ORIGINAL RESEARCH

Clinical comparison of three tooth-colored full-coronal restorations in primary maxillary incisors

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Abstract

Background: To study the comparison of three tooth colored full coronal restorations in primary maxillary incisors.

Materials & Methods: A sample of 30 deciduous maxillary incisors with severe decay requiring pulpectomy was randomly chosen. Data was collected, and intergroup comparisons were analyzed using the nonparametric Chi-square test. The results were analysed using SPSS software.

Results: The zirconia crowns showed no marginal discoloration whereas at 9 month interval, the strip crowns and luxa crowns showed high discoloration in teeth as 30% , 20% respectively.

Conclusion: Zirconia and Luxa crowns emerged as the most aesthetically pleasing options for primary anterior teeth.

Keywords: luxa, zirconia, discoloration.

Introduction

Orodental trauma and early childhood caries often result in loss of the clinical crown structure in primary maxillary anteriors.[1] Early loss of these teeth has deleterious effects, viz. space loss, speech problems, tongue thrusting habit, and psychological effects. To restore such severely damaged teeth with pulpal involvement is always a challenging task for the dentist. With the advancement of dental materials and techniques in conservative dentistry, a multitude of esthetic treatment modalities has been introduced for the management of dental caries and trauma in the primary dentition. [2]Esthetic treatment of severely decayed primary teeth is one of the greatest challenges for pediatric dentists. The use of esthetic restoration has become an important aspect of pediatric dentistry. Over the years, numerous techniques for restoring primary teeth have been attempted. Some techniques used for restoring complete crown coverage include polycarbonate crowns, acid etched crown, stainless steel crown (SSC), open–faced SSC with veneer placed on chair side, and commercially available preveneered SSC. The effective and efficient usage of these techniques is complicated due to technical, functional, or esthetic hurdles. [3] Prefabricated zirconia crown (EZ-Pedo, Loomis, CA, USA; NuSmile ZR Primary Crowns, Houston, TX, USA; Hu-Friedy Mfg. Co., LLC,

Chicago, IL, USA; Kinder Krowns, St. Louis Park, MN, USA; Cheng Crown, Exton, PA, USA; Zirkiz-Hass Corp. Korea) is an exceptionally strong ceramic crown and offers more esthetic and biocompatible full coverage for primary incisors and molars. They are anatomically contoured, metal free, completely bio-inert, and resistant to decay. Zirconia is well-known polymorph that occurs in three different forms: monoclinic (M), tetragonal (T), and cubic (C). Pure zirconia is monoclinic at room temperature and remains stable up to 1170°C. Above this temperature, it transforms into tetragonal and then into cubic phase at 2370°C. During cooling, the tetragonal phase transforms back to monoclinic in a temperature ranging from 100°C to 1070°C. The phase transformation taking place while cooling is associated with a volume expansion of approximately 3%–4%. [4]Zirconia crowns were introduced in 2008 as an alternative restorative treatment. Zirconia has an extensive history of being an excellent biocompatible material.[5] One of the main advantages of zirconia crowns are their esthetically excellent appearance alongside their durability.[6,7]In addition, zirconia crowns have shown less plaque accumulation in comparison to other materials due to their highly polished surface.[8] However, there are some clinical limitations and disadvantages for zirconia crowns as they require aggressive tooth reduction and are expensive.[6,9]Zirconia as a material demonstrated excellent mechanical properties. Its flexural strength could reach up to 1200 MPa, and its toughness may reach up to 10 MPa. When compared to porcelain-fused-to-metal crowns, zirconia crowns reported a higher strength which could reach to three times higher. [10] Currently known as the "strip crown" technique, this method produces a direct, mouth-formed, full-coverage restoration. A strip crown is essentially a crown form filled with a composite that is bonded onto the tooth. [11] Since these composite crowns provide superior esthetics than other forms of anterior coronal coverage restorative options and are easy to repair in case of subsequent chip or fracture, they are extremely popular for restoring primary anterior teeth. It remains the first choice among 46% of pediatric dentists for full coronal restoration of primary incisors. [12] Hence, this study was conducted to the comparison of three tooth colored full coronal restorations in primary maxillary incisors.

Materials & Methods

A sample of 30 deciduous maxillary incisors with severe decay requiring pulpectomy was randomly chosen and divided into three groups of 10 each as follows:

Group I: Resin composite strip crowns

Group II: Prefabricated primary zirconia crowns

Group III: Luxa crown

All of the full-coronal restorations were assessed at 3, 6, and 9 months using the modified USPHS criteria. Data was collected, and intergroup comparisons were analyzed using the nonparametric Chi-square test. The results were analysed using SPSS software.

Results

In the study, a total of 30 deciduous crowns were examined, and gingival health was assessed based on bleeding during probing. The results indicate that at the 3-month follow-up, there was a statistically significant increase in bleeding in the strip crown group compared to the zirconia group. Similarly, at the 6-month follow-up, a higher number of teeth in the strip crown group exhibited bleeding. However, at the final follow-up visit after 9 months, all three groups showed no signs of bleeding.

Table 1: Gingival health (bleeding on probing)

Gingival health (bleeding on probing)	Zirconia crown	Strip crown	Luxa crown
At 3 months	3 (30%)	4 (40%)	3 (30%)
6 months	0 (100%)	3 (30%)	0 (100%)
9 months	0 (100%)	0 (100%)	0 (100%)

The zirconia crowns showed no marginal discoloration whereas at 9 month interval, the strip crowns and luxa crowns showed high discoloration in teeth as 30%, 20% respectively.

Table 3: marginal discoloration

Groups	3 months	6 months		9 months		
	No discoloration	No discoloration	Slight discoloration	No discoloration	Slight discoloration	High discoloration
Strip	10 (100%)	7 (70%)	3 (30%)	6 (60%)	1 (10%)	3 (30%)

crown						
Zirconia	10 (100%)	10 (100%)	0	10 (100%)	0	0
Luxa crowns	10 (100%)	9 (90%)	1 (10%)	8 (80%)	0	2 (20%)

Discussion

Dental caries continues to be the most prevalent chronic disease of childhood. Children experiencing caries as infants or toddlers are at high risk for subsequent caries in both the primary and permanent dentition. The teeth most often involved are the maxillary central and lateral incisors and the maxillary and mandibular primary first molars, while the mandibular primary incisors are relatively unaffected. [13]A higher success rate was observed with zirconia crowns followed by luxa crowns and resin strip crowns. This can be explained by the fact that zirconia has a unique ability to resist crack propagation by being able to transform from one crystalline phase to another, and the resultant volume increase stops the crack and prevents it from propagating.[14] Luxa crown is reliably hard and resistant, with an exceptional fracture toughness of >2 MPa ensuring stable restorations. A crown fabricated with temporization material is not dependent on the direct bonding of the composite to the tooth material and thus may have better retention properties even in cases where remaining tooth structure is less. This might be the reason for fewer cases of anatomical distortion in the luxa crowns group. Al-Eheideb and Herman [15]reported a 70% success rate for 23 teeth with composite resin strip crowns followed between 6 and 27 months. Overall, from the abovementioned retrospective chart studies, the success rate for composite resin strip crowns ranges from 49 to 100% with follow-up periods from 6 to 27 months. Hence, this study was conducted to the comparison of three tooth colored full coronal restorations in primary maxillary incisors. In the present study, a total of 30 deciduous crowns were examined, and gingival health was assessed based on bleeding during probing. The results indicate that at the 3-month follow-up, there was a statistically significant increase in bleeding in the strip crown group compared to the zirconia group. Similarly, at the 6-month follow-up, a higher number of teeth in the strip crown group exhibited bleeding. However, at the final follow-up visit after 9 months, all three groups showed no signs of bleeding. A study by Nischal M et al, total 45 primary maxillary incisors were randomly selected and divided into three groups of 15 each: group I—strip crowns (Pedoform strip crowns, 3M, United States), group II—zirconia crown (kids-e-crown, India), and group III—luxa crown (DMG, Germany). All the full-coronal restorations were evaluated at 3, 6, and 9 months. Statistically nonsignificant difference was observed for most of the parameters except marginal integrity and secondary caries. Resin strip crowns showed maximum cases with distorted marginal integrity and secondary caries.Zirconia crown performed best among the three full-coronal restorations. Luxa crown performed similar to zirconia crown. It can be used as an alternative economical esthetic full-coronal restoration for primary maxillary anterior incisors.[16] In the present study, zirconia crowns showed no marginal discoloration whereas at 9 month interval, the strip crowns and luxa crowns showedhigh discoloration in teeth as 30% , 20% respectively. Another study by Gill A et al, a total of 135 teeth in 49 two- to four-year-olds with early childhood caries were randomly assigned to crown groups. Demographic and tooth-related variables at baseline and 12 months were assessed by calibrated examiners. Children were, on average, 3.4 years old, female (55 percent), and had a mean decayed, missing, and filled primary teeth (dmft) index score of 10.6. At 12 months, crown retention was significantly lower for CSCs versus PVSSCs or ZCs (79 percent, 100 percent, and 95 percent, respectively; P=0.002). Partial and complete loss of material was significantly higher in CSCs than PVSSCs or ZCs (29 percent, 11 percent, and zero percent, respectively; P<0.001). CSCs presented with increased marginal discrepancies and color change (P<0.001). Most parents were very satisfied (87 percent); those dissatisfied were concerned with the color of CSCs and PVSSCs (63 percent versus 37 percent; P=0.005). Composite strip crowns showed significantly reduced clinical success in retention, durability, marginal adaptation, and color compared to preveneered stainless steel crowns or zirconia crowns. Parental esthetic satisfaction was highest for NuSmile ZCs.[17] Ram D et al, records for 200 out of 387 children, aged 22-48 months, treated in a private paediatric dental practice and who presented for follow-up after at least 24 months were included in the study. More than 80% of the restorations were judged to be successful at the final follow-up examination. Only the number of carious surfaces of the tooth at baseline influenced the treatment

outcome. The failure rate was higher in central incisors with four affected surfaces (P = 0.005), and in lateral incisors with four carious surfaces (P = 0.0003), than in those presenting one or two carious surfaces in both central and lateral incisors (P = 0.002). The high success rate of resin-bonded composite strip crowns with a 2-year follow-up seen in this study suggests that this treatment modality is an aesthetic and satisfactory means of restoring carious primary incisors in young children. The retention rate is lower in teeth with decay in three or more surfaces, particularly in children with a high caries risk.[18] Grewal N et al, in vivo study aimed to assess the clinical, radiographic, and photographic performance of 66 composite strip crown restorations on primary anterior teeth for up to 15 months and compare the outcome based on the extent and surface area of tooth structure available.The teeth were thus grouped into three categories: group I with crown structure involvement up to the incisal one-third, group II with involvement up to the middle of the middle third, and group III with involvement up to the cervical one-third.Group III showed the highest mean scores at different time intervals and also the highest failure rate (52.38%), followed by group II (12%) and group I (5%). The overall retention rate observed for the strip crowns was 77.28% at the end of 15 months.Strip crowns should be considered for teeth that offer a minimum of half to two-thirds of the healthy tooth structure remaining. Further, longitudinal studies are required to add to the results of the final outcome of these restorations.[19] In 2008, zirconia crowns were introduced to pediatric dentistry as an alternative restorative option. Zirconia is a crystalline dioxide of zirconium that has mechanical properties similar to those of metals and its color is similar to that of teeth. [20] Advantages of the pediatric zirconia crowns include excellent esthetics, resistance to fracture, biocompatibility, reduced plaque accumulation, color stability, and potentially less technique sensitivity. Zirconia crowns require extensive tooth reduction due to their inflexibility and thickness as compared to resin strip crowns, in order to provide passive fit of crown to the tooth. [21] One of the important parameters to assess in a crown is its effect on gingival and periodontal health. An ideal material for a crown would have no plaque accumulation on the surface. Different materials used for crowns may have different properties leading to different plaque accumulation amounts. Other factors such as types of cements also may affect periodontal health. In this review, we found that most of the included studies found that zirconia crowns had significantly lower levels of plaque accumulation, especially when compared to resin-coated crowns.[22] This could be due to the surface properties of zirconia including its superior hardness. This makes them resistant to scratches and they may have a shiny, smooth polished surface. Another reason could be the low surface energy of zirconia crowns which may lead to low plaque and bacterial adhesion.Although,if the plaque accumulated on the surfaces, it was reported to be thinner than the plaque on stainless steel crowns. [23]

Conclusion

Zirconia and Luxa crowns emerged as the most aesthetically pleasing options for primary anterior teeth. I with crown structure involvement up to the incisal one-third, group II with involvement up to

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