

Comparative evaluation of Indirect Composite Shell Crowns and Direct Composite restorations in primary anterior teeth.

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Abstract

Aim: The purpose of this in vivo study was to evaluate and compare the outcomes of direct composite restoration and indirect composite shell crown techniques in primary anterior teeth.

Methodology: 60 primary anterior teeth of children aged 3-7 years were chosen. They were randomly divided into two groups, Group I (Indirect Composite Shell crowns) and group II (Direct composite restorations). Each group consisted of 30 teeth, Group I: full arch impressions made in first visit, composite shell crowns fabricated on cast model and in second visit shell crowns were cemented. Group II: direct composite restorations done with

incremental technique. Both the groups were evaluated at baseline, 1 month, 3 months & 6 months using United states public health service criteria. The data was statistically analysed using Chi Square tests with p value <0.05 indicating significant differences.

Results: There was no statistical difference found between the two groups at baseline and 1 month in terms of retention, color match, marginal integrity, marginal discoloration, post-operative hypersensitivity, gingival bleeding and secondary caries. However, at 1 month slightly rough surface texture (20%) and slightly staining (23.3%) was seen in group II and highly significant difference was seen in all the parameters at 3 & 6 months.

Conclusion: Based on the results of the present study, composite shell crowns proved to be much better in terms of retention, color match, marginal integrity, marginal discoloration, surface texture, surface staining, post-operative hypersensitivity, secondary caries & gingival bleeding when compared at 1 month, 3 month and 6 months interval.

Keywords: composite shell crowns, composite restoration, primary teeth, indirect restoration, direct restoration.

Introduction

Functional and aesthetic rehabilitation of the carious mutilated deciduous anterior teeth is a challenge to the Paediatric Dentist even with advent of improved restorative materials. The caries in deciduous dentition, affects the maxillary central and lateral incisors and in more severe cases also involve the maxillary canines. Rehabilitation in such cases becomes difficult as multiple teeth are involved.[1] Carious involvement of maxillary incisors and traumatic injuries, not only compromises the integrity of dentition, but can also create an undesirable esthetic appearance, making the management of these teeth difficult. Moreover, a child's behavior makes moisture control and subsequent restoration very difficult. [2]

It is important to restore the destroyed crowns in order to preserve and promote the integrity of primary dentition, its exfoliation and eruption of a permanent tooth. [3] Increase in demand for esthetics has led to the development of tooth-colored, nonmetallic restorations such as composite restorations. There are different methods for placement of composite resin restorations, which are direct and indirect techniques. The advantages of direct technique include increased strength of remaining tooth structure and potential for repair. [4] They are durable, long-lasting restoration option for cavities. The achievement of a

proper interproximal contact and the complete cure of composite resins in the deepest regions of a cavity are some challenges related to direct composite restorations. [5] On the other hand Indirect technique refers to fabrication of the restoration outside the oral cavity. They were introduced to reduce marginal leakage effects and improve the properties of material, since the polymerization shrinkage occurs outside the oral cavity, being limited to the cementing and adhesive agent. Additional clinical benefits include precise marginal integrity, ideal proximal contacts, excellent anatomic morphology, and optimal esthetics. [5,6] Hence, The selection between direct and indirect technique is a challenging decision making process. Composite shell crown, is a another novel technique for aesthetic rehabilitation of the maxillary anterior teeth It gives advantages of time management and also helps to achieve desired perfection of the restoration. [1]

Many clinical studies have been performed on success or survival rate of direct composite restorations and few on indirect composite restoration (Shell crowns) technique in primary anterior teeth, but none of the studies have been there regarding the comparison of these two techniques. Therefore, the aim of this in vivo study was to evaluate and compare the outcomes of direct composite restoration and indirect composite shell crown technique in primary anterior teeth.

Materials and Methods

Patients were selected from the outpatient Department of Paedodontics and Preventive Dentistry, HIDS, Paonta Sahib, Himachal Pradesh. Sixty primary anterior teeth were included in the study of patients aged 3-7 years. The participants were equally divided into two groups: Group I: Indirect Composite Shell Crown (n=30) Group II: Direct Composite Restoration (n=30). Ethical clearance was taken from the Institutional Ethical committee Review Board.

Inclusion criteria

- Children falling in the age group of 3-7 years
- Decayed anterior teeth with remaining crown structure
- Presence of fluorosis, hypoplasia, early childhood caries
- Ellis class IX fracture of anterior teeth
- Post-operative restoration after the endodontic procedure
- Discoloured non-vital teeth
- Children whose parents have given the written consent.

Exclusion criteria:

- Tooth mobility
- Presence of fistula and/or edema
- inter-radicular radiolucency
- Habits of bruxism

In both the groups, participants satisfying the inclusion criteria were selected and a written consent was obtained. All the cases were treated under rubber dam isolation. Removal of the carious enamel and dentin was done using a #330 round diamond bur. In all the participants of both group, shade selection was done under natural light.

In Group I (Indirect Composite Shell Crowns) Full arch alginate impressions were made and cast was obtained. Double coating of separating media (cold mould seal) was applied on the cast to act as a spacer for luting resin during the cementation process [Figure 1: a,b]. The composite build-up was done on the cast with dental composite resin (Tetric N Ceram, Ivoclar Vivadent) using the incremental technique with composite instrument (Optra sculpt pad, Ivoclar Vivadent) [Figure 1: c,d] Each increment was cured for 20 sec as per the manufacturer's instructions. After completion of indirect restoration on the teeth, the shell crowns were finished, polished and carefully detached from the cast [Figure 1: e]

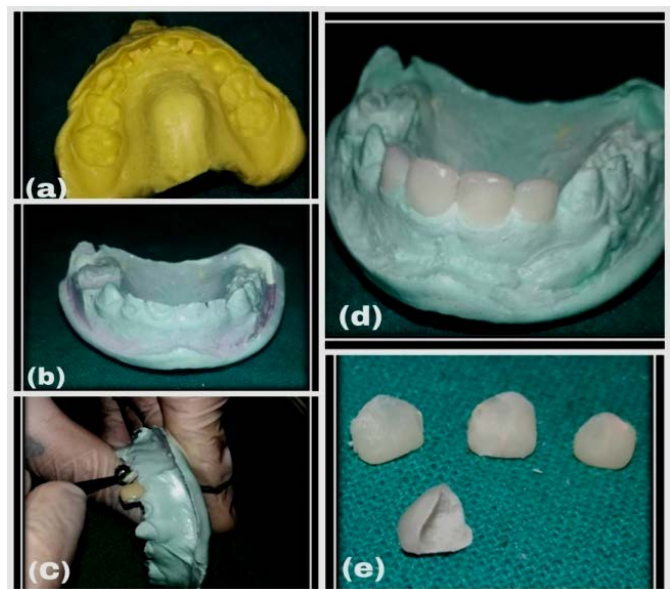


Figure 1: (a) Impression made after caries excavation (b) Application of separating media (c) Composite build up on cast model (d) Fabricated Shell Crowns (e) Detached Shell Crowns

In the second visit, tooth to be restored with the indirect restoration was cleaned and as per the manufacturer's instructions a coat of adhesive (Tetric N bond universal, Ivoclar Vivadent) was applied and agitated for 20 sec, light-cured for 20 sec,[7] then shell crown was taken and on its inner surface, a thin coat of primer (Monobond N) was applied with a micro brush and allowed it to react for 60 sec and then made air-dried. Luting resin was taken in the ratio of 1:1 (base: catalyst) (Variolink N, Ivoclar Vivadent) and was mixed for 20 sec following the cementation procedure. After seating the crown, light pressure was exerted and gross excess was removed. The crown's margin was covered with glycerine gel/air block (e.g. Liquid Strip, Ivoclar Vivadent) immediately after the removal of excess. After complete polymerization (20 sec), the glycerine gel was rinsed off with water.[7] [Figure 2,3]

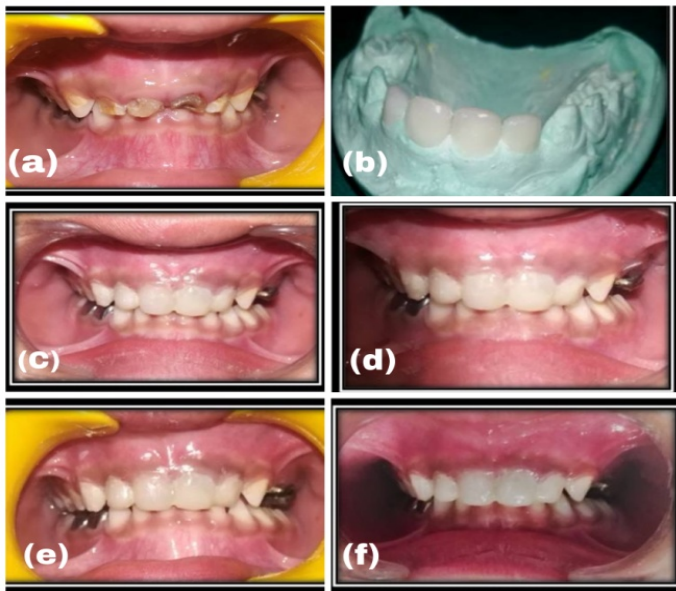


Figure 2: Case I (Indirect composite Shell Crowns, Group I) (a) Pre-operative (b) Fabricated Shell crowns) (c) At baseline (d) At 1 month (e) At 3 months (f) At 6 months



Figure 3: Case II (Indirect composite Shell Crowns, Group I) (a) Pre-operative (b) Fabricated Shell crowns) (c) At baseline (d) At 1 month (e) At 3 months (f) At 6 months

In Group II (Direct Composite Restorations) The tooth to be restored with a direct restoration was conditioned with 37 % phosphoric acid gel for 15 seconds, it was then rinsed with water for 30 seconds and dried with cotton pellets. [8] As per the manufacturer’s instructions a coat

of adhesive (Tetric N bond universal, Ivoclar Vivadent) was applied with an applicator tip which was further agitated and light cured for 20 secs. Composite resin (Tetric N Ceram, Ivoclar Vivadent) was placed in increments and each increment was light cured for 20 sec. finishing of the restoration was done [Figure 4, 5].



Figure 4: Case I (Direct composite restorations, Group II) (a) Preoperative (b) At baseline (c) At 1 month (d) At 3 months (e) At 6 months.

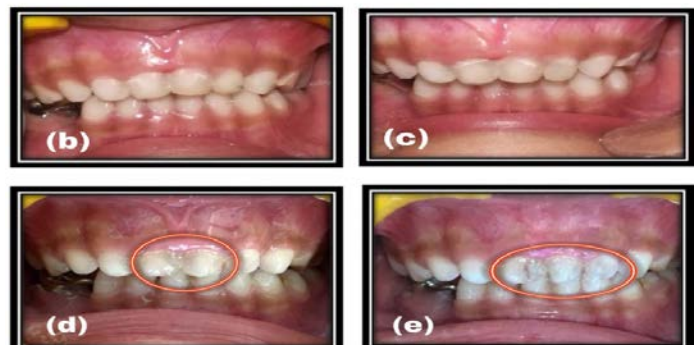


Figure 5: Case II (Direct composite restorations, Group II) (a) Preoperative (b) At baseline (c) At 1 month (d) At 3 months (e) At 6 months

Results

Clinical evaluation was done using United States Public Health Service Criteria (Table 1) Results were compared at baseline, 1 month, 3 months and 6 months and tabulated (Table 2) (Table 3). The data was statistically analysed using Chi Square tests with p value <0.05 indicating significant differences. Table 2 showed difference between the two groups, indirect composite shell crowns (Group I) and direct composite restorations (Group II) at baseline and 1 month. There was no statistical difference found between the two groups at baseline and 1 month in terms of retention, color match, marginal integrity, marginal discoloration, post-operative hypersensitivity, gingival bleeding and secondary caries. However, at 1 month slightly rough surface texture (20%) and slightly staining (23.3%) was seen in group II. Table 3 shows the comparison between two groups at 3 and 6 months interval and highly significant results were seen in both the groups. Overall, Indirect composite shell crowns were better in all the parameters as compared to the direct composite restoration when evaluated at 1 month, 3 month and 6 months.

Discussion

Placement of restorations in primary teeth is a technique sensitive procedure requiring time, patient cooperation, and careful isolation of the work field.[2,10] For these reasons, a restorative technique that can provide efficient, durable and functional restorations, and that is simple to perform would enhance the management of patients presenting with carious primary anteriors.[6] Composite based resins when used directly or indirectly, have been an excellent choice for decayed teeth due to their adhesive bonding and esthetic appearance.[11] In the present study, Indirect composite shell crowns showed complete retention i.e 100% in all the cases when compared to the direct composite restorations, as complete retention was

seen only in 36.7% cases, 40% restorations showed slight mobilization and 23.3% cases presented the loss of restoration at 6 months follow up. Loss of retention may be seen due to the difficulties that have been occurred while maintaining proper isolation. Contamination of the adhesive surface can lead to the inability of the composite based resin to bond with the adhesive, potentiating microleakage around the restoration and subsequent failure. [8,12] Indirect composite shell crowns presented better “marginal integrity” in 100% of cases. In contrast, direct composite restorations manifested good marginal integrity in only 60% of cases whereas 16.7% showed discrepancy without any dentin exposure and 23.3% of cases presented discrepancy with dentin exposure at 6 months follow-up. Variations in the integrity can be seen due to the polymerisation shrinkage as in indirect restoration the whole fabrication was done extra-orally, thus shrinkage was better controlled. Indirect composite shell crowns didn't show any “surface staining” in 16.7% but slight staining was seen in 83.3% cases which were somehow less than the direct composite restorations as they presented slight staining in 30% of cases and high staining in 70% of cases at 6 months follow-up. At 6 months follow up Indirect Composite Shell Crowns showed better “Color match” i.e. 36.7% cases manifested perfect color match. It was seen that none of the direct composite restorations presented perfectly matched restorations and 36.7% cases were unacceptable at 6 months.

Table 1: Clinical evaluation was done using United States Public Health Service Criteria [9]

	Test procedure	SPHS score	
Retention	Visual inspection with mirror at 18inches	Complete retention of the restoration Mobilization of the restoration, still present Loss of the restoration	Alpha (A) Bravo (B) Charlie (C)
Colour Match	Visual inspection with mirror at 18inches	Restoration is perfectly matched for color shade Restoration is not perfectly matched for color shade Restoration is unacceptable for color shade	Alpha (A) Bravo (B) Charlie (C)
Marginal Integrity	Visual inspection with explorer & mirror, if needed	Absence of discrepancy at probing Presence of discrepancy at probing, without dentin exposure Probe penetrates in the discrepancy at probing, with dentinexposure	Alpha (A) Bravo (B) Charlie (C)
Marginal Discoloration	Visual inspection with mirror at 18inches	Absence of marginal discoloration Presence of marginal discoloration, limited and not extended Evident marginal discoloration, penetrated toward the pulp chamber	Alpha (A) Bravo (B) Charlie (C)
Surface texture	Visual inspection with explorer and mirror, if needed	Surface is not rough Surface is slightly rough Surface is highly rough	Alpha (A) Bravo (B) Charlie (C)
Surface Staining	Visual inspection with explorer & mirror, if needed	Surface is not staining Surface is slightly staining Surface is highly staining	Alpha (A) Bravo (B) Charlie (C)
Post-operative Sensitivity	Ask patients	Absence of the dentinal hypersensitivity	Alpha (A)

		Presence of mild and transient hypersensitivity Presence of strong and intolerable hypersensitivity	Bravo (B) Charlie (C)
Gingival bleeding	Visual inspection with explorer and mirror, if needed	Gingival tissues are perfect Gingival tissues are slightly hyperemic Gingival tissues are inflamed	Alpha (A) Bravo (B) Charlie (C)
Secondary Caries	Visual inspection with explorer & mirror, if needed	No evidence of caries Evidence of caries along the margin of the restoration	Alpha(A) Bravo (B)

Table 2: Comparison between Group I and Group II at baseline months and 6 months. Group I (Indirect composite restorations) Group II (Direct composite restorations).

Evaluation criteria	Baseline		At 1 M	
	Group I	Group II	Group I	Group II
Retention				
A	30(100%)	30(100%)	30(100%)	30(100%)
B	0(0%)	0(0%)	0(0%)	0(0%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Color Match				
A	30(100%)	30(100%)	30(100%)	27(90%)
B	0(0%)	0(0%)	0(0%)	3(10%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Marginal Integrity				
A	30(100%)	30(100%)	30(100%)	27(90%)
B	0(0%)	0(0%)	0(0%)	3(10%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Marginal Discoloration				
A	30(100%)	30(100%)	30(100%)	29(96.7%)
B	0(0%)	0(0%)	0(0%)	1(3.3%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Surface texture				
A	30(100%)	30(100%)	30(100%)	24(80%)
B	0(0%)	0(0%)	0(0%)	6(20%)

C	0(0%)	0(0%)	0(0%)	0(0%)
Surface staining				
A	30(100%)	30(100%)	30(100%)	23(76.7%)
B	0(0%)	0(0%)	0(0%)	7(23.3%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Postoperative hypersensitivity				
A	30(100%)	30(100%)	30(100%)	30(100%)
B	0(0%)	0(0%)	0(0%)	0(0%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Gingival bleeding				
A	30(100%)	30(100%)	30(100%)	30(100%)
B	0(0%)	0(0%)	0(0%)	0(0%)
C	0(0%)	0(0%)	0(0%)	0(0%)
Secondary caries				
A	30(100%)	30(100%)	30(100%)	30(100%)
B	0(0%)	0(0%)	0(0%)	0(0%)

Table 3 Comparison between Group I and Group II at 3 months and 6 months. Group I (Indirect composite restorations)
Group II (Direct composite restorations)

Evaluation criteria	At 3 Months		At 6 Months	
	Group I	Group II	Group I	Group II
Retention				
A	30 (100%)	23 (76.7%)	30 (100%)	11 (36.7%)
B	0 (0%)	7 (23.3%)	0 (0%)	12 (40%)
C	0 (0%)	0 (0%)	0 (0%)	7 (23.3%)
Color Match				
A	30 (100%)	1 (3.3%)	11 (36.7%)	0 (0%)
B	0 (0%)	29 (96.7%)	19 (63.3%)	19 (63.3%)
C	0 (0%)	0 (0%)	0 (0%)	11 (36.7%)
Marginal Integrity				
A	30 (100%)	18 (60%)	30 (100%)	18 (60%)
B	0 (0%)	12 (40%)	0 (0%)	5 (16.7%)
C	0 (0%)	0 (0%)	0 (0%)	7 (23.3%)
Marginal Discoloration				
A	30 (100%)	4 (13.3%)	29 (96.7%)	3 (10%)
B	0 (0%)	26 (86.7%)	1 (3.3%)	20 (66.7%)
C	0 (0%)	0 (0%)	0 (0%)	7 (23.3%)
Surface texture				
A	25 (83.3%)	2 (6.7%)	10 (33.3%)	0 (0%)
B	5 (16.7%)	22 (73.3%)	20 (66.7%)	11 (36.7%)
C	0 (0%)	6 (20%)	0 (0%)	19 (63.3%)
Surface staining				
A	25 (83.3%)	1 (3.3%)	5 (16.7%)	0 (0%)
B	5 (16.7%)	23 (76.7%)	25 (83.3%)	9 (30%)
C	0 (0%)	6 (20%)	0 (0%)	21 (70%)
Postoperative hypersensitivity				
A	30 (100%)	12 (40%)	30 (100%)	6 (20%)
B	0 (0%)	18 (60%)	0 (0%)	18 (60%)
C	0 (0%)	0 (0%)	0 (0%)	6 (20%)
Gingival bleeding				
A	30 (100%)	29 (96.7%)	30 (100%)	25 (83.3%)
B	0 (0%)	1 (3.3%)	0 (0%)	5 (16.7%)

C	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Secondary caries				
A	30 (100%)	30 (100%)	30 (100%)	16 (53.3%)
B	0 (0%)	0 (0%)	0 (0%)	14 (46.7%)

Indirect composite shell crowns didn't show any roughness of "surface texture" in 33.3% cases but slightly rough surfaces were seen in 66.7% of cases. While, direct composite restorations showed slightly rough surface in 36.7% and highly rough in 63.3% of cases at 6 months follow-up. Reason of staining, color changes and roughness may be linked to the finishing of restorations, oral hygiene of the patient and daily intake of food with staining ability such as tea, coffee, and cola which can also compromise the esthetics of restorative materials. Rough surfaces have greater ability to stain, so proper finishing of restoration is necessary which becomes difficult in young age children whereas, in indirect restorations finishing and polishing procedure is completed extra orally, minimizing the surface staining. [2,13] Indirect composite shell crowns showed "Marginal discolouration" in only 3.3% of cases whereas, direct composite restorations presented limited discolouration in 66.7% & evident discolouration in 23.3% of cases at 6 months. The reason behind these variations could be the marginal gap formation that may exist when the composite resin is placed on dentin or cementum. This gap predisposes the restorative margin to microleakage, further causing marginal discolouration.[14,15] There was no "post-operative sensitivity" seen in the patients with indirect composite restorations. Direct composite restorations showed mild hypersensitivity in 60% and intolerable sensitivity in 20% of cases at 6 months follow-up. Post-operative sensitivity in teeth may be seen due to the residual stress build-up occurred by the polymerization shrinkage and microleakage at the margins of the

restoration.[6,16] In Indirect composite shell crowns "Gingival bleeding" wasn't evident in any of the cases. Whereas, the direct composite restorations showed slight hyperemic gingiva in 16.7 % of cases at 6 months follow-up. The reason behind gingival bleeding may be the plaque accumulation, which is aggravated by the surface roughness of the material. Indirect composite shell crowns didn't show any sign of secondary caries whereas direct composite restorations presented caries in 46.7% of cases at 6 months follow up. Secondary caries can be seen due to plaque accumulation or polymerisation shrinkage leading to marginal leakage ultimately causing secondary caries. [61]

Conclusion

Composites, when used as a direct restorative material have certain demerits like post-operative sensitivity, lack of patient cooperation for longer procedures, compromising the success of the treatment, difficulty in restoring the normal anatomic forms and requiring multiple visits if many teeth are involved. Indirect composite shell crowns are a better alternative to direct composite restoration as the main negative factor of composite resin i.e polymerization shrinkage is reduced as the whole procedure is done extra- orally. Composite shell crowns proved to be much better in terms of retention, color match, marginal integrity, marginal discoloration, surface texture, surface staining, post-operative hypersensitivity, secondary caries & gingival bleeding when compared at 1 month, 3 month and 6 months. However, long-term data on the performance and longevity of composites as direct and indirect restorative materials in the primary dentition remains sparse.[18,8]

To our knowledge, there is no literature regarding the comparison between Indirect composite shell crowns and direct composite restorations. Therefore, further research with larger sample size and longer follow up periods are needed to support our findings.

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