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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF COLOUR CHANGE, CRAZING AND DIMENSIONAL STABILITY OF STAINLESS STEEL, ZIRCONIA AND FIGARO CROWNS BY STERILIZATION

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Abstract

Introduction: Full coverage restorations are indicated in primary teeth following pulp therapy, in teeth with multi-surface caries, developmental defects and fractures. There are various types of restorations for complete coverage. In the process of trial and error, the crown gets contaminated and demands sterilization for the purpose of reuse. Therefore, the study was carried out to evaluate the physico-mechanical outcome after sterilization of paediatric preformed crowns.

Aim: The purpose of the study was to compare the effect of sterilization on the colour, crazing and dimensional stability of Stainless steel, Zirconia and Figaro crowns.

Methodology: The study was conducted on a total of 36 crowns consisting of 12 each, Stainless steel crowns, Zirconia crowns and Figaro crowns, which were divided into two groups: G₁ in which crowns did not undergo any sterilization, G₂ consisted of sterilization with steam autoclaving at 121°C, 15 psi pressure for 20 min. Following sterilization, all the crown samples were observed under a stereomicroscope at ×200 magnification and assessed for colour change, crazing and dimensional stability.

Results: There was no color change or crazing following sterilization among crowns in any of the groups. Highest crazing was noted in stainless steel and the least in Zirconia crowns. Zirconia Crowns were the most dimensionally stable followed by Figaro crowns and SSCs were the least dimensionally stable.

Conclusion: Zirconia Crown was the most dimensionally stable followed by Figaro Crowns and Stainless steel crowns.

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Introduction:-

Dental caries involving primary teeth is very common in children.¹ The endodontic treatment of carious primary teeth demands using full coronal restorations over them to increase their fracture resistance.¹ A full coronal restoration is defined as a tooth shaped covering which is cemented onto the tooth structure and its main function is to protect the

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tooth structure, retain the function, esthetics, maintaining occlusion, restoring speech and preventing psychological trauma.² Various types of restorations for complete crown coverage includes acrylic crowns, polycarbonate crowns, acid etched crown, stainless steel crown (SSC), open-faced stainless steel crown, pre-veneered stainless steel crown, zirconia crown and figaro crowns.³

Stainless steel crown (SSC) is a strong, less technique sensitive, durable, economical full coverage restoration.⁴ It has a disadvantage of unaesthetic metallic appearance which demanded for introduction of esthetic crowns.⁵

Zirconia is a crystal-like dioxide of zirconium with metal like mechanical properties and is tooth coloured. Zirconia crown has advantages of full coverage, less techniquesensitivity, premium esthetics, undetachable material and adequate strength.

Figaro crowns are esthetic, metal & BPA-free, strong pre-formed crowns which consist of composite resin with embedded fiberglass or quartz fibers. The fiber imparts support and strength to the composite matrix.³ Figaro crowns are esthetic, strong, adjustable, flexible, biocompatible and exhibit restoration of the natural tooth anatomy.⁴

The preformed crowns may get contaminated with saliva and blood in the process of trial and error of crowns for crown selection.⁵ Hence, before re-use in another patient, the indirect and direct contact surfaces of crowns need to be sterilized.⁶ However, the various parameters of the crowns like colour, crazing and dimensional stability can get affected by sterilization. The purpose of the study was to compare the effect of sterilization on the colour, crazing and dimensional stability of Stainless steel, Zirconia and Figaro crowns.

Materials And Methodology:-

This study was done in the Department of Pediatric Dentistry, Government Dental College & Hospital, Srinagar. The sample size was determined using GPOWER software (Version 3.0.10). A total of 36 Crowns were taken consisting of 12 each, Stainless steel crowns (3M ESPE), Zirconia crowns (Signature crown) and Figaro crowns (Figaro Crowns, USA), which were divided into two groups:

G₁ in which crowns did not undergo any sterilization,

G₂ consisted of sterilization with steam autoclaving at 121°C, 15 psi pressure for 20 min.

The crowns in groups **G₂** were packed in sterilization pouches and placed in an autoclave. All samples of crowns were studied under a stereomicroscope at ×200 magnification with the positioner measurement gauge of 50 μm placed in a slot provided on the microscope. For the stereomicroscopic study, proximal surfaces of SSCs, Zirconia crowns, and Figaro Crowns were used as these surfaces are flatter than other surfaces which minimizes blurring of vision.

Stereomicroscopic images of **G₁** were used as the locus data for evaluating any changes on the crowns after sterilization. The scoring of crown surfaces for the absence or presence of any changes was done using the Wickersham et al. criteria with modifications.⁷ The parameters color change, crazing and dimensional stability were assessed by the single examiner who was trained for calibration for the determination of all the parameters in the study. After a week, all micrographs were reassessed by the same examiner to validate the reproducibility for assessing each criterion.

Color change:

Color change was scored by viewing the crowns belonging to control group and experimental groups side by side against green background.

Score 0: No change

Score 1: Change in color

Crazing:

Crazing is defined as internal cracks visible under ×10 magnification, but not detectable with an explorer gently moved over the surface. Crazing was scored by checking for fine lines (internal cracks) under the stereomicroscope at ×200 magnification for reconfirmation.

Score 0: No crazing was observed

Score 1: Few isolated cracks relating to less than one-third of surface

Score 2: Cracks relating to one-third to one-half of the surface

Score 3: Cracks involving greater than > one half of the surface.

Dimensional stability:

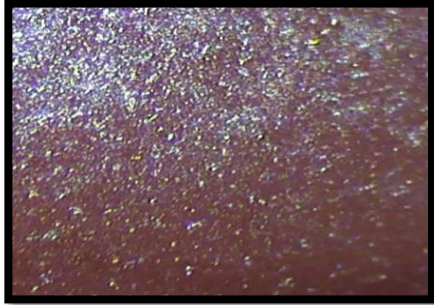
Dimensional stability was scored by checking for irregularities such as dipping in or flattening of any part visible under the field at $\times 200$ magnification.

Score 0: No change

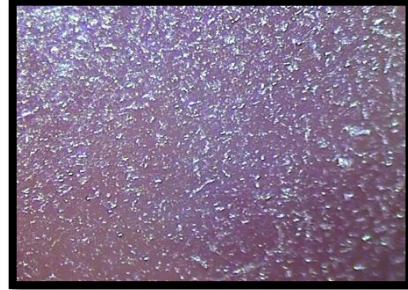
Score 1: Few isolated irregularities involved less than $<$ one third of the surface

Score 2: Irregularities restricted to one-third to one-half of the surface

Score 3: Irregularities relating to >1 half of the surface.



SSC Before Sterilization



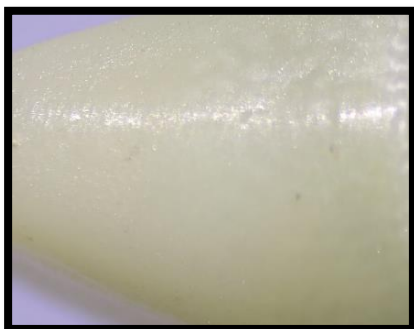
SSC After Sterilization



Zirconia Crown Before Sterilization



Zirconia Crown After Sterilization



Figaro Crown Before Sterilization



Figaro Crown After Sterilization

Statistical Methods:-

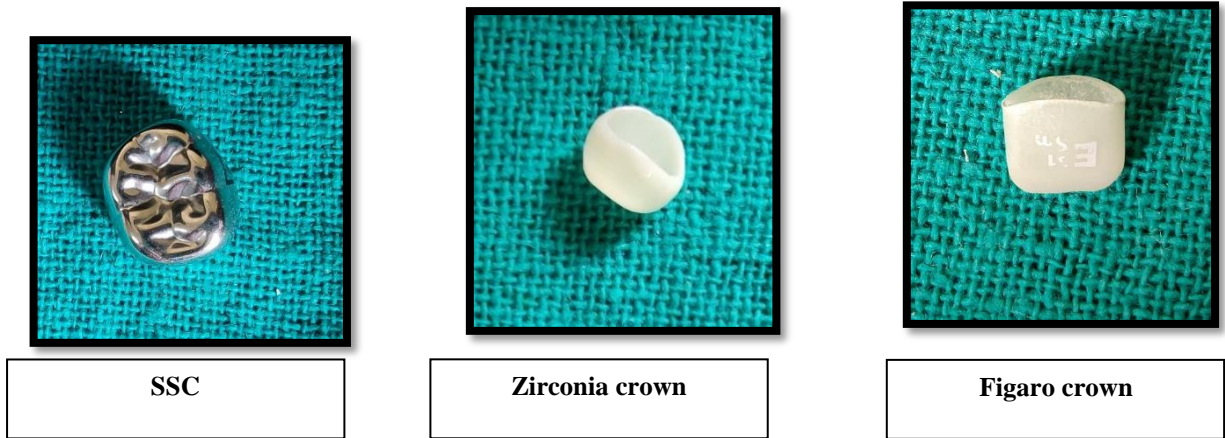
The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Categorical variables were summarized as percentages. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. Graphically the data was presented by bar diagrams. A P-value of less than 0.05 was considered statistically significant.

Results:-

Micrographs of the results for SSCs, Zirconia Crowns and Figaro Crowns in the control and experimental groups for crazing and dimensionally stability were checked and the following results were obtained.

Color changes:

No color changes were observed in any type of sterilization, either in control or experimental group

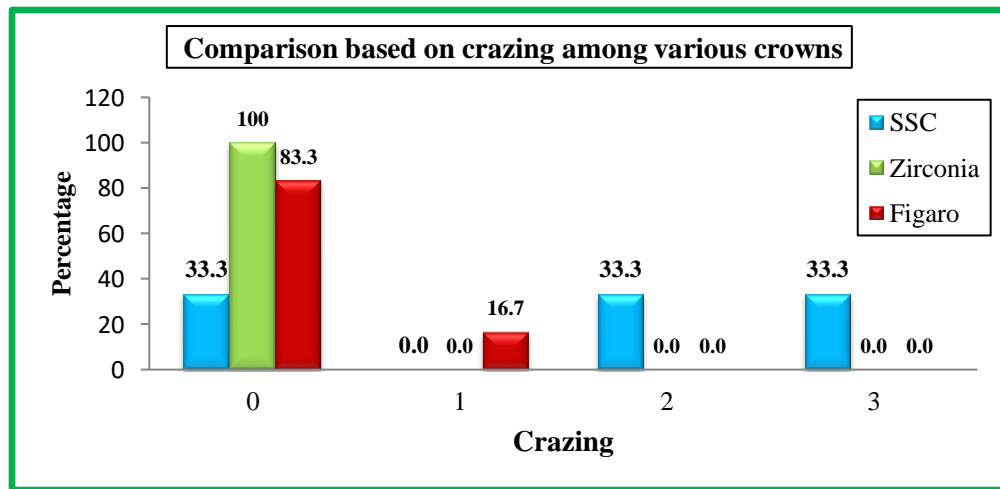


Crazing

For stainless steel crowns crazing score 0, score 2 and score 3 were seen in 33.3%, 33.3% and 33.3% crowns respectively. For Zirconia Crowns, crazing score 0 was seen in 100% crowns. For Figaro crowns, crazing score 0 was seen in 83.3% crowns and score 1 was seen in 16.7% crowns.

Crazing	SSC		Zirconia		Figaro	
	No.	%age	No.	%age	No.	%age
0	4	33.3	12	100	10	83.3
1	0	0.0	0	0.0	2	16.7
2	4	33.3	0	0.0	0	0.0
3	4	33.3	0	0.0	0	0.0
Comparison	SSC vs Zirconia		Zirconia vs Figaro		Figaro vs SSC	
P-value	0.002*		0.478		0.006*	

Table 1:- Comparison based on crazing among various crowns.



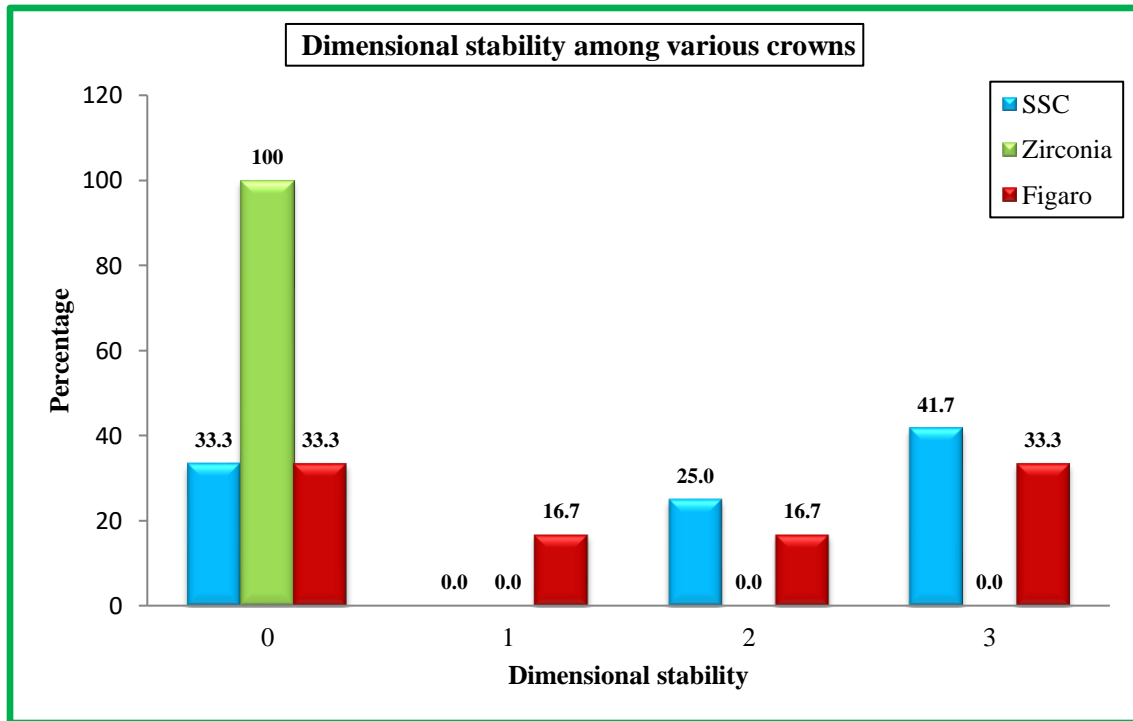
Graph 1:- Comparison based on crazing among various crowns.

Dimensional Stability

For stainless steel crowns Dimensional Stability score 0, score 2 and score 3 were seen in 33.3%, 25% and 41.7% crowns, respectively. For Zirconia Crowns, Dimensional stability score 0 was seen in 100% crowns. For Figaro crowns, Dimensional stability score 0, score 1, score 2 and score 3 was seen in 33.3%, 16.7%, 16.7% and 33.3% crowns, respectively.

Table 2						
Dimensional stability	SSC		Zirconia		Figaro	
	No.	% age	No.	% age	No.	% age
0	4	33.3	12	100	4	33.3
1	0	0.0	0	0.0	2	16.7
2	3	25.0	0	0.0	2	16.7
3	5	41.7	0	0.0	4	33.3
Comparison	SSC vs Zirconia		Zirconia vs Figaro		Figaro vs SSC	
P-value	0.003*		0.007*		0.511	

Table 2:- Comparison based on dimensional stability among various crowns.



Graph 2:- Comparison based on dimensional stability among various crowns.

Discussion:-

Preformed crowns are used in primary dentition for restoration and stabilization of primary teeth.⁸ During trial and error fitting of preformed crowns to the prepared tooth, theselected preformed crowns may not always fit to toothandsuchcrownswhen re-used on other patients have the risk of transferring infectious body fluids.⁹The decontamination process of preformed crowns for prevention of such transmission from contaminating saliva or bloodshould be reliable and not cause any changes to physical properties of the crown.¹⁰

According to American Academy of Pediatric Dentistry Guidelines for Infection Control in the Dental Health-Care Setting–2003 and Guidelines for Disinfection and Sterilization in Healthcare Facilities–2008, a critical instrument is one which penetrates soft tissue or bone, contacts blood stream or other sterile tissue.¹¹Preformed crownsare included in the list of critical instruments and are heat stable, therefore, sterilization by steam under pressure is advocated.

In this study, autoclaving was done using front loading autoclave with digital display because of its ease of use, and is mostly available in dental clinics which was in accordance to Padmanabh S.⁶ For assessing color change, the crowns belonging to control and experimental groups were kept side by side on a green cloth as a background so as to ensure a good contrast for assessing colour changes in crowns following sterilization. No color change was observed in any types of crowns which was similar to results by Padmanabh SK.⁶ Similar results were seen in study by Yilmaz Y et al whereas contradictory results were seen by Wickersham et al.^{7,12}

Crazing is termed as internal cracks that are observed under $\times 10$ magnification with no rough surface evident on moving the explorer on the surface. Highest crazing was observed in SSCs and the least in zirconia crowns. Highest crazing in SSC was also seen by Padmanabh SK and Shital DP Kiran.^{6, 13} Crazing in preformed crowns was also seen in a study by Yilmaz Y.¹² The surfaces of dental restorations should be well polished as there is increased accumulation of plaque on rough surfaces. There are increased chances of periodontal tissue inflammatory changes using crowns with rough surfaces. Kopel and Batterman reported that crazing can lead to plaque formation.¹⁴ Similar observations were reported by Van Dijken et al who reported that there is increased accumulation of dental plaque on rough surfaces.¹⁵

Dimensional stability was evaluated by checking for irregularities such as dipping in or flattening of any part visible under the field at $\times 200$ magnification. Highest dimensional stability was observed in Zirconia crowns and the least in SSCs. Padmanabh SK et al reported similar results where dimensional stability was least in SSCs.⁶

Conclusion:-

Within the limits of this study, it can be observed that there was no change in color following sterilization in Stainless steel, Zirconia crowns and Figaro crowns. Zirconia crowns were the most dimensionally stable followed by Figaro crowns and SSCs were the least dimensionally stable. Highest amount of crazing was seen in SSCs followed by Figaro crowns and almost nil in Zirconia crowns following sterilization.

Bibliography:-

1. Farooqi FA, Khabeer A, Moheet IA, Khan SQ, Farooq I, ArRejaie AS. Prevalence of dental caries in primary and permanent teeth and its relation with tooth brushing habits among schoolchildren in Eastern Saudi Arabia. *Saudi Med J.* 2015 Jun;36(6):737–42.
2. Alzanbaqi SD, Alogaiei RM, Alasmari MA, Al Essa AM, Khogeer LN, Alanazi BS, et al. Zirconia Crowns for Primary Teeth: A Systematic Review and Meta-Analyses. *Int J Environ Res Public Health.* 2022 Feb 28;19(5):2838.
3. El-Habashy L, Meligy O. Fiberglass crowns versus preformed metal crowns in pulpotomized primary molars: a randomized controlled clinical trial. *Quintessence Int.* 2020 Sep 10;51:2–10.
4. Chakraborty S, Das A. Esthetic Rehabilitation Of Decayed Primary Incisors Using Figaro Crowns And Strip Crowns. *IJDSIR.* 2019 2(2): 490 - 494
5. Infection control recommendations for the dental office and the dental laboratory. ADA Council on Scientific Affairs and ADA Council on Dental Practice. *J Am Dent Assoc* 1939. 1996 May;127(5):672–80.
6. Davangere Padmanabh SK, Patel V. The effect of sterilization and disinfection on the physical-mechanical properties of preformed crowns. *J Indian Soc Pedod Prev Dent.* 2021 Mar;39(1):53.
7. Wickersham GT, Seale NS, Frysh H. Color change and fracture resistance of two veneered stainless-steel crowns after sterilization. *Pediatr Dent.* 1998;20(5):336–40.
8. Sztylek K, Wiglusz RJ, Dobrzynski M. Review on Preformed Crowns in Pediatric Dentistry—The Composition and Application. *Materials.* 2022 Mar 11;15(6):2081.
9. 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(1):18–22.
10. Upendran A, Gupta R, Geiger Z. Dental Infection Control. 2023 Aug 8. In: *StatPearls*
11. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM, et al. Guidelines for infection control in dental health-care settings--2003. *MMWR Recomm Rep Morb Mortal Wkly Rep Recomm Rep.* 2003 Dec 19;52(RR-17):1–61.
12. Yilmaz Y, Guler C. Evaluation of different sterilization and disinfection methods on commercially made preformed crowns. *J Indian Soc Pedod Prev Dent.* 2008 Dec;26(4):162–7.
13. Kiran S, Patel M, Bhatt R, Bhatt K. Evaluation of Preformed Stainless Steel Crown's Crazing by Various Sterilization Methods of Steam Autoclave: A Pilot Study. *Adv Hum Biol.* 2015 Jan 1;5:14–7.

14. Kopel HM, Batterman SC. The retentive ability of various cementing agents for polycarbonate crowns. *ASDC J Dent Child.* 1976;43(5):333-9.
15. Van Dijken J, Persson S, Sjöström S. Presence of *Streptococcus mutans* and lactobacilli in saliva and on enamel, glass ionomer cement, and composite resin surfaces. *Scand J Dent Res.* 1991 Feb;99(1):13-9.