

Evaluation of Clinical Success, Parental and Child Satisfaction of Stainless Steel Crowns and Zirconia Crowns in Primary Molars

Mebin George Mathew¹, Korishettar Basavaraj Roopa², Ashu Jagdish Soni³,
Md Muzammil Khan⁴, Afreen Kauser⁵

¹Department of Pedodontics and Preventive Dentistry, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, ²Department of Pedodontics and Preventive Dentistry, College of Dental Sciences, Davangere, Karnataka, ³Department of Pediatric Dentistry, Dr. Ashu's Dental Clinic, Vadodara, ⁴Department of Pedodontics and Preventive Dentistry, Bapuji Dental College and Hospital, Davangere, ⁵Department of Orthodontics, College of Dental Sciences, Davangere, Karnataka, India

ABSTRACT

Introduction: Stainless steel crowns are the most successful restoration for multisurface carious lesions in primary molars. The esthetics has been poorly accepted which led to the introduction of zirconia crowns. **Objectives:** The aim of the study was to evaluate and compare the clinical success, parental satisfaction, and child satisfaction of stainless steel and zirconia crowns in primary molars. **Methods:** Thirty healthy patients aged 6–8 years bilateral pulp therapy treated primary molars were randomly divided into two equal groups of stainless steel and zirconia crowns. Tooth preparation was done according to the manufacturers' recommendations depending upon the crown each patient would receive. All crowns were cemented with Type I GIC luting cement. Patients were evaluated at 6 months, 12 months, 18 months, 24 months, and 36 months. **Results:** Clinical success for stainless steel crowns and zirconia crowns were similar with no statistical difference between them. Zirconia accumulated less plaque than stainless steel crowns ($P = 0.047$). The parental satisfaction was high with both crowns. A highly significant statistical difference existed between the 2 groups in relation to the acceptance of color ($P < 0.001$) and child's satisfaction ($P < 0.001$). **Conclusion:** Zirconia can be considered as an esthetic alternative in the future.

Keywords: Clinical success, primary molars, stainless steel crowns, zirconia

Introduction

The treatment of carious primary molars has always been a challenge to the clinician. Various materials have been used over the years such as amalgam, composites, and stainless steel crowns (SSC) to restore such teeth with varying success rates.^[1]

Address for correspondence: Dr. Mebin George Mathew, Senior Lecturer, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai - 600 077, Tamil Nadu, India.

E-mail: mebingmathew@gmail.com

Received: 13-11-2019

Revised: 23-01-2020

Accepted: 11-02-2020

Published: 26-03-2020

SSCs were introduced into pediatric dentistry by Rocky Mountain Company in 1947, first described by Engel and then popularized by Humphrey in 1950. Over the past 70 years, SSCs have been placed on primary and permanent molars to restore teeth with multisurface caries, in patients with high caries risk, after pulp therapy and restore teeth with developmental defects and teeth that are brittle and prone to fracture. For more than half a century, SSCs have outperformed other materials like amalgam and composite in terms of durability and longevity. In the past, no restorative material has been able to offer the advantages of low cost, durability, and reliability when interim full-coronal coverage is required.^[1,2]

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Mathew MG, Roopa KB, Soni AJ, Khan MM, Kauser A. Evaluation of clinical success, parental and child satisfaction of stainless steel crowns and zirconia crowns in primary molars. J Family Med Prim Care 2020;9:1418-23.

Access this article online

Quick Response Code:



Website:
www.jfmipc.com

DOI:
10.4103/jfmipc.jfmipc_1006_19

In spite of these benefits, the notable pitfall to the SSC is esthetics, due to the metallic appearance which has been poorly received by patients, parents, and practitioners alike.^[1] The increasing demand from parents for esthetic restorations led to the introduction of veneered SSC. These crowns consisted of resin or ceramic facing which was fused to the metal SSC. Although the esthetics was highly accepted by parents, these crowns had drawbacks such as being bulky with poor gingival health and the possible fracture of the veneer which made it appear unesthetic.^[3] Hence, practitioners searched for a crown which would combine the durability and longevity of the SSC and still be esthetically pleasing.

Zirconia crowns have been used for over two decades in permanent dentition with high acceptability due to its esthetics, high biocompatibility, and excellent mechanical properties. In 2008, EZ Pedo (formerly EZ Pedo, now EZ crown by Sprig) introduced the first commercially available pediatric zirconia crown. Since then various companies have introduced zirconia crowns as a new full-coverage restoration which combines excellent esthetics with superior mechanical properties.^[4] In spite of increasing parental demands, a recent review of the literature revealed that no studies have been published with the clinical success and parental satisfaction of zirconia crowns in primary molars.^[5]

This study was designed to explore the clinical success and parental satisfaction of the newly introduced zirconia crowns against the time tested SSC in primary molars.

Methods

Ethical approval was obtained from the Institutional Review Board of the College of Dental Sciences, Davangere (CODS/1977/2015-2016). This prospective randomized controlled trial was designed as a split-mouth study. The study population consisted of patients who visited the Department of Pedodontics and Preventive Dentistry, College of Dental Sciences, Davangere.

The sample size was calculated on a two-sample comparison of proportions of clinical success: one group with Zirconia and one control group (SSC) using power analysis. The inclusion of 25 crowns in each group would be sufficient to detect a statistically significant difference between interventions at a significance level of 5% with a power of 80. To compensate for dropouts, 5 additional patients were included in each group leading to a total of 30.

Thirty patients who fulfilled the specified inclusion criteria were asked to enroll in the study and informed consent was obtained from the parents. The inclusion criteria included healthy patients aged 6–8 years who had bilateral pulp therapy treated second primary molars. The exclusion criteria included patients with American Society of Anesthesiologists physical status \geq III, patients in whom endocarditis prophylaxis was required, tooth in

which exfoliation was imminent, tooth with internal resorption, and tooth with acute infection.

The patients with bilateral pulp therapy treated teeth were randomly divided into two groups by coin toss in which group I consisted of 30 primary second molars which would receive SSC (3M ESPE, Minneapolis, USA) and group II consisted of 30 primary second molars which would receive zirconia crowns (Kinder Krown, Minneapolis USA).

The pulp therapy treated teeth considered for study were radiographed preoperatively and only those which fulfilled the selection criteria were included in the study. All crowns were placed by a single operator and a new set of burs were used for each crown. The crown selection was determined by a coin toss.

Local anesthesia was administered and a rubber dam was placed. The manufacturer's guidelines were followed to develop a step by step customized tooth preparation to ensure all crowns were fitted in a similar manner. All crowns were luted using type I Glass Ionomer Cement (GC Corp, Japan). The type and size of crown chosen as well any adaption methods done for each molar were recorded. Patients were given postoperative instructions and scoring upon placement was completed. Participants were recalled for follow up at 6 months, 12 months, 18 months, 24 months, and 36 months. Variables for the clinical outcome were scored using a customized scoring table which was modified from similar previous studies^[6,7] [Table 1].

Parental satisfaction was assessed on a Likert type scale from 1 to 5 using the seven following variables: shade, size, shape, retention, durability, overall satisfaction, and child's satisfaction. The questionnaire was administered to the parent in the absence of the dentist by the receptionist. Parents were asked to return the questionnaire on completion to the receptionist. Scores 1

Table 1: Clinical success criteria

Criteria	Score
Crown retention	0=present
	1=absent
Customized modified gingival index ^[7]	0=healthy
	1=mild inflammation involving some papilla
	2=moderate inflammation involving entire papilla
	3=severe inflammation
Plaque index ^[8]	0=no staining
	1=film at gingival margin
	2=moderate accumulation
	3=abundance of plaque
Stain resistance	0=no staining
	1=minor staining
	2=noticeable staining
Gingival marginal extension	0=subgingival
	1=supragingival
Occlusion	0=contact visible
	1=no contact
Proximal Contact	0=good contact
	1=poor/no contact

and 2 were combined as satisfied, score 3 as neutral response and scores 4 and 5 were combined as dissatisfied. Scoring of clinical success, parental and child satisfaction were taken at 6 months, 12 months, 18 months, 24 months, and 36 months. The values obtained were subjected to statistical analysis with one way ANOVA and *Post Hoc* T-tests using SPSS version 21.0 (SPSS Inc. Chicago, Illinois, USA).

Results

The results of clinical success and parental satisfaction are summarized in Tables 2 and 3, respectively. The clinical success of both SSC and zirconia crowns was 100% (criteria scoring = 0) throughout the study period in terms of crown retention, modified gingival index, stain resistance, gingival marginal extension, occlusion, and proximal contact at placement. Both crowns varied only in plaque index. 6 SSCs (20%) showed the formation of a plaque film at 12 and 18 months, whereas, at 24 months, only 4 SSC (13%) showed the presence of a film. By 36 months, none of the SSCs (100%) showed plaque accumulation. Zirconia crowns (100%) did not show any plaque accumulation throughout the study period. A significant statistical difference was present between both groups with *P* value of 0.047 at the end of 36 months.

Parental satisfaction for both groups was equal in terms of shape, size, retention, durability, and overall satisfaction. Only 12 parents (40%) were satisfied with the color of SSC, whereas 30 parents (100%) were satisfied with the color of zirconia. A significant statistical difference (*P* < 0.001) was seen between the groups. The parental view did not change during the study

period. All 30 patients (100%) were satisfied with the zirconia crowns, while only 16 of the patients (53.3%) were satisfied with SSC. A significant statistical difference (*P* < 0.001) was present between both groups.

Discussion

Parental demand for esthetic restorations for their children is increasing.^[4] However, very few clinical studies have been done with this esthetic alternative and none have been done on primary molars till date.^[4,5]

All crowns showed 100% crown retention despite differences in crown tooth preparation. Zirconia requires more aggressive tooth preparation compared to SSC, including subgingival reduction.^[8] While SSC requires a snap-fit,^[1,2] zirconia crowns required passive fit per the manufacturer's recommendation.^[9] Despite these differences, there was equal crown retention for both groups. Retention of zirconia could be due to the unique internal retention threads present within crowns manufactured by Kinder Krowns which increases the surface area for cementation despite the greater tooth reduction. Seminaro *et al.*^[10] found the survival rate to be 76% for zirconia on primary incisors after 36 months follow up for children done under anesthesia which is a lower survival rate compared to our study.

The results of this study showed that the clinical success of SSC and zirconia varied only in plaque index. None of the zirconia crowns showed the presence of plaque throughout the study period, whereas 6 SSC showed the presence of a plaque film at the gingival margin at 12 months and 18 months, which

Table 2: Comparison of parental satisfaction of group I (SSC) and group II (zirconia) at 6 months, 12 months, 18 months, 24 months, and 36 months

Clinical success (in %)	GROUP 1					GROUP 2				
	6 m	12 m	18 m	24 m	36 m	6 m	12 m	18 m	24 m	36 m
Crown retention	100	100	100	100	100	100	100	100	100	100
Modified gingival index	100	100	100	100	100	100	100	100	100	100
Plaque index	100	80	80	87	100	100	100	100	100	100
Stain resistance	100	100	100	100	100	100	100	100	100	100
Gingival Marginal extension	100	100	100	100	100	100	100	100	100	100
Occlusion	100	100	100	100	100	100	100	100	100	100
Proximal contact	100	100	100	100	100	100	100	100	100	100

Table 3: Comparison of parental satisfaction of group I (SSC) and group II (zirconia) at 6 months, 12 months, 18 months, 24 months, and 36 months

Parental satisfaction (in %)	GROUP 1					GROUP 2				
	6 m	12 m	18 m	24 m	36 m	6 m	12 m	18 m	24 m	36 m
Color	40	40	40	40	40	100	100	100	100	100
Shape	100	100	100	100	100	100	100	100	100	100
Size	100	100	100	100	100	100	100	100	100	100
Retention	100	100	100	100	100	100	100	100	100	100
Durability	100	100	100	100	100	100	100	100	100	100
Overall satisfaction	100	100	100	100	100	100	100	100	100	100
Childs satisfaction	53.3	53.3	53.3	53.3	53.3	100	100	100	100	100

reduced to 4 patients at 24 months follow up. By 36 months none of the patients, who had received SSC showed any signs of plaque. The difference between the SSC and zirconia can be attributed to the irregularities of polymeric surfaces of SSC which promote bacterial adhesion and biofilm deposition,^[11,12] whereas the ultra-smooth and glazed surface of zirconia did not favor bacterial adhesion and biofilm deposition.^[13] The frequent manipulation of the SSC through trimming and crimping would have led to surface irregularities. The difference within the SSC group can be attributed to the personal oral hygiene practices of each patient.^[12] A reduction in plaque index scores could be due to repeated reinforcement of oral hygiene instructions at all recall visits. The results are similar to that of Taran and Kaya^[14] who found that zirconia accumulated less plaque than SSC.

The customized modified gingival index score was zero for all patients of both groups which meant that the gingiva was healthy for all patients. Seale^[1] and Randall^[1] have stressed that only improperly seated SSC present with gingivitis. The present study shows that none of the patients who received SSC and zirconia crowns had any issues with gingival health. This could be due to the fact that all crowns were seated properly and patients maintained proper oral hygiene throughout the study period.

Both SSC and zirconia crowns were stain-resistant. The main reason for stains to occur on a newly introduced restoration is the presence of micro porosities.^[15] The polished surface and lustrous appearance of SSC do not allow the crowns to stain.^[1] Zirconia crowns have an ultra-smooth surface with an additional layer of glaze which prevents the occurrence of porosities on the surface.^[13] Hence, both crowns did not show any stain. To the best of our knowledge, there are no studies which have evaluated the staining of SSC or zirconia *in vivo*.

The gingival marginal extension score was 100% for all of the crowns of both groups throughout the study, i.e. crown margins remained subgingival for all crowns. Both SSC and zirconia crowns had the same margin thickness which is 0.2 mm. A subgingival extension of one mm is optimal for the retention of SSC.^[1,3] SSC were placed from lingual side to buccal, allowing the crown to slide over the buccal bulge and give a snap-fit with the crown margin seated subgingivally.^[3] Crimping allows the crown to have an additional benefit of mechanical retention, thus allowing the marginal extension to remain subgingival. Zirconia crowns, however, require subgingival reduction of 2 mm with the removal of the buccal bulge. Zirconia crowns used in the present study derive their retention from internal threads which increase the surface area and create a “cement anchor” which allows the crown to remain firm.^[9]

It is recommended that functional contact relationships should be restored following restorative treatment. The placement of crown restoration should maintain the morphology and function of tooth.^[1,3] All crowns from both SSC and zirconia showed 100% maintenance of occlusion during the entire study period. In our study, all crowns were cemented only after proper occlusion was

achieved, compared to the preoperative occlusion. All crowns were again rechecked after cementation to confirm the occlusion.

The results of the present study showed that all 60 crowns maintained 100% proximal contact with the adjacent tooth. In the present study, the smallest crown which would restore the pre-existing proximal contact was chosen. A major difference between is that zirconia crowns cannot be adjusted, whereas SSC could be adjusted. All crowns maintained the same alignment with none of the adjacent teeth being lost during the course of study.

Current efforts to develop new dental materials and treatment techniques reflect a high level of interest in esthetic dentistry among the dental profession and general public.^[4] Parents play a major role in decision-making, which was previously the individual opinion of the dentist. Clinical decision-making has become a social process that includes the dentist, patient, parents, and occasionally other family members. Dentists should consider parental attitudes, beliefs, and values regarding esthetics and function when presenting treatment options. Since dentist's and parents' opinions of optimum treatment can vary, understanding these differences helps to improve communication and aid in formulating a parent-sensitive treatment plan.^[4,16,17]

Society is becoming more aware about esthetics and parents are insisting on more esthetically pleasing restorations.^[5] This is reflected in our study as only 40% parents were satisfied with the color of SSC compared to 100% in zirconia. Zirconia has esthetics that matches the color of the natural tooth which allowed parents to be naturally satisfied with the crown. Only one study has taken into consideration the parental acceptance of esthetic crowns in primary molars, in which 93% of parents were satisfied with the esthetics of the veneered crown.^[15] This result is similar to our study, wherein all parents were satisfied with the color. However, the dentist should understand that parent's standards and demands may not match his or her expectations of what the final esthetic outcome may be. Parental view of the child's restored teeth may vary with the clinician's point of view. The preoperative appearance of their child's tooth might be taken into deliberation by parents when evaluating the clinician's work. Also, the thought that extraction may be the only treatment might have led some parents to be satisfied with the esthetics of SSC as the tooth was saved instead of being extracted.^[18]

The dentist may keep the ease of treatment and esthetics as most important, while to the parent, durability and cost of treatment may be of most concern. Therefore, even if the crowns are not as esthetically acceptable to the selective eye of the clinician, the parent might express high satisfaction because the teeth were able to be retained and restored, rather than being extracted.^[16,18] This is reflected in our study in terms of the 100% acceptance of the size and shape of SSC despite the fact that 40% of the parents were not satisfied with the color of SSC. Zirconia crowns showed 100% parental satisfaction. Our results are similar to that of Leith and Connell (93%)^[15]

who stated that parental acceptance of veneered posterior crowns was high despite the fact that many crowns showed fracture of the veneer. All parents in the zirconia group were satisfied with size and shape.

When parents expressed their overall satisfaction, they often include many dimensions of treatment that the clinical evaluation may not include. Parents may critically construct their experience with their child's treatment in different distinct ways. Parents might have evaluated psychosocial outcomes, clinical outcomes, and the treatment process. This may explain the results of this study in which parents may have been dissatisfied with the color of their child's restoration, yet the same parents rated overall satisfaction as being excellent.^[18]

The questionnaire was completed by the parent in the absence of the dentist. This was done to avoid the possibility of parents feeling pressured to produce more positive ratings in the presence of the dentist. The results suggest that parents were not coerced into giving higher ratings.

An interesting finding in this study was that only 53.3% of the children were satisfied with SSC, whereas all children were satisfied with zirconia crowns. This may be due to the fact that most children disliked the metallic appearance of SSC while zirconia crowns gave a natural appearance to the restored tooth. Few patients stated that the presence of SSC was a matter of ridicule among friends when asked why they disliked SSC. This also shows that children themselves have high esthetic expectations for the treatment of posterior teeth. The results are similar to those of Peretz and Ram.^[19] and Fishman *et al.*,^[20] both of whom found that children preferred tooth-colored restorations. This could be due to the increasing influence of media, television, and exposure to a concept of "ideal beauty" from a very young age. The findings of our study show that even young children were able to appreciate and give an opinion about dental esthetics which is often in consensus with their parents' view.

In the recent past, there have been several articles suggesting that the zirconia crowns may be a strong and esthetically superior restoration for carious primary teeth.^[5,20-24] The results of our study seem to suggest that, as more esthetic options become available, parents and children will have higher esthetic expectations for the treatment of posterior primary teeth. The strength of this study is that no patients were lost in follow-up during 36 months as parents were reminded in person about follow up and messages were sent as a reminder on the day of appointment. None the less, there were some limitations to the present study that were difficult to overcome, most significant being small sample size. However, all patients are being followed till the exfoliation of their respective crowns. Since our study is the first of its kind with a 3-year follow-up, clinical studies with regular follow-up for a longer period will prove whether zirconia will be as successful as SSC for primary molars in the future.

Conclusions

Based on the findings of this study, the following conclusions were drawn:

1. SSC and zirconia were both equally 100% clinically successful
2. SSCs were more likely to have minimal plaque accumulation compared to zirconia crowns.
3. Both SSC and zirconia crowns had high parental satisfaction.
4. Both parents and child patients were more satisfied with the color of zirconia crowns compared to SSC.
5. Posterior zirconia crowns can be considered a clinically acceptable, esthetic alternative to SSC in primary molars after 3 years of service.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Randall RC. Preformed metal crowns for primary and permanent molar teeth: Review of the literature. *Pediatr Dent* 2002;24:489-500.
2. Seale NS. The use of stainless steel crowns. *Pediatr Dent* 2001;24:501-5.
3. Ram D, Fuks AB, Eidelman E. Long-term clinical performance of esthetic primary molar crowns. *Pediatr Dent* 2003;25:582-4.
4. Holsinger DM, Wells MH, Scarbecz M, Donaldson M. Clinical evaluation and parental satisfaction with pediatric zirconia anterior crowns. *Pediatric Dent* 2016;38:192-7.
5. Seale NS, Randall R. The use of stainless steel crowns: A systematic literature review. *Pediatr Dent* 2015;37:145-60.
6. Lobene RR, Weatherford T, Ross NM, Lamm RA, Menaker L. A modified gingival index for use in clinical trials. *Clin Prev Dent* 1986;8:3-6.
7. Loe H. The Gingival index, the Plaque index and the retention index systems. *J Periodontol* 1967;38:610-6.
8. Clark L, Wells MH, Harris EF, Lou J. Comparison of amount of primary tooth reduction required for anterior and posterior zirconia and stainless steel crowns. *Pediatr Dent* 2016;38:42-6.
9. Kinder Crown. Posterior preparation and seating guide. Available from: <http://www.kindercrowns.com/wpcontent/uploads/2014/12/Posterior-Prep Guide.pdf>. [Last accessed on 2015 Nov 11].
10. Seminario AL, Garcia M, Spiekerman C, Rajanbabu P, Donly KJ, Harbert P. Survival of zirconia crowns in primary maxillary incisors at 12-, 24- and 36-month follow-up. *Pediatr Dent* 2019;41:385-90.
11. Townsend JA, Knoell P, Yu Q, Zhang JF, Wang Y, Zhu H, *et al.* *In vitro* fracture resistance of three commercially available zirconia crowns for primary molars. *Pediatr Dent* 2014;36:125-9.
12. Bin AlShaibah WM, El-Shehaby FA, El-Dokky NA, Reda AR. Comparative study on the microbial adhesion to veneered and stainless steel crowns. *J Indian Soc Pedod Prev Dent* 2012;30:206-11.

13. Daou EE. The zirconia ceramic: Strengths and weaknesses. *Open Dent J* 2014;8:33-42.
14. Taran PK, Kaya MS. A comparison of periodontal health in primary molars restored with prefabricated stainless steel and zirconia crowns. *Pediatr Dent* 2018;40:334-9.
15. Leith R, O'Connell A. A clinical study evaluating the success of 2 commercially available veneered primary stainless steel crowns. *Pediatr Dent* 2011;33:300-6.
16. Woo D, Sheller B, Williams B, Mancl L, Grembowski D. Dentists' and parents' perceptions of health, esthetics, and treatment of maxillary primary incisors. *Pediatr Dent* 2005;27:19-23.
17. Zimmerman JA, Feigal RJ, Till MJ, Hodges JS. Parental attitudes on restorative materials as factors influencing current use in pediatric dentistry. *Pediatr Dent* 2009;31:63-70.
18. Kupietzky A, Waggoner WF. Parental satisfaction with bonded resin composite strip crowns for primary incisors. *Pediatr Dent* 2004;26:337-40.
19. Peretz B, Ram D. Restorative material for children's teeth: Preferences of parents and children. *J Dent Child* 2002;69:233, 243-8.
20. Fishman R, Guelmann M, Bimstein E. Children's selection of posterior restorative materials. *J Clin Pediatr Dent* 2006;31:1-4.
21. Ashima G, Sarabjot KB, Gauba K, Mittal HC. Zirconia crowns for rehabilitation of decayed primary incisors: An esthetic alternative. *J Clin Pediatr Dent* 2014;39:18-22.
22. Walia T, Salami AA, Bashiri R, Hamodi AM, Rashid F. A randomised controlled trial of three aesthetic full coronal restorations in primary maxillary molars. *Eur J Pediatr Dent* 2014;15:113-8.
23. Salami A, Walia T, Bashiri R. Comparison of parental satisfaction with three tooth colored full coronal restorations in primary maxillary incisors. *J Clin Pediatr Dent* 2015;39:423-8.
24. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial. *Clin Oral Invest* 2020. Available from: <https://doi.org/10.1007/s00784-020-03204-9>.