maximum changes seen in the surface texture of composite with stainless steel band may be due to the metal composite interface, which may lead to microleakage over a period of time. A gap may occur between composite and metal, which was previously

occupied by dentin bonding agent leading to marginal leakage at this interface, which result in degradation of the metal composite junction with dissociation of these two materials.^[19] Changes were also seen in the surface texture of biologic restoration, which may be due to the autoclaving procedure of tooth fragment making the enamel brittle, which might later on present as craze lines.^[5] Minimal changes were seen in the surface structure of strip crowns, which may be due to their glossy finish.^[7] Ram and Fuks 2006, found in their study that color and texture of the restoration using strip crowns remained either good or acceptable with no pitting or discoloration that compromised the esthetics.^[8]

Anatomic form

At baseline and after 48 h no change in anatomic form was shown by any group. Only 7.7% of samples in Group I (composite) and IV (composite with band) showed discontinuity in anatomic form after 3 months. At 6 months except for Group II (strip crown), discontinuity in anatomic form was observed in all the groups with maximum discontinuity in Group I. Thereafter, at 9 months 15.4% sample in Group I and II exhibited worst score for anatomic form exposing the dentin or base. Discontinuity in anatomic form was seen in all the groups at 9 months although the difference was not significant. However, on inter- and intra-group comparison no significant differences ($P > 0.05$) existed between the various groups at different time intervals. Changes in anatomic form of groups were seen because of the loss in retention of the restoration, whether partial or complete. According to the Saleh *et al.*, changes seen in anatomic form seemed to be due to loss of material caused by disintegration or fracture.^[13]

CONCLUSION

Composite, strip crowns, biological restoration, and composite with stainless steel band exhibited comparable results for all the parameter — retention, surface texture and anatomic form. However, biological restoration was found to be most satisfying esthetically owing to color compatibility with the patient's tooth. Thus, it has a great potential to be used as esthetic restorative option in primary anterior. However, further long-term research is required to validate their use in primary anteriors.

Substantial improvement is required in clinical practice by introducing realistic approaches for easy

management of challenges faced in the pedodontic clinic.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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