

Clinical Evaluation of Restoration of Grossly Carious Primary Teeth Using Biological Approach

Preeti Singh¹, Nikhil Srivastava², Vivek Rana³, Noopur Kaushik⁴

ABSTRACT

Background: To widen the treatment option of primary teeth with mutilated crown tooth structure but having more than two-thirds of root structure were restored by using natural tooth crowns with the help of adhesive materials.

Aim and objective: To restore the grossly decayed primary molars with biological crowns and to evaluate them for longevity, change in color, occlusal wear, marginal integrity, and patient/parent acceptance.

Materials and methods: Twenty primary molars from 6 to 10 years old children were restored with biological crowns (extracted/exfoliated tooth crowns) and follow-up was done till 12 months. Data tabulated and results were statistically analyzed using Kaplan–Meier survival analysis. The statistical software SPSS 19.0 was used.

Results: 89.47% of biological restorations survived successfully till 12 months follow-up period. No occlusal wear was found in any of the samples, a breach in marginal integrity was seen only in 16.6% of cases, and only 5.5% of biological crowns showed discoloration (darker) at 12 months intervals. 65.00% of patients well accepted the treatment and showed satisfaction while 20.0% of patients remained neutral. Only 15% of patients experienced dissatisfaction at the end of the study.

Conclusion: Biological restorations proved to be a viable alternative for the restoration of grossly mutilated primary molars.

Keywords: Biological restorations, Marginal integrity, Occlusal wear, Primary teeth.

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INTRODUCTION

Despite the best efforts in the field of prevention, dental caries continues to be a major problem in maintaining good oral health.¹ The best possible way to treat caries is by removing all the decayed portions, before restoring them and if pulp involvement is present then restoration is preceded by pulpotomy or pulpectomy in primary teeth. However, re-establishing the original form of teeth with the restorative material is not possible, particularly with multisurface cavities, where the occlusal load is high and can lead to loss or fracture of restoration.² But if left untreated, they might cause loss of vertical dimension of the occlusion, functional disharmony, deleterious habits such as mouth breathing and tongue thrusting, which can further lead to malocclusion.³ Thus, an ideal restoration should maintain dentition in such a manner that the tooth can remain in a healthy condition necessary for occlusion, esthetic, phonetics, proper mastication, and space maintenance.⁴

In an attempt to widen the treatment option of primary teeth with mutilated crown tooth structure which is non-restorable, having more than two-thirds of root structure remaining and otherwise indicated for extraction were restored by using natural tooth crowns with the help of materials with adhesive properties. However, no material has yet been discovered to match the properties of a natural tooth tissue in all its biomechanical aspects.⁵ Several authors have suggested the use of natural tooth structure as a restorative material. Santosh and Bianchi⁶ in 1991 coined the term “Biological Restoration” while in the year 1964 Chosack and Eidelman published the first paper on the use of extracted teeth as restorative materials.⁷ This technique consists of bonding sterile dental fragments to teeth to re-establish the lost part. Fragments obtained either from the patient or from a tooth bank may be used as a safe and reliable alternative to restore dental anatomy and function with excellent biomechanical properties.⁸ When the

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fractured fragment of the patient’s own tooth is reattached, it is referred to as autogenous bonding. When the patient does not present with the fractured fragment or its use is not recommended, donated extracted teeth or tooth taken from tooth bank can be used for reattachment procedure, it is referred to as homogeneous bonding.⁹ Tavares et al. in 1992 first described the technique of biological restoration in the primary dentition.¹⁰ Biological restoration is aimed at the reconstruction of mutilated crowns of molars. Limited studies have been done on this concept of biological restoration of the whole coronal part in primary molars. So, the aim of the present study was undertaken to restore the mutilated teeth with biological crowns and evaluate the efficacy of biological crowns in terms of longevity, discoloration, occlusal wear, marginal integrity, and patient/parent’s acceptance on grossly carious primary teeth.

MATERIALS AND METHODS (FLOWCHART 1 AND IMPRESSION, CAST AND BIOLOGICAL CROWN ADAPTION FIG. 1)

Ethical Aspects and Informed Consent

The present study was conducted in the Department of Pediatric and Preventive Dentistry. This study was approved by the Institutional Ethical Committee before the conduction of the study and informed consent was taken from the parents/guardians of the children participating in the study.

Population and Sample

Twenty primary molars from children aged 6–10 years with more than two-thirds of the root length but minimum or less crown structure remaining were randomly selected from the Out-Patient Department of Pediatric and Preventive Dentistry.

Inclusion and Exclusion Criteria

Primary molars which were having grossly mutilated crown tooth structures with more than two-thirds of the crown structure with or without requiring endodontic treatment and non-restorable with conventional methods were included in the study.

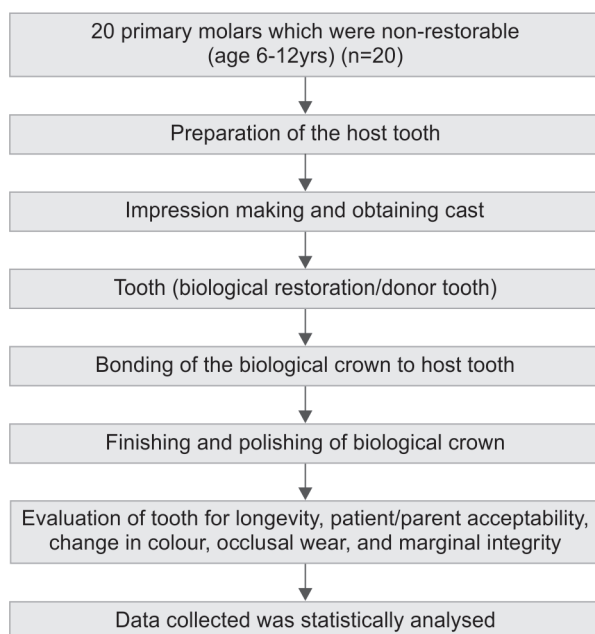
The primary tooth having sufficient time for exfoliation and eruption of the succedaneous tooth was included. Patients/parents' willing to save the tooth and do not want extraction.

Children with systemic illness were excluded from the study. Teeth with grade III mobility and with periapical or furcation pathology, internal/external resorption, or root caries.

Host Tooth Preparation

Teeth were evaluated both clinically and radiographically. If required, the endodontic procedure was done under local anesthesia, following the standard guidelines. The tooth was then prepared to receive a biological crown. Tooth surface flattened and buccolingual serrations were prepared on the occlusal surface for better bonding and adaptability. Margins were prepared supra gingivally.

Flowchart 1: Flow diagram of the methodology



Impression and Cast

Perforated stiff stainless steel trays that covered whole dentition were selected and an impression was made with help of light body material and medium body material using simultaneous (one-stage) technique. Dental stone casts were prepared.

Collection and Preparation of Biological Crown

Extracted teeth for therapeutic purposes or exfoliated teeth with intact crowns at CEJ were collected from the department of pediatric and preventive dentistry. Teeth were cleaned in ultrasonic cleanser at 42 GHz and 100 W output, 5 working cycles in 6% H₂O₂. Teeth collected were decoronate 1 mm apical to CEJ and the whole pulp was excavated with the help of a spoon excavator. Irrigation of the teeth was done with 5.25% NaOCl followed by normal saline. Disinfection of the collected teeth was done by keeping them in 10% formalin solution for 1 week. Collected teeth that were prepared for biological restoration were then stored in eye lens solution until used.

Biological Crown Selection

Shade selection was done by comparing the shade of the adjacent tooth with the help of the Vita classic shade guide. Mesiodistal, cervico-occlusal, and buccolingual dimensions of the tooth were measured using a divider on the cast. An extracted tooth crown from a tooth bank whose coronal dimensions best fit the prepared tooth was selected.

Surface Preparation of Biological Crown

The biological crown was etched with 37% phosphoric acid gel for 30 seconds, rinsed, and then dried. Then, bonding agent was applied and light-curing was done for 10 seconds and pulp chamber was filled with a nanohybrid composite (3M ESPE) and light cured. Bevel was given if required and buccolingual serrations were prepared.

Occlusal Adjustment and Cementation

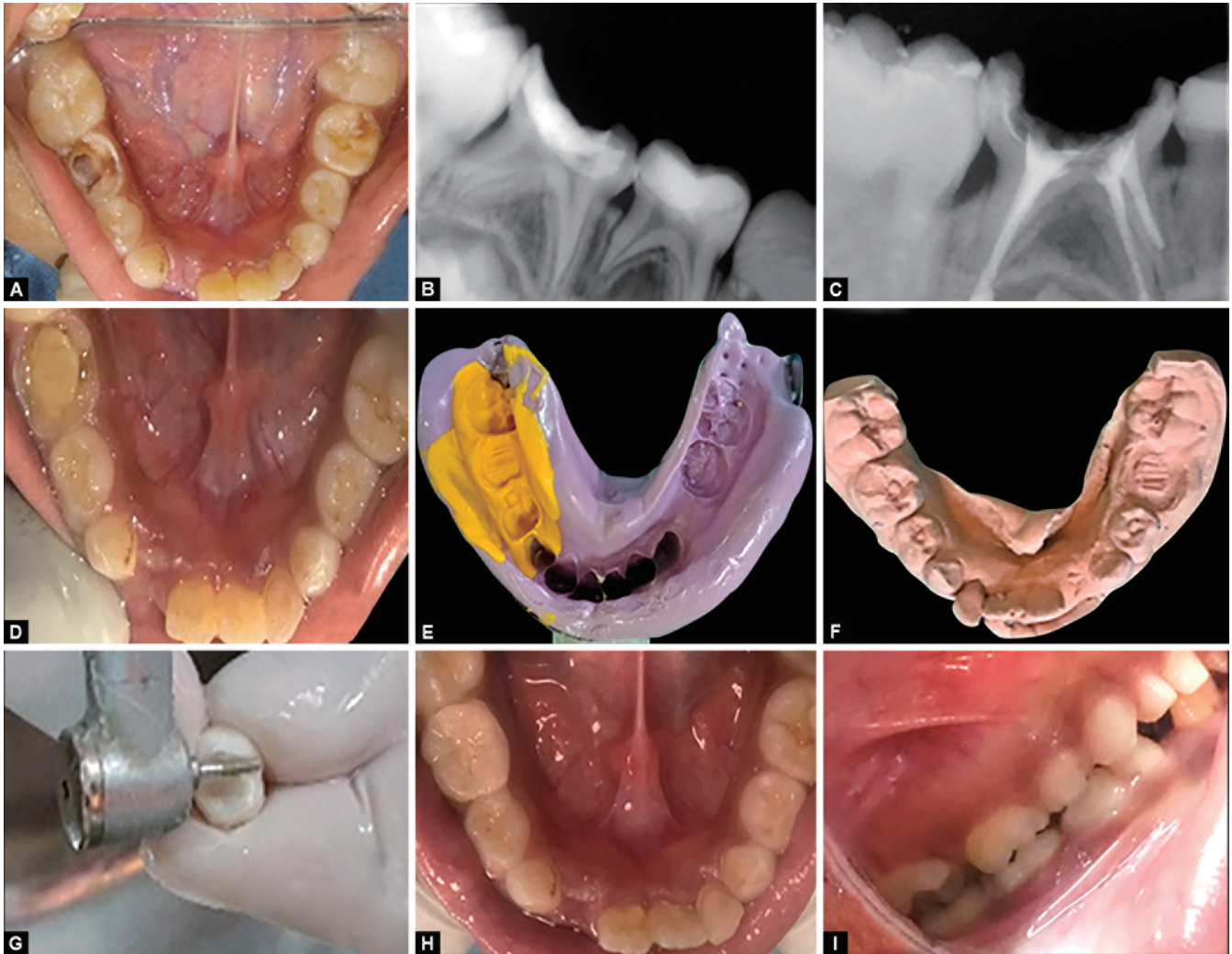
The biological crown was adjusted cervically on the cast. After achieving proper isolation with cotton rolls, both the host tooth and biological crown were etched with 37% phosphoric acid gel for 30 seconds, rinsed, and then dried. A bonding agent was applied and rubbed for 20 seconds to the host tooth and biological crown. The second layer was applied in the same fashion and air thinned lightly with help of a three-way syringe for 5 seconds and light-curing was done for 10 seconds. Resin composite (Transbond XT adhesive) was applied over the host tooth and then the biological crown was adapted onto the host tooth. The biological crown was then placed by pressing with the finger against the host tooth, excess material was removed with an explorer after tag cure for 2 seconds, and then light-curing was done of all surfaces.

Finishing and Polishing

These were done using a finishing and polishing kit with a 20- μ m finishing bur. Occlusion was checked with articulating paper before discharging the patient.

Follow-up Examination

The patient was recalled for examination for follow-up at 3, 6, 9, and 12 months intervals, and blinding was done by an independent operator to assess longevity, discoloration, wearing, marginal integrity, and patient/parent acceptability of biological crown.



Figs 1A to G: Restoration of the tooth with a biological crown: (A) Intraoral picture depicting grossly decayed tooth irt (75); (B) Radiographic picture showing sufficient tooth structure; (C) Obturated tooth; (D) Preparation of host tooth obturated with metapex; (E) Impression made and cast poured; (F) Cervical adaptation of biological crown with a bur and air rotor; (G) Biological crown was bonded to host tooth and occlusion and occlusion checked

Table 1: Evaluation criteria for patient acceptability

Score	Interpretation
1	Very dissatisfied
2	Dissatisfied
3	Neutral
4	Satisfied
5	Very satisfied

5-point Likert-type scale

For evaluation of the above-discussed parameter, the following criteria were used.

- Evaluation criteria for patient acceptability according to Likert 5-point scale (Table 1).
- Evaluation criteria of occlusal wear (Table 2).
- Evaluation criteria for color change were done by using the vita shade guide (Table 3).
- Evaluation criteria for marginal integrity (Table 4).

Table 2: Evaluation criteria of occlusal wear

Score	Interpretation
1	No loss of enamel surface characteristics
2	Loss of enamel surface characteristics
3	Buccal, lingual, and occlusal loss of enamel, exposing dentin for less than one-third of the surface Incisal loss of enamel Minimal dentine exposure
4	Buccal, lingual, and occlusal loss of enamel, exposing dentin for more than one-third of the surface Incisal loss of enamel Substantial loss of dentine
5	Buccal, lingual, and occlusal complete loss of enamel, pulp exposure, or exposure of secondary dentine Incisal pulp exposure or exposure of secondary dentine

by Smiths and Knight's tooth wear index

STATISTICAL ANALYSIS

The data tabulated and results were statistically analyzed using Kaplan–Meier survival analysis. The statistical software SPSS 19.0 was used.

RESULTS

The mean survival time of the biological crown was found to be 11.6 months, 95% of the values fall under these time limits. All biological

crowns survived till 3 months but 2 biological crowns failed at 6 months and 1 got exfoliated at 9 months.

Table 5 shows the gender and age distribution of study subjects. The mean age of the study group was 7.40 + 0.821 years. A total of 20 children (n = 20 primary molars) were included in the study, out of which 15 (75.90%) were males and 05 (25.0%) were females (Fig. 2).

Table 6 depicts the longevity of the biological crowns at the period of 0, 1, 3, 6, 9, and 12 months intervals. At 6 months follow-up period, 2 (10%) biological crowns were failed (because of de-bonding); however, at 9 months, 1 (5%) tooth with biological crown got exfoliated, which means only 2 (10.53%) biological crowns failed after 12 months (Fig. 3).

Table 3: Evaluation criteria for color change with help of vita shade guide

Score	Interpretation
-2	2 shade lighter than the selected crown shade
-1	1 shade lighter than the selected shade
0	Selected crown shade
+1	1 shade darker than the selected crown shade
+2	2 shade darker than the selected crown shade

Table 4: Evaluation criteria for marginal integrity

Score	Description
0	All crown margins intact, explorer does not catch
1	Explorer catch present in any of the one surfaces (cavo-surfaces)
2	Explorer catch present in any of the two surfaces (cavo-surfaces)
3	Explorer catch present in any of the three surfaces (cavo-surfaces)
4	Explorer catch present in all the surfaces (cavo-surfaces)

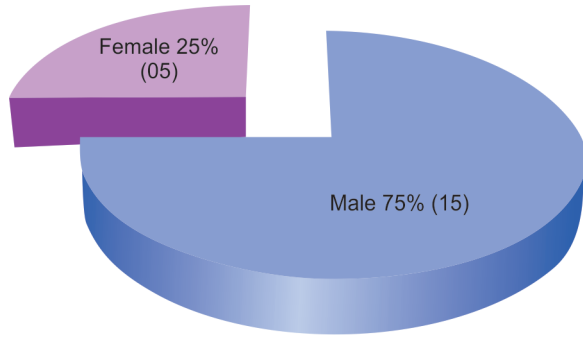


Fig. 2: Gender distribution in the study

Table 5: Description of study subjects

	Gender		Total (N)
	Male	Female	
N	15	05	20
%	75.90	25.0	100.00
Age (mean ± SD)	7.47 ± 0.915	7.20 ± 0.447	7.40 ± 0.821

Table 6: Longevity of the biological crowns at different time intervals

	0 month	1 month	3 months	6 months	9 months	12 months
Survival n = 20 (%)	20 (100)	20 (100)	20 (100)	18 (90)	17 (89.47)	17 (89.47)
Failed n = 20 (%)	00 (00)	00 (00)	00 (00)	02 (10)	02 (10.53)	02 (10.53)

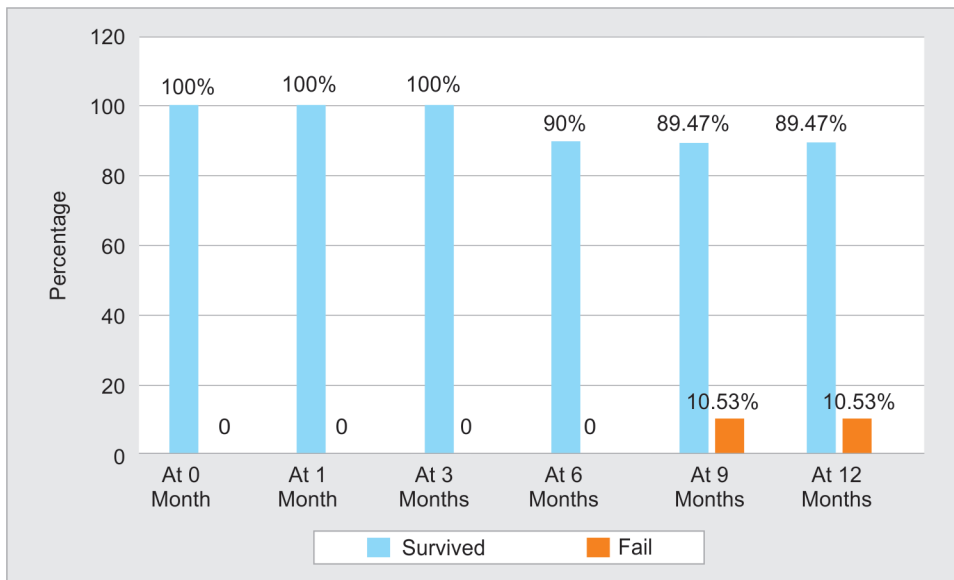


Fig. 3: Longevity of the biological crowns at different time intervals

Table 7 depicts the patient's satisfaction at different time intervals (0, 1, 3, 6, 9, and 12 months), according to Likert's 5-point scale. At 12 months follow-up, out of 20 biological crowns present, acceptance was found to be "very satisfied" (score 5) and "satisfied" (score 4) in 07 (35.00%) and 7 (35.00%) patients, respectively. However, only 03 (15.00%) patient were "dissatisfied" (score 2), rest (15.00%) were "neutral" (score 3) (Fig. 4).

Table 8 shows the occlusal wear of biological crowns at a different time interval. At 0, 1, 3, 6, 9, and 12 months follow-up, all the biological crowns appeared normal with no loss of enamel surface (score 1). Scores 2, 3, 4, and 5 were not found in any biological crowns (Fig. 5).

Table 9 depicts marginal integrity at 0, 1, 3, 6, 9, and 12 months follow-up period. At 12 months follow-up, all biological crown margins were intact except 3 crowns where explorer catch was

found on 1 surface (score 1) in 2 (11.11%) crowns and on 2 surfaces (score 2) in 1 (05.55%) biological crown. Score 3 and score 4 for marginal integrity were not found in any biological crowns (00.0%) (Fig. 6).

Table 10 depicts a change in color at 0, 1, 3, 6, 9, and 12 months follow-up. It was observed that only one biological crown showed discoloration at 6 months (Fig. 7).

DISCUSSION

Dental caries is a disease of concern in humans because it can manifests with an extremely high caries index in several countries, especially among young children. Nutrition examination survey was conducted in 1999 to 2004 which states that in the age group of 2–11 years, 42% of children have had dental caries.⁸ Primary molars with the grossly carious crown are routinely observed in pediatric clinical

Table 7: Patient's/parent's acceptance of biological crowns at a different time interval

5-point Likert-type scale	Total no. of patients received biological crowns [n (%)]	0 month	1 month	3 months	6 months	9 months	12 months
Score 1	n (%)	4 (20.0)	0 (0.0)	0 (0.0)	2 (10.0)	00 (00.00)	00 (00.00)
Score 2	n (%)	0 (0.0)	0 (0.0)	0 (0.0)	01 (5.0)	03 (15.00)	03 (15.00)
Score 3	n (%)	11 (55.0)	13 (65.0)	11 (55.0)	07 (35.0)	04 (20.00)	03 (15.00)
Score 4	n (%)	0 (0.0)	0 (0.0)	04 (20.0)	05 (25.0)	06 (30.0)	07 (35.5)
Score 5	n (%)	5 (25.0)	07 (35.0)	05 (25.0)	05 (25.0)	07 (35.5)	07 (35.5)

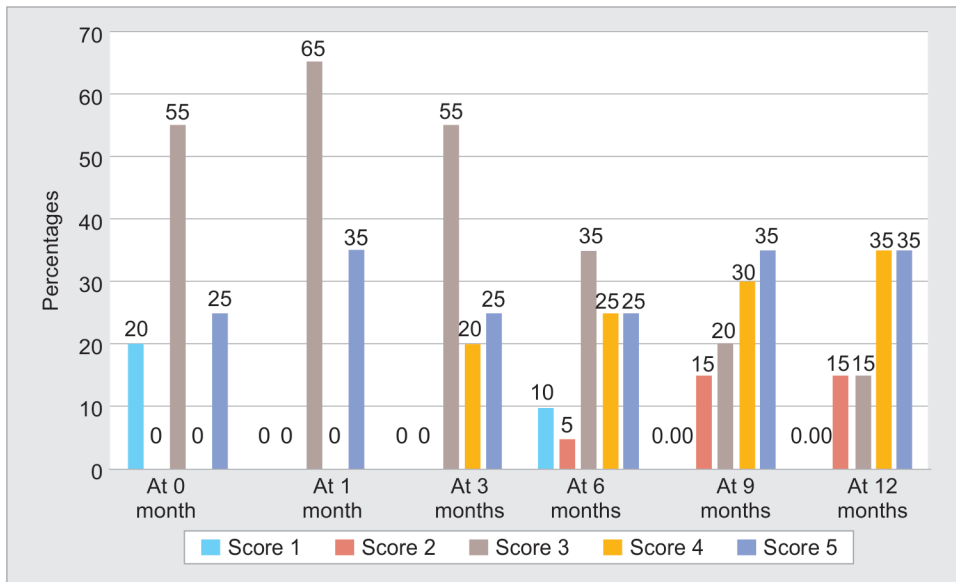


Fig. 4: Patient's/parent acceptance of biological crowns at different time interval according to 5-point Likert-type scale

Table 8: Occlusal wear of biological crown at a different time interval

Scoring for occlusal wear	Biological crowns	0 month	1 month	3 months	6 months	9 months	12 months
Score 1	n (%)	20 (100.0)	20 (100.0)	20 (100.0)	18 (100.0)	18 (100.0)	18 (100.0)
Score 2	n (%)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Score 3	n (%)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Score 4	n (%)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Score 5	n (%)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

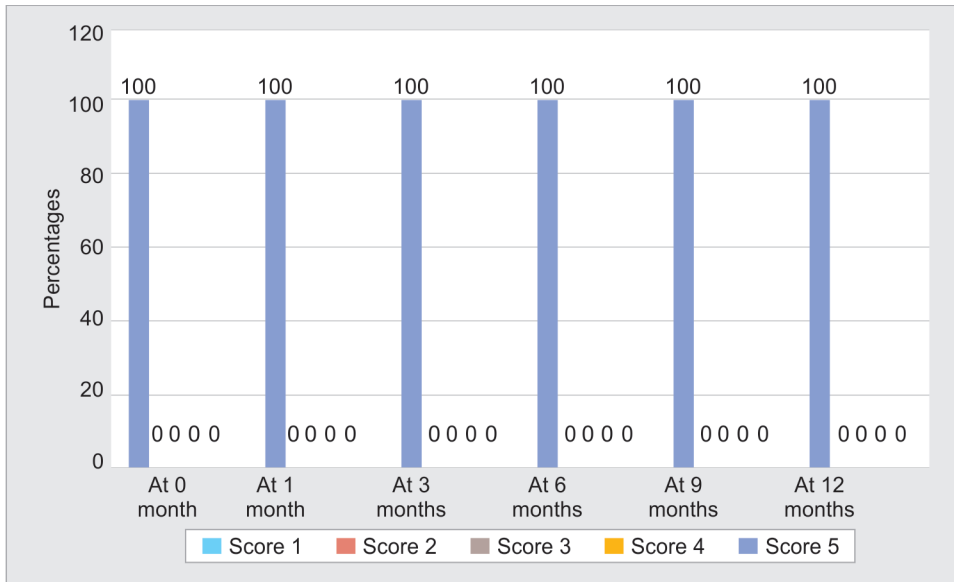


Fig. 5: Occlusal wear of the biological crown at a different time interval

Table 9: Marginal integrity of biological crowns at a different time interval

Scoring for marginal integrity	Biological crowns	0 month	1 month	3 months	6 months	9 months	12 months
Score 0	n (%)	20 (100.0)	20 (100.0)	18 (90.0)	16 (88.9)	15 (83.3)	15 (83.3)
Score 1	n (%)	00 (00.0)	00 (00.0)	01 (5.0)	01 (5.55)	02 (11.11)	02 (11.11)
Score 2	n (%)	00 (00.0)	00 (00.0)	01 (5.0)	01 (5.55)	01 (5.55)	01 (5.55)
Score 3	n (%)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)
Score 4	n (%)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)	00 (00.0)

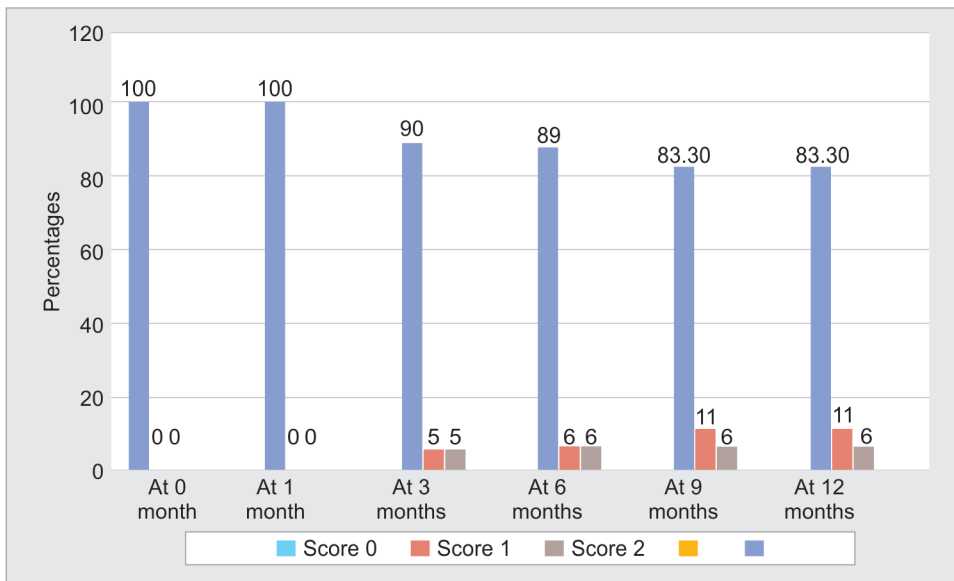


Fig. 6: Marginal integrity of the biological crowns at a different time interval

practice and often indicated for extraction. Their loss at an early age may lead to neuromuscular imbalance leading to decreased masticatory efficacy and esthetic and also phonetics problems, development of parafunctional habits, and psychological problems. Thus to restore such teeth is a challenge for the pediatric dentist.⁸

Recent developments in restorative materials such as composite resins reinforced composite, strip crowns, and biological restoration with natural tooth along with placement techniques, and adhesive protocols have made it possible to restore mutilated primary teeth to quite an extent.¹¹

Table 10: Change in color of the biological crown at a different time interval

Scoring for change in color	Biological crown	0 month	1 month	3 months	6 months	9 months	12 months
Score -2	n (%)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Score -1	n (%)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Score 0	n (%)	20 (100.0)	20 (100.0)	20 (100.0)	17 (94.4)	17 (94.4)	17 (94.4)
Score +1	n (%)	0 (00.0)	0 (00.0)	0 (00.0)	01 (5.55)	01 (5.55)	01 (5.55)
Score +2	n (%)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)

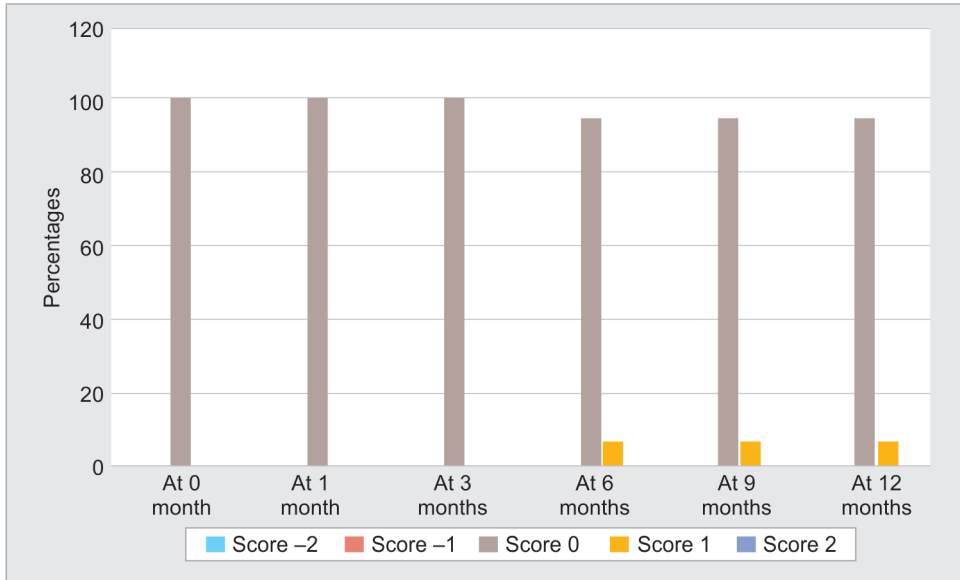


Fig. 7: Change in color of the biological crown at a different time interval

The authors have proposed the classification of biological restorations, based on the types and uses of these restorations in different situations (Table 11). This technique of restoring grossly carious or broken teeth with help of biological restorations is though technique sensitive. It provides excellent esthetics as well as preserves natural tooth color compared to composite resins and stainless steel crowns, allows the preservation of sound tooth structure, and has low cost.¹²

Despite of many advantages, literature regarding the clinical efficacy of these biological restorations in primary posterior teeth is sparse. Hence, this study was designed to assess the clinical efficacy of biological crowns.

Despite of many advantages, literature regarding the clinical efficacy of these biological restorations in primary posterior teeth is spare. Hence, this study was designed. A total of 20 grossly carious primary molars with minimal crown structure but more than two-third s of the root length, which otherwise indicated for extraction were selected in children aged 6–10 years to receive biological crowns.

The age group of 6–10 years was selected because this particular age group falls in the time interval when there is sufficient time for normal exfoliation of the primary molars and eruption of succedaneous permanent teeth.¹³

Present study used flowable composite for bonding the biological crowns to the remaining tooth structure because of its high wet ability of the tooth surface, ensuring penetration into every irregularity, ability to form layers of minimum thickness, thereby improving or eliminating air inclusion or entrapment and its high flexibility, so less likely to be displaced in stress concentration areas like cervical wear processes and cavitated dentine areas.¹⁴

Table 11: Nikhil and Rana’s classification of biological restorations

Autogenic-Homodontic	Tooth fragment of the same tooth attached on to the same tooth of the same person. For example, reattachment of fractured central incisor with composites
Autogenic-heterodontic	Tooth fragment of one tooth attached on to another tooth of the same person. For example, carious 1st permanent molar restored with the tooth fragment of exfoliated primary molar of the same person using adhesive capabilities of the composites
Allogenic-homodontic	Tooth of a person restored with the help of same tooth of another person. For example, extensively carious 2nd primary molar restored by attaching the tooth fragment of the extracted 2nd primary molar, obtained from a tooth bank using composites
Allogenic-heterodontic	Tooth of a person restored with the help of different tooth of another person. For example, use of the root of the extracted lateral incisor, obtained from a tooth bank to restore the fractured central incisor using post & core preparation

In the present study, patient satisfaction was assessed using the Likert 5-point scale as patient acceptability is now considered a key part of improved health care quality. Likert-type scale has been

used in most patient satisfaction studies, because it is a simple tool with adequate reliability and validity.¹⁵

Also to assess the quality of marginal integrity, a mouth mirror and explorer were used. This technique was first described by McCune et al. in 1967 and has since been adopted as the US Public Health Service Criteria (Ryge Criteria).¹⁶

Because of the popularity, ease, simplicity, and quick assessment of the right color shade that matches restoration with adjacent teeth, a vita classical shade guide was used in the present study to observe the change in color in biological crowns.¹⁷

Smiths and Knight's tooth wear index criteria were used in the study to evaluate the occlusion wear, as this criterion has a more general concept of measuring tooth wear *per se*, irrespective of the cause.¹⁸

The longevity of the biological crown was observed at the different time interval. Two (10%) biological crowns failed at 6 months follow-up period because of de-bonding and at a period of 9 months, 1 (5%) biological crown got naturally exfoliated. Thus at the end of the 12 months, the success rate (longevity) of biological crowns is 11.6 months. The reason for the failure of the loss of 2 biological crowns can be contributed to the following facts, first, the flowable composite materials rely highly on the remaining tooth structure for bonding, the amount of clinical tooth structure after caries removal, and crown preparation is critical to their retention rate.¹⁴

Second, resin composites are moisture sensitive and lack of child cooperation can compromise its bonding leading to its compromised durability.

Similar results were obtained in a retrospective case-control study conducted by Sarapultseva and Sarapultsev,¹⁹ Mendes et al.,²⁰ and Karre et al.²¹ who showed a success rate of the patients treated with a biological approach and it could be indicated a good alternative to all other techniques.²²

In the present study, it was observed that most of the patients were either neutral, satisfied, or very satisfied with biological crowns, however, few patients/parents' dissatisfactions were also observed, because biological restoration did not match adjacent teeth color.²³

The high acceptance rate of biological crowns can be attributed to the fact that the biological crown placement technique is simple and the length of each appointment is short as biological teeth were prepared extraorally, thus shortening the clinical chair time for biological crown bonding which shows as an advantage especially while treating pediatric patients.

The cost of these restorations, when compared with conventional methods of restorations, was much less hence it proved to be a cost-effective alternative.²⁴

Also, as the biological crowns are esthetically more pleasing due to their natural appearance, allowing natural results in terms of anatomic shape, surface shine, smoothness, and translucency of the enamel; which further enables improvement of the chewing function.²⁵ Although patient/parental dissatisfaction can be attributed to the fact that there was difficulty in obtaining biological crown matching color with adjacent tooth color and also, having tooth from other people's teeth in their mouth might not be a pleasant idea for some patients.²³

The results of the present study are in accordance with the study done by Kupietzky and Waggoner²⁶ in which parental satisfaction with bonded resin composite strip crowns and for biological restorations for the treatment of primary teeth with large or multisurface caries was excellent. According to Glendor²⁷

and Busato et al.,²⁸ also the allogeneic technique of biological restoration was preferred among the clinicians since it restored the function and esthetics of the teeth with much ease, convenience, and speed due to the use of part of the biological restorations.²⁷⁻²⁹

In the present study, all the crowns present (89.47%) appeared normal with no loss of enamel surface characteristics. This could be attributed to the fact that the enamel of the biologically restored tooth offers superficial smoothness and physiological wear compatible with those of surrounding teeth.

The results of the present study are similar to studies conducted by Mandroli,³⁰ Chosack and Eidelman,⁷ Botelho et al.,³¹ and Tavano et al.³² who concluded that the enamel of the biologically restored tooth offers superficial smoothness, and this technique allows less or no physiological wear of the tooth structure.

Another study conducted by Chu et al.³³ concluded that the use of the natural tooth minimizes problems like aging and degradation of the restorative material, color difference discrepancies, and difficulties in reproducing the texture and contours associated with restorative materials.

One shade darker than the selected crown shade was observed in 1 (5.6%) biological crown out of 17 biological crowns present at 12 months. Thus, it was observed that only 1 biological crown showed discoloration at 12 months follow-up.

This could be attributed to the fact that biological restorations are less subjected to extrinsic pigmentation and plaque accumulation because of their superficial smoothness, surface shine, anatomic shape, the translucence of enamel, and physiological wear compatible with those of surrounding teeth.

Similar results were obtained in a study conducted by Duhan et al.,³⁴ Ramires-Romito et al.,³⁵ and Sanches et al.³⁶ which concluded that biological restorations are less subjected to extrinsic pigmentation, plaque accumulation, and provide excellent esthetics especially regarding translucency compared to composite resins.

At 12 months, it was observed that though margins were continuous, explorer catch was present in 3 biological crowns (17.6%) without any visible crevice. The reason for the breach in surface integrity is because moisture along with the effect of salivary esterases might reduce the lengths of polymer chains, leading to fatigue of the residual resin at the marginal areas that cause the release of residual stresses. Temperature fluctuations also cause resin contraction and expansion at the margins, promoting crack propagation through areas of weak resin, which might increase marginal discrepancy.³⁷

Another reason for explorer caught in the margin is due to some polymerization shrinkage of resin, which may have led to the formation of marginal gaps.

Similar results were observed in the study conducted by Grewal and Reeshu²⁴ in which biological restorations showed some imperfect margins where the explorer was slightly caught.

Hence, it can be concluded that this technique provides excellent anatomic form, preserves the marginal integrity, has good longevity as well as maintains the esthetic demand of the patients. Therefore, it can be said that biological crowns are restorative options for grossly mutilated teeth otherwise indicated for extraction.

CONCLUSION

Based on the results of the present study, the following conclusions were drawn:

- 89.47% of biological restorations survived successfully till 12 months follow-up period.
- No occlusal wear was found in any of the samples over a period of 12 months.
- Breach in marginal integrity was seen only in 16.6% and the rest 86.4% cases showed good marginal integrity.
- At 12 months intervals, only 5.5% of biological crowns showed discoloration (darker).
- 70.00% of patients well accepted the treatment and showed satisfaction while 15.0% of patients remained neutral. Only 15% of patients experienced dissatisfaction at the end of the study.
- Thus, biological restorations proved to be a viable alternative for the restoration of grossly mutilated primary molars in terms of survival, occlusal wear, discoloration, marginal integrity, and patient satisfaction.

However, further studies are suggested to be conducted with a larger sample and long-term follow-up to evaluate the clinical efficacy of biological restorations in pediatric dental practice.

Why this paper is important to pediatric dentists

- This study highlights about use of extracted teeth, as a biological restoration that re-establishes the original form of teeth.
- It offers pediatric dentists a viable option for the restoration of teeth, which otherwise would have undergone extraction.

Teeth of children with grossly mutilated crown structure and multisurface caries can be rehabilitated with the help of biological restoration which has a good survival rate.

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