



COMPARISON OF RETENTION OF STAINLESS-STEEL CROWNS VS ZIRCONIA CROWNS IN PRIMARY TEETH- A RANDOMISED CONTROL TRIAL

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Abstract: Aim: The increase in demand for aesthetic crowns in primary teeth necessitates the evaluation of various other factors contributing to the success of the crowns. One such factor, which is of utmost importance is the retention rate. Hence, The motive of the present study was to compare the retention rates of two pre-formed crowns - Stainless steel and Zirconia crowns for restoring deciduous molars.

Materials and method: 20 children with 2 contra-lateral primary molars in the same arch requiring crowns were selected and restored with SSC and Zirconia crowns. The retention of the crowns were evaluated at 3,6,9 and 12 months follow-up. Descriptive statistics and chi square test were used for statistical analysis.

Results: A total of 20 children with mean age of 4.25 + 0.7 years participated in the trial. None of the SSC got chipped till 12 months of follow up period, whereas 13 zirconia crowns showed chipping. Similarly there was no large loss of crown seen with SSC whereas 3 zirconia crowns showed large loss. Also there was no crown lost reported with SSC but 3 Zirconia crown lost was observed at 12 months follow up.

Conclusion: The Retention of zirconia crowns in primary teeth is not as good as Stainless steel crowns in primary teeth.

Keywords: Primary teeth, Retention, Stainless steel crowns, Zirconia.

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INTRODUCTION

Tooth decay being the most prevalent chronic disease in children despite various preventive measures serves to be challenging for the dental practitioners (Dean et al., 2011; Roberson et al., 2006; Hosoya et al., 2002). Management of carious primary teeth serves to be challenging for a paediatric dentist. With the introduction of Stainless Steel Crowns (SSC) by Humphrey in 1950, treating multi-surface carious primary teeth is become trouble free. For decades, SSCs have outperformed the other restorative materials in terms of cost, durability and longevity (Randall., 2002; Seale., 2001). A systematic review in 2015

studied the effectiveness of Stainless Steel Crowns and concluded that Stainless Steel Crowns are the most acceptable restorative technique in primary teeth (Innes et al., 2015). But the greatest disadvantage with Stainless Steel Crowns is the metallic appearance which makes it unaesthetic and led to the search of new aesthetic and acceptable materials (Randall., 2002; Seale., 2001). A survey conducted in 2009, reported that 87% of the parents were concerned about the aesthetics for restoration of primary molars (Zimmerman et al., 2009). A study conducted among the children regarding the preference for tooth coloured composite and silver coloured amalgam restoration showed more preference towards tooth coloured restorations (Fishman et al., 2006). Though the stainless steel crowns are clinically successful, the parents and the children still feel unsatisfied owing to its metallic appearance (Randall., 2002; Seale., 2001; Innes et al., 2015). Thus, Aesthetic Full coverage restoration of carious deciduous teeth is an evolving and demanding field of interest in paediatric dental practice.

This paved way for the instigation of Zirconia crowns (ZC) in deciduous teeth as it was approved to have high aesthetics, biocompatibility and mechanical properties in permanent dentition. EZ-Pedo, introduced by Dr John Hansen and Dr Jeffrey Fisher was the initial pediatric zirconia crowns that were commercially available (Khatri., 2017). A systematic review published in 2020 stated that Zirconia crowns are a cut above in terms of gingival, & periodontal health, aesthetics and fractures but still more Randomised Clinical Trials are needed on this topic (Ajayakumar., 2020; Heboyan., 2020; Avetisyan., 2021). Retention of the crown is an important clinical factor to be considered to declare its success. In primary teeth, the Retention of

the crowns used depends on the tooth preparation and luting cements used. With regards to tooth preparation, Zirconia crowns requires more tooth reduction, making the retention of the crown questionable (Clark., 2016). However another study declares that Zirconia crowns are highly retentive (Walia et al., 2014). Due to the controversies existing apropos of the retention of zirconia crowns in deciduous teeth, there is a need for a head to head comparison of the retention of zirconia crowns with gold standard SSCs. Hence the present study aims to compare the Retention of SSCs and Zirconia crowns in primary teeth.

MATERIALS AND METHOD

Study population: The study was conducted as a split mouth randomised control trial after approval from the ethical committee. 20 healthy children between the ages of 4 and 7 years with two contra-lateral Primary molars in the same arch requiring full coverage restorations were included in the study. Severely damaged (more than two third of the crown structure lost) Primary molar, primary molar in infra-occlusion, primary molar with no antagonist tooth were excluded from the study. Also, parents/guardian who refused to partake in the study were also excluded. Inclusion and exclusion criteria is depicted in Table 1.

Randomization and allocation concealment: Computer generated randomisation sequence was used to allocate the children to first receive Stainless Steel Crowns or Zirconia crowns. 1 week later, the other crown was placed on the contra-lateral side. The allocation sequence was concealed using sealed envelopes.

Informed consent and Blinding: Informed consent in written format was obtained from the parents/ Guardians prior to enrolling the children to the study. Ethical approval was obtained from the Institutional ethical committee of Saveetha Institute of Medical and Technical Sciences (IHEC/SDC/FACULTY/21/PEDO/269). Blinding was not applicable as the crowns were of different colours and hence neither the participant nor the operator was blinded.

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Healthy children between 4-7 years	Molar with no antagonist
Contralateral primary molars requiring crowns in same arch	Molar in infra-occlusion
Multi-surface caries lesion/ pulp therapy treated teeth	Molar with less than 1/3rd of the crown structure remaining

RESULTS

20 children with mean age of 4.25 + 0.7 years were involved in the trial. Graph 1 shows that till 12 months all the SSCs placed were intact whereas only 18 zirconia crowns were found to be intact at 6 months and 15 at 9 and 12 months. With regards to chipping of the crown, none of the SSC got chipped till 12

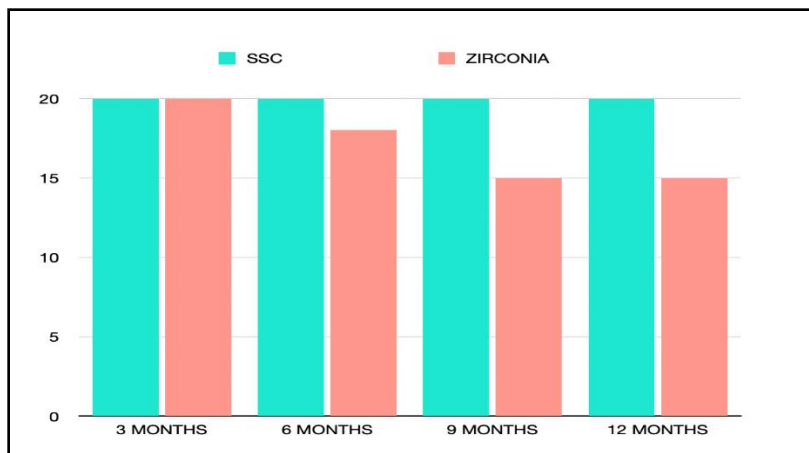
Study protocol: A single paediatric dentist performed the procedures for all the participants to prevent operator bias. The selected tooth was anaesthetised using local anaesthesia containing lignocaine with 1:80000 adrenaline (Lingo 2% A, Indoco Remedies Ltd.). Maxillary primary teeth were infiltrated and Inferior alveolar nerve block was given for the mandibular primary teeth. Caries removal was done using No 3 round bur (Mani, Inc). Pulp therapy if needed was done under Rubber Dam isolation. The subsequent restoration was done using Glass Ionomer Cement (GC Fuji II, GC corporation, Tokyo, Japan). Following which the tooth preparation was carried out. Proximal and occlusal reduction was done. SSC was selected by Trial and error method (3M ESPE, St.Paul, Mind., USA). The crown is then adjusted to fit the tooth by crimping and contouring for better adaptation. The crown was trimmed to extend upto 1 mm sub-gingivally. Occlusion was checked and the crown was cemented using Type 1 Glass Ionomer Cement. (GC Fuji I, GC corporation, Tokyo, Japan).

Preparation for Zirconia Crowns was performed according to manufacturer instructions (NuSmile ZR Pediatric Crowns, Houston, Texas, USA). 2 mm of occlusal reduction and 1 mm of circumferential reduction was done. Sub-gingival finish line was established. The size of the crowns were selected using the try-in crowns and further tooth preparation was done if necessary. The Zirconia crowns were checked for passive seating. The selected crowns were then cemented under cotton roll isolation using Type 1 Glass Ionomer Cement. (GC Fuji I, GC corporation, Tokyo, Japan).

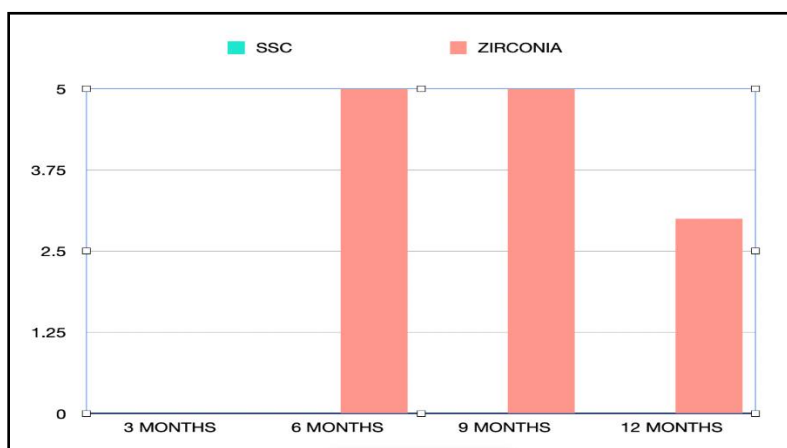
Study Outcome and Follow up: Post-operative Follow up of the children were done at 3,6,9,12 months to check for the retention of the crown. 2 other evaluators who were not a part of this study evaluated the retention of the crowns. The retention of the crown was evaluated as 1. Intact crown, 2. Chipped crown, 3. large loss and 4. Crown lost. Agreement between the examiners was evaluated with kappa statistics and was excellent. (k=0.92)

Statistical analysis: Collected Data was statistically analysed using SPSS Software Version 26.0. (SPSS software Chicago, IL, USA). Chi square test was done to find out the statistical significance between the two groups with statistical significance set at p<0.05.

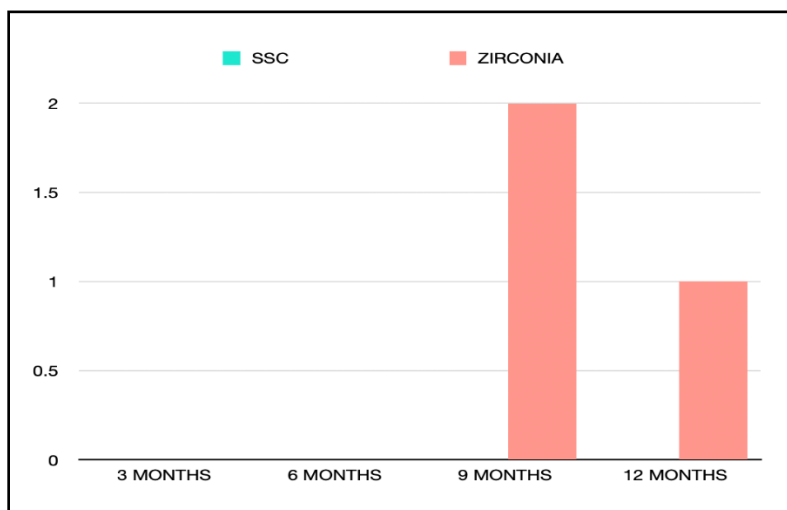
months of follow up period, whereas 13 zirconia crowns showed chipping. (Graph 2) Similarly there was no large loss of crown seen with SSC whereas 3 zirconia crowns showed large loss. (Graph 3) Also there was no crown lost reported with SSC but 3 Zirconia crown lost was observed at 12 months follow up. (Graph 4)



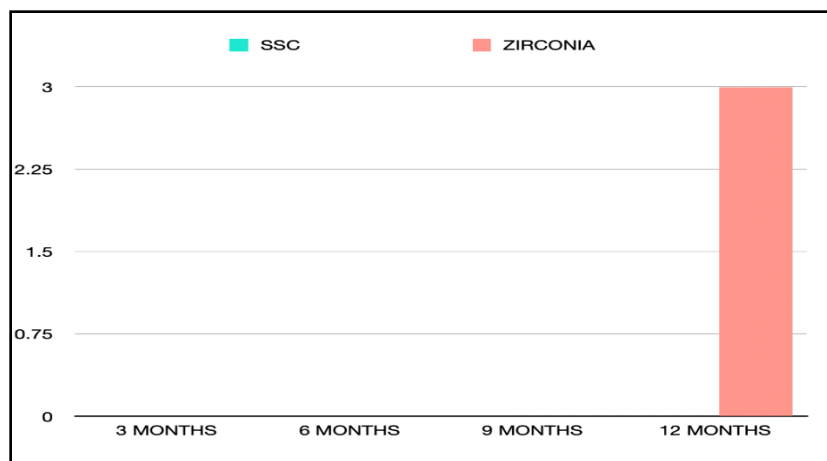
Graph 1. Intact Crown - SSC and Zirconia at 3,6,9 and 12 months , statistically not significant ($p=0.341$).



Graph 2. Chipped crown - SSC and Zirconia at 3,6,9,12 months , statistically significant (0.001)



Graph 3. Large loss - SSC and Zirconia at 3,6,9,12 months, statistically significant (0.001)



Graph 4. Crown lost - SSC and Zirconia at 3,6,9,12 months, statistically significant (0.001)

DISCUSSION

Full coverage restoration of carious primary teeth serves to be challenging for a paediatric dentist. Increasing aesthetic demands of the parents and the children had resulted in the evolution of metal free preformed tooth coloured zirconia crowns for use in paediatric dental practice (Heboyan et al., 2021; Heboyan et al., 2020). However the clinical success rate of these crowns is still questionable owing to the retention rate of these crowns. Hence, the present study evaluated the retention rate of Stainless Steel Crowns and Zirconia crowns in primary molars. To prevent the potential confounders, the present study was conducted as a split mouth trial to comparatively evaluate the retention of Zirconia Crowns and Stainless Steel Crowns in primary teeth.

In the present study it was noted that the 100% SSCs were intact till 12 months of follow up where as only 75% of the Zirconia crowns were intact at 12 months follow up. With regards to chipping of the crowns, none of the Stainless Steel Crowns showed chipping till 12 months of follow up whereas 65% of the Zirconia crowns were recorded to show chipping at 12 months with a statistically significant difference. Similarly none of the Stainless Steel Crowns showed large loss whereas 15% of the zirconia crowns showed large loss at 12 months of follow up period with statistically significant difference. Also, none of the Stainless Steel Crowns were lost at 12 months follow up but 15% of the zirconia crowns were reported to be lost at 12 months follow up and the difference was statistically significant.

To the best of our literacy, there are no head to head comparison of retention of Stainless Steel Crowns and Zirconia crowns in primary molars. Retention has been checked only as one of the factors in determining the clinical success rates of the crowns. The results of previously published studies are conflicting. A study done by Mebin George Mathew in 2020 have shown 100% retention of zirconia crowns till 3 years follow up (Mathew et al., 2020). The variations in the results could be because of the difference in the Zirconia crowns used. In the present study NuSmile ZR Pediatric Crowns (Houston, Texas, USA) were used but in the study conducted by Mebin George Mathew KINDER crowns were used. KINDER crowns are said to have unique internal threads that increases the retention of the crown. However another study done by Pinar Kinay Taran using NuSmile ZR Pediatric crowns have showed that only 2

zirconia crowns were decemented at the end of 12 months (Taran et al., 2018). This result is almost similar to the results of the present study as at the end of 12 months only 3 ZCs were completely lost and other crowns showed only chipping.

In the present study it was noted that chipping of zirconia crown was the most common issue faced followed by large loss and crown lost. Blinding of the participants/ operator or assessor is not applicable as the crowns are different in colour and can be identified easily. Also the study was conducted as a split mouth study to avoid potential confounders. Though aesthetics is an advantage of using zirconia crowns, due to its poor retention there are high chances for the child to ingest or aspirate the crowns leading to serious complications (Adewumi et al., 2008). The present study was conducted using only one type of zirconia crown available at market and also was followed up only for 12 months. More Randomised Clinical Trials should be carried out comparing different Zirconia crowns for a longer period of time and at different settings to get into definite conclusion. Also, the use of Zirconia should be reconsidered and search for a new material that will overcome the disadvantages of zirconia and have properties and durability similar to Stainless Steel Crowns should be continued.

CONCLUSION

The Retention of zirconia crowns in primary teeth is not as good as Stainless steel crowns in primary teeth despite using the same luting cement and hence use of zirconia crowns in children should be re-considered.

Conflict of interest: No conflict of interest.

REFERENCES

- i. Adewumi, A. and Kays, D.W. (2008). Stainless steel crown aspiration during sedation in pediatric dentistry. *Pediatr Dent*, 30: 59-62.
- ii. Ajayakumar, L.P., Chowdhary, N., Reddy, V.R. and Chowdhary, R. (2020). Use of Restorative Full Crowns Made with Zirconia in Children: A Systematic Review. *Int J Clin Pediatr Dent*, 13: 551-558.

- iii. Avetisyan, A., Markaryan, M., Rokaya, D., Tovani-Palone, M. R., Zafar, M. S., Khurshid, Z., Vardanyan, A., and Heboyan, A. (2021). Characteristics of Periodontal Tissues in Prosthetic Treatment with Fixed Dental Prostheses. *Molecules*, 26: 1331.
- iv. Clark, L., Wells, M.H., Harris, E.F. and Lou, J. (2016). Comparison of amount of primary tooth reduction required for anterior and posterior zirconia and stainless steel crowns. *Pediatr Dent*, 38: 42-46.
- v. Dean, J.A., Avery, D.R. and McDonald RE. (2011). McDonald and Avery's dentistry for the child and adolescent. 9th edn. St Louis: Elsevier Health Sciences, 117–204.
- vi. Heboyan, A., Azeem, U.Y. Syed., Rokaya, D., Cooper, P.R., Manrikyan, M. and Markaryan, M. (2020). Cyto-morphometric Analysis of Inflammation Dynamics in the Periodontium Following the Use of Fixed Dental Prostheses. *Molecules*, 20: 4650.
- vii. Heboyan, A., Manrikyan, M., Markaryan, M. And Vardanyan, I. (2020). Changes in the parameters of gingival crevicular fluid in masticatory function restoration by various prosthodontic constructions. *Int. J. Pharm. Res*, 12: 2088–2093.
- viii. Heboyan, A., Manrikyan, M., Zafar, M.S., Rokaya, D., Nushikyan, R., Vardanyan, I., Vardanyan, A. and Khurshid, Z. (2021). Bacteriological Evaluation of Gingival Crevicular Fluid in Teeth Restored Using Fixed Dental Prostheses: An In Vivo Study. *Int. J. Mol. Sci.*, 22: 5463.
- ix. Hosoya, Y., Omachi, K. and Staninec M. (2002). Colorimetric values of esthetic stainless steel crowns. *Quintessence Int*, 33: 537–541.
- x. Innes, N.P.T., Ricketts, D., Chong, L.Y., Keightley, A.J., Lamont, T. And Santamaria, R.M. (2015). Preformed crowns for decayed primary molar teeth. *Cochrane Database Syst Rev*, 12: CD005512.
- xi. Khatri, A. (2017). Esthetic zirconia crown in pedodontics. *Int J Pedod Rehabil*, 2: 31-33.
- xii. Mathew, M.G., Roopa, K.B., Soni, A.J., Khan, M.M. and Kauser, A. (2020). Evaluation of Clinical Success, Parental and Child Satisfaction of Stainless Steel Crowns and Zirconia Crowns in Primary Molars. *J Family Med Prim Care*, 9:1418-1423.
- xiii. Randall, R.C. (2002). Preformed metal crowns for primary and permanent molar teeth: review of literature. *Pediatr Dent*, 24: 489-500.
- xiv. Roberson, T.M., Heymann, H., Swift, E.J. and Sturdevant CM. (2006). Sturdevant's art and science of operative dentistry. 5th edn. St Louis: Mosby, 49–72.
- xv. Seale, N.S. (2001). The use of stainless steel crowns. *Pediatr Dent*, 24: 501-505.
- xvi. Taran, P.K. and Kaya, M.S. (2018). A Comparison of Periodontal Health in Primary Molars Restored with Prefabricated Stainless Steel and Zirconia Crowns. *Pediatr Dent*, 40: 334-339.
- xvii. Walia,T., Salami, A.A., Bashiri, R., Hamoodi, O.M. and Rashid F. (2014). A randomised controlled trial of three aesthetic full- coronal restorations in primary maxillary teeth. *Eur J Paediatr Dent*, 15: 113-118.