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Original Research Article

Comparative Evaluation Clinical Outcome of Strip Crowns and Primary Anterior Zirconia Crowns in 3-5 Years Old Children

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Abstract

Objective: To evaluate and compare clinical outcome of strip crowns and preformed primary anterior zirconia crowns at one year follow up in 3-5 years old children.

Material and methods: Forty maxillary primary incisors were restored by either strip crown or zirconia crown. Permuted block randomization method was used for allocation of participants. Data was analyzed using Chi-Square test.

Results: Comparing the gingival health at one year from baseline within each group, there was decrease in the mean gingival health score in strip crowns (mean difference ¼ 0.03) and zirconia crowns (mean difference ¼ 0.60). Zirconia crowns showed significantly less gingival bleeding at the 3- and 6-months follow up periods ($p < 0.005$, $p < 0.001$; respectively),

Conclusion: Overall, zirconia crowns were found more successful than strip crowns for the rehabilitation of caries affected primary incisors. Based on our data we conclude that overtime teeth covered with zirconia crowns show better gingival health and less bleeding, plaque accumulation as well as less loss of material. On the other hand, zirconia can cause more loss of opposing tooth structure.

Keywords: strip crown, zirconia, dental caries

Introduction

Severe early childhood caries (S-ECC) is a progressive carious form in children, categorized in accordance to the number of affected teeth and the age of patient. The presence of smooth surface caries is considered to be an indication of S-ECC in patients below three years of age [1]. In children between three to five, S-ECC is defined as "one or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of greater than or equal to four (age three), greater than or equal to five(age four), or greater than or equal to six (age five) surfaces"[2].

Nowadays, children as well as their guardians are involved in the selection of the restoration for caries affected teeth, and aesthetic demand by children and acceptance for toothcoloured restorations

by guardians has been increased [3,4].Two most common anterior aesthetic full coronal restorations, the resin composite strip crowns and the preformed primary anterior zirconia crowns, are available [5].

For many years, Strip crowns had been considered as the most aesthetic option for the mutilated primary anterior teeth until the preformed pediatric zirconia crowns were introduced [6]. Strip crowns are highly technique sensitive, which require proper moisture control during bonding and the placement of the crowns [6].

More recently, zirconia aesthetic crowns for pediatric patients appeared in the market. Zirconia is a crystal-like dioxide of zirconium that possess a metal like mechanical properties and a tooth like color, and the ready to use zirconia crowns are available for primary teeth. Although there is high acceptance of zirconia crowns, the literature lacks solid proof for their pediatric clinical performance [7]. There are limited clinical studies that are currently ongoing, however until the outcomes of adequate number of prospective clinical trials with enough long-term follow-up periods is available evidence to ensure clinical success and durability of these crowns are leftover uncertain [8]. So, our study aimed to evaluate and compare the strip crowns and preformed primary anterior zirconia crowns at one year follow up in 3-5 years old children.

Material and methods:

The randomized controlled clinical trial design of this study in Department of Dentistry, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar followed the Consolidated Standards of Reporting Trials (CONSORT) guidelines [16]. The study was approved by the Research Ethics Committee of the College. Every child's parent/guardian explained and signed an informed consent form before the enrolment.

Participants:

The participants included in the study had good general health and with dmft of 3 (WHO Index, Federation Dentaire International, WHO, 2006) [17], mandibular primary incisors present, carious primary maxillary incisors with involvement of minimum two surfaces, out of which one must be palatal caries and at least 2/3 crown remains after caries removal require full coronal restoration in the primary incisor involving enamel or enamel and dentin only, managed by behavioral management techniques only and with firm tooth with adequate root support.

Randomization:

Randomization was done on children in place of individual tooth. Two individuals block size were included. Each block comprised of children who needed similar number of crowns. Hence, a child who needed crowns was only registered in the study when other child who required a same number of crowns was available.

Procedure:

After the crown size selection, local anesthesia and good isolation with rubber dam were achieved. Caries excavation was done and the cases with very deep lesions, resin modified GIC liner/base (Viterbond, 3M-ESPE Dental products, St.Paul, Minn®) was used for protection of pulp. The tooth preparation was done. Incisal edge was reduced using no. 330 carbide bur by approximately 1.5 mm and the interproximally contact opened. Both labial and palatal surface were prepared by a coarse tapered round diamond bur by 1e1.5 mm, further the preparation was smoothened and 1 mm sub gingival preparation was done a fine tapered round-end diamond bur. In both the groups, principles followed for the tooth preparation were similar.

Resin composite strip crown placement procedures: First the gingival margin of the strip crown was cut to get a good adaptation, then shade selection of the resin composite (3 M, Filtek™ Z250 Universal Restorative®) was done and celluloid crown form was filled. 37% phosphoric acid solution (3 M™ ESPE™ Etching Liquid®) was used for etching the tooth surfaces for 20 s, and then the light cure bonding adhesive (3 M, Scotchbond-UniversalAdhesive-Refill-Vial-41258®) was applied onto the etched surfaces. The strip crown then inserted and extra resin was swiped and polymerized with curing light, followed by celluloid form removal. Occlusal adjustments and finishing were done, if needed, using polishing discs (3 M ESPE, Sof-Lex® Polishing-Strip).

Pre-fabricated primary zirconia crown placement procedure: After a trial for the selection of the crown, labial and lingual borders adjustments were done only if needed, using high-speed fine diamond bur under water irrigation because excess heat may lead to micro-fractures in the zirconia. Final passive fit was checked and cemented with type II GIC (ShofuVersion 2 Glass Ionomer Restorative cement).

Results:

Table 1: Distribution of 20 teeth in each group at baseline

No. of teeth restored per child	No. of children in strip crowns group (Total ¼ 12 children)	No. of children in zirconia crowns group (Total ¼ 12 children)	Total crowns in strip crowns group (20 crowns)	Total crowns in zirconia crowns group (20 crowns)
1	**9**	**9**	9 (9×1)	9 (9×1)
2	**5**	**5**	10 (5×2)	10 (5×2)
3	**1**	**1**	3 (3×1)	3 (3×1)
4	**1**	**1**	2 (2×1)	2 (2×1)

Table 2: Baseline data of the teeth restored.

Primary maxillary incisors (Tooth number- FDI system)	Count (%)
Right lateral (52)	6 (15)
Right central (51)	11 (27.5)
Left central (61)	13 (32.5)
Left lateral (62)	8 (20)
Right lateral (52)	2 (2.5)

In our study, total 40 full coverage restorations were placed on primary maxillary incisors, out of which 29 were in central incisors and 11 in lateral incisors in 24 children (12 male, 12 female) (Table 2).

Table 3: Mean gingival health score of strip crowns group and zirconia crowns group at baseline & after one year.

Gingival health	Strip crowns group				Zirconia crowns group			
	Mean	Standard Deviation	Mean difference	Level of significance	Mean	Standard Deviation	Mean difference	Level of significance
Baseline	1.76	0.51	− 0.03	0.601	1.32	0.52	− 0.60	0.636
1 year	1.54	0.50	− 0.03		1.01	0.30	− 0.60	

Comparing the gingival health at one year from baseline within each group, there was decrease in the mean gingival health score in strip crowns (mean difference ¼ 0.03) and zirconia crowns (mean difference ¼ 0.60)

Table 4: Gingival health evaluation

Chi-square test	Zirconia crowns	Strip crowns	p- value
Gingival Health (assessed as bleeding on probing)			
At 3 months	17 (42.5%)	31 (77.5%)	0.005
At 6 months	0 (100.0%)	13 (32.5%)	<0.001
At 12 moths	0 (100%)	0 (100%)	N/A

Gingival health as measured by bleeding with probing is depicted in Table 3. It can be seen that at the 3-months follow-up significantly more teeth in the strip crown group were bleeding compared to the zirconia groups ($p < 0.005$). At the 6-months follow-up also more teeth in the strip crown group were bleeding ($p < 0.001$). However, at the last follow-up visit at 12 months both groups showed no bleeding.

Table 5: Gingival health, Plaque Accumulation, Teeth wear, Color match and Restoration failure results at the one year follow up.

Outcome measures	Grades	Strip crowns group		Zirconia crowns group	
		n	%	n	%
Gingival health	0	2	10	4	20
	1	10	50	14	70
	2	6	30	0	0
Plaque Accumulation	0	1	5	1	5
	1	11	55	15	75
	2	6	30	0	0
Teeth wear	0	17	85	11	55
	1	3	15	3	15
Color match	0	8	40	10	50
	1	2	10	6	30
	2	7	35	20	100
Restoration failure	0	13	65	0	0
	1	2	10	0	0
	2	3	15	0	0
	3	2	10	4	20

Comparing the gingival health at one year from baseline within each group, there was decrease in the mean gingival health score in strip crowns (mean difference ¼ 0.05) and zirconia crowns (mean difference ¼ 0.61) (Table 4). Thus, the improvement in the gingival health was found to be more in the zirconia crowns group than strip crowns group over a period of one year.

Discussion:

In evaluation of gingival health, this study shows better gingival response in zirconia crowns which can be explained by the fact that zirconia is biocompatible and possesses a polished and smooth surface leading to less plaque accumulation and hence less gingival irritation [9-11]. Another recent retrospective study by Holsinger et al. [12] assessing 57 primary anterior teeth treated with zirconia showed

significant healthy gingiva in relation to these crowns.

According to Hackmyer and Donly (2010), preparation of the tooth and its finishing are aspects that may influence the gingival health of the crowns [13]. The extent of gingival inflammation is closely related to the position of the crown margin and location of margins coronal to the free margin of gingiva are desirable [14].Related finding from a retrospective analysis of Kupietzky et al. (2003) included 112 resin composite strip crowns showed that 43% of the restored teeth had gingival inflammation all around the crowns [15]. In this study, in zirconia crowns group, also significant decrease in the mean gingival health from baseline was observed. Zirconia is extremely biocompatible when used as a tooth material and has a smooth and polished surface contributing to less plaque formation and therefore less gingival irritation.

Johnsen et al. [18] stated that patients diagnosed with ECC had higher tendency to develop recurrent caries after treatment. Another study done in 2000 by Almeida et al., found that young patients having ECC who were managed under general anesthesia to receive resin composite strip crown restorations exhibited significantly higher caries rates versus the control group who were caries free originally.

The greater restoration failure of the composite strip crowns in this study may be explained by the fact that treatment was done under nitrous oxide sedation and physical restrains to manage the children behavior. Eidelman et al. [19] reported that improved results for strip crowns were found in cases done under general anesthesia than those done under sedation.

A retrospective study done in 2003 by Kupietzky et al. [9] included 112 composite resin strip crowns found that 43% of the restored teeth showed gingival irritations around the crowns. These findings could be explained as the gingival health of teeth restored with composite strip crowns can be affected by tooth preparation and finishing [13, 20]. Unfortunately, upon reviewing the literature there were no sufficient data with regards to gingival response related to primary teeth restored by composite resin strip crowns. Padbury in 2003 [21], suggested placement of the strip crown margin supra gingivally to reduce gingival inflammation. Despite this recommendation being clinically logical, it is considered not applicable in most cases as it will result in poor aesthetics and appearance.[22]

Conclusion:

Based on our data we can conclude that overtime teeth covered with zirconia crowns show better gingival health and less bleeding, plaque accumulation as well as less loss of material. On the other hand, zirconia can cause more loss of opposing tooth structure.

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