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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF TITANIUM NITRIDE COATED CROWNS AND SANDBLASTED STAINLESS STEEL CROWNS WITH CONVENTIONAL STAINLESS STEEL CROWNS IN PRIMARY DENTITION- AN IN VIVO STUDY

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Key words:-
Titanium nitride-coated crowns, sandblasted stainless steel crowns, full-coverage restoration.

Abstract

Background: Dental caries is a major cause of pain and tooth loss in children,often requiring full coverage restorations. Stainless steel crowns (SSCs)are durable and easy to place but lack esthetics.Titanium nitride-coated crowns (TiNCs) improve appearance and wear resistance, while sandblasted SSCs may enhance bonding and efficiency. However, clinical evidence in pediatric use remains limited.
Aim: To clinically evaluate and compare titanium nitride coated crowns and sandblasted stainless steel crowns with conventional stainless steel crowns in primary dentition.
Methods: A randomized comparative in vivo study was conducted on 45 endodontically treated primary molars in children aged 3–10 years, assigned to three groups (n=15 each): Group I—TiNCs, Group II—sandblasted SSCs, and Group III—conventional SSCs. Clinical and radiographic assessments were performed pre-operatively and at 1, 3, and 6 months. Data were analyzed using Kruskal-Wallis and Friedman statistical tests.
Results: TiNCs showed superior esthetics and plaque resistance but exhibited minor wear and reduced marginal fit over time. Sandblasted SSCs demonstrated the shortest chairside time with stable performance. All crown types yielded comparable outcomes for gingival health, occlusal stability, parental satisfaction, and radiographic findings.
Conclusion: Both TiNCs and sandblasted SSCs are viable alternatives to conventional SSCs for restoring primary molars, providing additional advantages in esthetics and efficiency.
Clinical Significance: TiNCs offer superior esthetics and plaque resistance, while sandblasted SSCs provide greater efficiency without loss of function. Both are viable alternatives to conventional SSCs in pediatric dentistry

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Introduction:-

Dental caries is a prevalent and preventable disease caused by acid-producing bacteria in dental plaque, leading to tooth demineralization. In India, the prevalence of dental caries among primary school children aged 6–11 years is notably high, with studies reporting rates of 78.9%.[1] This condition affects both primary and permanent teeth, impacting function, aesthetics, and overall well-being. Primary molars with extensive decay or after pulp therapy often require full coronal restorations due to their anatomical limitations. While intracoronal restorations are used, they lack cuspal protection and increase the risk of fracture and endodontic failure due to coronal leakage.

Stainless steel crowns (SSCs) are the gold standard for restoring such teeth. They offer durability, full coverage, ease of placement, and high success rates. SSCs preserve arch integrity, reduce the risk of reinfection, and are especially effective in young or uncooperative children. Studies show over 90% success rates compared to lower outcomes with composite restorations.[1]

Despite their proven effectiveness, SSCs are limited by poor aesthetics and potential concerns over metal ion release. Still, their clinical reliability makes them the most trusted option. Some parents now prefer gold-colored crowns over traditional silver SSCs, indicating a shift toward aesthetic alternatives.

Titanium nitride-coated crowns (TiNCs) are a recent innovation in pediatric full-coverage restorations. Their golden-yellow appearance enhances aesthetics, making them more acceptable to parents and children.[2]TiNCs are created using a titanium nitride layer (4–6 µm), which is thicker and harder (180 HV) than conventional stainless steel crowns (SSCs), offering improved surface durability and corrosion resistance.[2] Unlike SSCs, which contain potential allergens like nickel and chromium, TiNCs have shown good biocompatibility in previous studies.[2]
TiNCs may serve as a cost-effective alternative to zirconia crowns while retaining the clinical benefits of SSCs. However, due to their recent introduction in pediatric dentistry, limited clinical data is available.[2]

Sandblasting of SSCs has also emerged as a technique to enhance bonding. Roughening the crown's internal surface with 250 µm aluminium oxide particles improves micromechanical retention without compromising crown integrity.[3] This approach, based on earlier studies by Garcia-Godoy and O'Connor et al., avoids high-speed burs to prevent perforation and ensures better adhesion with resin cements.[3]
Given the limited research on TiNCs and sandblasted SSCs in children, this study aimed to compare their clinical success with conventional SSCs in restoring primary molars.

Aim Of The Study:
To clinically evaluate and compare titanium nitride coated crowns and sandblasted stainless steel crowns with conventional stainless steel crowns in primary dentition.

Objectives:-

- To assess oral health condition, esthetics and cost.
- To evaluate the occlusion, marginal adaptation and contacts after cementation of these crowns.
- To evaluate the alignment and retention of the crowns.
- To assess the behaviour of the child and parental satisfaction for these crowns.
- To estimate the changes in the crowns regarding to wear and fracture.
- Radiographical comparison of alveolar bone changes around the cemented crowns.

Methodology:-

Study Design and Ethical Approval

This randomized clinical trial was conducted in the Department of Paediatric and Preventive Dentistry, SVS Institute of Dental Sciences, after obtaining approval from the Institutional Ethical Committee (IEC No: SVSIDS/PEDO/5/2022). The trial was carried out from December 2023 to November 2024 and reported in accordance with the CONSORT 2010 guidelines, with a follow-up period of six months.

Study Population

A total of 45 children aged 3–10 years requiring pulp therapy for primary molars were recruited after obtaining written informed consent from parents or legal guardians. The upper age limit of 10 years was included to account for delayed exfoliation of primary molars; however, only teeth exhibiting a minimum of two-thirds root length radiographically were considered suitable for crown placement.

Inclusion Criteria

Clinical criteria

- Children indicated for full-coverage restoration following pulpotomy or pulpectomy of primary molars
- Primary molars with extensive carious involvement requiring stainless steel crown therapy
- Teeth with adequate coronal structure to support crown placement

Radiographic criteria

- Presence of at least two-thirds of root length
- Absence of pathological root resorption affecting crown prognosis

Exclusion Criteria

Clinical criteria

- Children with special healthcare needs or systemic diseases
- History of bruxism or parafunctional habits
- Teeth exhibiting mobility suggestive of advanced physiologic resorption
- Teeth with developmental enamel or dentinal defects

Radiographic criteria

- Teeth with periapical or furcal radiolucency
- Teeth with internal or external pathological root resorption
- Teeth presenting with clinical or radiographic signs of abscess were excluded from the study

Treatment Protocol:

All pulp therapies (pulpotomy or pulpectomy) were performed by a single experienced operator using standardized protocols to eliminate operator bias. Following pulp therapy, the teeth were restored with high-viscosity glass ionomer cement (Fuji IX, GC Corporation, Tokyo, Japan) as an interim core buildup prior to crown placement.

Randomization and Allocation Concealment

Participants were randomly allocated into three groups (n = 15 per group) using a computer-generated random number sequence.Group assignment was revealed only at the time of crown placement.

- **Group I:** Titanium Nitride Coated Crowns (TiNCs)
- **Group II:** Sandblasted Stainless Steel Crowns
- **Group III (Control):** Conventional Stainless Steel Crowns (SSCs) as show in figure1

Figure 1: Titanium nitride coated crowns, stainless steel crowns and sandblasted SSC

Preoperative and postoperative clinical photographs and intraoral periapical radiographs were taken for all cases.

Procedure:

Preoperative photographs, radiographs, occlusion, dental midline, cusp–fossa relationships, and bite registration were recorded. Local anesthesia was administered using 2% lidocaine with 1:80,000 epinephrine. Crown selection was based on mesiodistal width of clinical crown intraorally measured with a vernier caliper.

Tooth Preparation

Occlusal reduction of approximately 1–1.5 mm was performed using a tapered diamond bur, guided by the height of adjacent cusps. Proximal reduction was carried out using a thin tapered bur to break contacts with minimal clearance while preserving tooth structure. Interocclusal clearance was verified using a 1.5–2 mm wax sheet. All line angles were rounded to reduce stress concentration. Knife-edge margins were prepared circumferentially, and crowns were placed no more than 1 mm subgingivally. Retention and resistance form were achieved through adequate axial wall height, parallelism of walls, and precise marginal adaptation, as recommended in standard pediatric crown preparation protocols (McDonald and Avery; Seale & Randall).

Crown Adaptation and Cementation

The crowns were contoured and crimped using contouring pliers and crimping instruments to achieve optimal marginal adaptation and snap-fit retention. Trial fitting was performed to assess marginal integrity, occlusion, and proximal contacts. Final cementation was carried out using Type I glass ionomer luting cement (Fuji I, GC Corporation, Tokyo, Japan) under isolation, following the manufacturer's instructions. Excess cement was removed immediately using an explorer and dental floss passed interproximally to ensure complete removal without disturbing proximal contacts. Occlusion was re-checked after cementation, and any premature contacts were adjusted.

Postoperative Records

Postoperative intraoral photographs and radiographs were taken to document crown placement and marginal adaptation.

Outcome Assessment

Crowns were evaluated at baseline (placement), 1 month, 3 months, and 6 months by an independent, blinded investigator. The following parameters were assessed:

- Chair-side time: Measured using a stopwatch from the start of tooth preparation until completion of crown cementation.
- Child behavior: Assessed using Frankl's Behavior Rating Scale.
- Parental satisfaction: Evaluated using a structured questionnaire assessing esthetics, function, and overall satisfaction.

- Plaque index: Recorded using the Silness and Löe Plaque Index on the crowned tooth and adjacent teeth.
- Gingival health: Assessed using the Modified Gingival Index.
- Occlusion: Evaluated clinically using articulating paper.
- Marginal adaptation, proximal contacts, crown alignment, retention, and crown staining: Assessed clinically using standardized criteria.
- Radiographic evaluation: Assessed for alveolar bone changes and periapical status.

Results:-

Statistical Analysis

Data were analyzed using SPSS version 23.0. Continuous variables were summarized as mean ± SD, and categorical data as percentages. Intergroup comparisons among TiNC, sandblasted SSC, and conventional SSC were performed using the Kruskal-Wallis test for continuous data, while intragroup comparisons used the Friedman test for categorical data.

The results for plaque index for intergroup comparsion are summarized in table 1 and figure 2. Kruskal-Wallis test revealed a significant difference in plaque scores among the groups at 1 month (p = 0.00), with Group I showing the lowest scores. However, by 3 and 6 months, differences were no longer significant (p = 0.31 and 0.99), indicating convergence in plaque accumulation across groups over time.

Time Interval	Groups	Mean Rank	χ^2 Value	P Value
One Month	Group 1	11.50	23.24	0.00*
	Group 2	26.93		
	Group 3	30.57		
Three Months	Group 1	20.30	2.30	0.31
	Group 2	22.93		
	Group 3	25.77		
Six Months	Group 1	22.97	0.002	0.99
	Group 2	23.07		
	Group 3	22.97		

Table 1: Intergroup comparsion for plaque index

Figure 2: Mean rank of plaque index among all groups

The results for plaque index for intragroup comparsion are summarized in table 2. Friedman test showed a significant increase in plaque scores over time in Group I (p = 0.00), indicating progressive plaque accumulation. Group II showed a non-significant upward trend (p = 0.10), while Group III showed a slight increase with borderline significance (p = 0.05)

Groups	Time Interval	Mean Rank	χ^2 Value	P Value
Group 1	One Month	1.13	24.13	0.00*
	Three Months	2.23		
	Six Months	2.63		
Group 2	One Month	1.77	4.52	0.10
	Three Months	2.03		
	Six Months	2.20		
Group 3	One Month	1.80	6.00	0.05*
	Three Months	2.10		
	Six Months	2.10		

Table 2: Intragroup comparsion for plaque index

The results for wear, fracture and retention of crown for intergroup comparsion are summarized in table 3 and figure 3. Kruskal-Wallis test revealed no significant differences in crown-related wear, fracture, or retention at 1 month. However, at 3 and 6 months, Group I showed significantly greater crown wear compared to the other groups ($p \leq 0.05$), indicating higher susceptibility to wear over time.

Time Interval	Groups	Mean Rank	χ^2 Value	P Value
One Month	Group 1	25.00	4.09	0.12
	Group 2	22.00		
	Group 3	22.00		
Three Months	Group 1	38.00	44.00	0.00*
	Group 2	15.50		
	Group 3	15.50		
Six Months	Group 1	38.00	44.00	0.00*
	Group 2	15.50		
	Group 3	15.50		

Table 3: Intergroup comparsion for wear, fracture and retention of crown

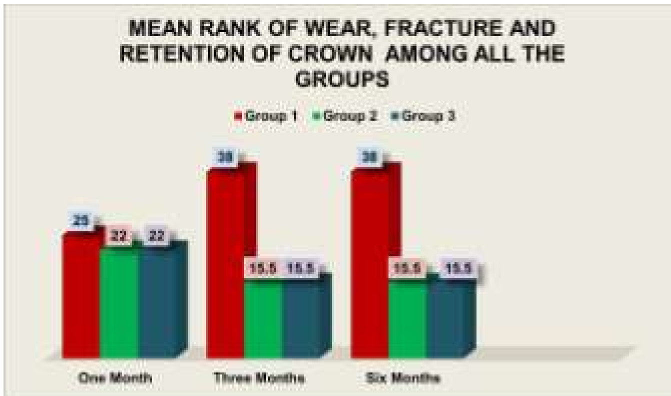

Figure 3: Mean rank of wear, fracture and retention of crown among all groups

The results for wear, fracture and retention of crown for intragroup comparsion are summarized in table 4. Friedman test showed a significant increase in wear, fracture, and retention issues over time in Group I (titanium nitride-coated crowns), with mean ranks rising from 1.70 at 1 month to 2.20 at 3 months and staying high at 2.10 at 6 months (p = 0.01).

Groups	Time Interval	Mean Rank	χ^2 Value	P Value
Group 1	One Month	1.13	26.00	0.00*
	Three Months	2.43		
	Six Months	2.43		
Group 2	One Month	2.00	-	-
	Three Months	2.00		
	Six Months	2.00		
Group 3	One Month	2.00	-	-
	Three Months	2.00		
	Six Months	2.00		

Table 4: Intragroup comparsion for wear, fracture and retention of crown

Figures 4 and 5 illustrate the postoperative appearance of Group I and the crown wear observed at the 6-month follow-up, respectively.

Figure 4: Post-op of Group I

Figure 5: 6 Month follow

The results for chairside time are shown in table 5 and figure 6 summarizes Intergroup comparison using ANOVA showed a significant difference in chairside time ($p \leq 0.05$). Group 1 took the longest time (40.73 ± 6.22 minutes), Group 2 the shortest (35.20 ± 4.49 minutes), and Group 3 had a moderate duration (38.67 ± 3.94 minutes).

Group	Mean	SD	F Value	P Value
Group 1	40.73	6.22		
Group 2	34.06	7.75	4.56	0.01*
Group 3	38.53	3.85		

Table 5: Intergroup comparsion for chairside

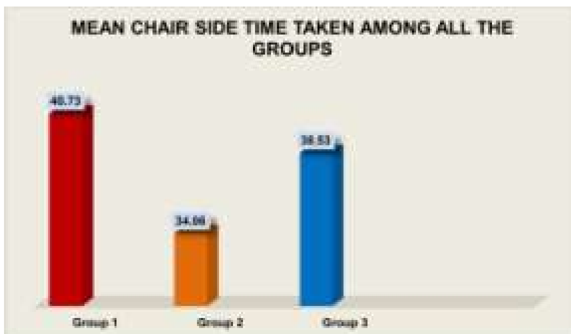

Figure 6: Mean chairside time among all the groups

Parental acceptance showed no significant intergroup differences ($p > 0.05$), though Groups 1 ($p = 0.03$) and 2 ($p = 0.00$) improved significantly over time, while Group 3 showed a non-significant increase. The modified gingival bleeding index and radiographic evaluation revealed no significant inter- or intragroup changes ($p > 0.35$ and $p = 1.00$, respectively). Marginal adaptation showed no intergroup differences ($p > 0.05$), but Group 1 improved significantly over time ($p = 0.01$). Staining and crown alignment remained unchanged across all groups. Wear of opposing teeth showed no intergroup difference ($p > 0.05$), though Group 1 demonstrated a significant increase ($p = 0.01$). Interproximal contact improved significantly in all groups over time ($p < 0.05$), despite no intergroup differences ($p > 0.05$). Occlusion showed no significant differences within or between groups ($p = 0.36$).

Figures 7 and 8 illustrate the postoperative appearance of Group II and 6-month follow-up, respectively.

Figure 7: Post-op of Group II

Figure 8: 6 Month follow up

Figures 9 and 10 illustrate the postoperative appearance of Group III and 6-month follow-up, respectively.

Figure 9: Post-op of Group III

Figure 10: 6 Month follow up

Discussion:-

Children are highly susceptible to caries soon after the eruption of the first tooth (~6 months), and early childhood caries remains prevalent worldwide, affecting up to 90% of 3–5-year-olds in some regions.[4]Caries in primary teeth impacts esthetics, self-esteem, mastication, speech, arch integrity, and overall health. While extraction is common, preserving primary teeth until permanent successors erupt is crucial for function and psychosocial development.[5] Management includes preventive strategies—oral hygiene education, diet counseling, fluoride, sealants—and restorative treatment. Deep caries often requires endodontic therapy, followed by a definitive restoration to seal the tooth, restore function, and replace lost structure.[6] Tooth weakness post-endodontic therapy is primarily due to structural loss rather than treatment itself; an MOD cavity can reduce stiffness by up to 63% (Reeh et al., 1989), highlighting the need for full-coverage restorations.[7]

Stainless steel crowns (SSCs) remain the gold standard for primary molars due to durability, affordability, and ease of placement, but their metallic appearance limits esthetics and parental acceptance. Titanium nitride-coated crowns (TiNCs) offer a tooth-colored, golden-yellow appearance with enhanced hardness, wear resistance, corrosion resistance, and biocompatibility, providing a promising esthetic alternative.[8]

Surface modification, such as sandblasting SSCs, creates micro-retentive features that improve bond strength with resin-based cements, enhancing retention and restoration longevity. This study aims to evaluate cost-effective, evidence-based options for restoring endodontically treated primary molars with improved esthetic and functional outcomes.[9]

The study was conducted at the Department of Paediatric and Preventive Dentistry, SVS Institute of Dental Sciences, after Institutional Ethical Committee approval. Forty-five primary molars from children aged 3–10 years (mostly 6–8) were randomly assigned to three groups (n = 15 each): Group I—titanium nitride-coated SSCs (TiNC), Group II—sandblasted SSCs, and Group III—conventional SSCs. Sample size was calculated using G*Power 3.1.9 ($\alpha = 0.05$, power = 80%).

After clinical and radiographic assessment, teeth underwent pulpotomy or pulpectomy under local anesthesia (2% lidocaine with 1:80,000 epinephrine), followed by restoration of remaining tooth structure. Crowns were randomly selected and cemented with glass-ionomer cement (GIC). Pre- and post-operative photographs and periapical radiographs were obtained. Follow-ups were conducted at 1, 3, and 6 months by the same examiner to evaluate clinical performance, aesthetics, retention, and bone integrity.

Parameters assessed at each follow-up: gingival status, plaque index, occlusion, crown retention, interproximal contacts, marginal adaptation, crown alignment, staining, and radiographic changes. Gingival health was evaluated using the plaque index and Modified Gingival Index, as material properties and surface characteristics influence plaque accumulation and periodontal outcomes.

Plaque index scores (Löe & Silness, 1967)[10] showed that Group I (TiNC) had the lowest accumulation at 1, 3, and 6 months (11.50, 20.30, 22.97), followed by Group II (Sandblasted SSC: 26.93, 22.93, 23.07) and Group III (Conventional SSC: 30.57, 25.77, 22.97). Intergroup differences were significant at 1 month ($p = 0.00$) but not at later time points. Within-group analysis revealed a significant increase over time only for Group I ($\chi^2 = 24.13$, $p = 0.00$).

Group III showed higher initial plaque due to rougher surfaces and poorer marginal adaptation, contrasting with Agarwal et al. (2022),[11] while Group II performed moderately, as sandblasting can paradoxically enhance plaque retention. These findings are consistent with Bamadadian et al. (2019),[12] who reported superior plaque resistance and wear for TiNCs, and with Walia et al. (2014)[13,14] and Al Shobber et al. (2021),[15] who emphasized the importance of crown surface smoothness, contour, and marginal adaptation in controlling plaque and gingival inflammation. Overall, TiNCs maintained superior early performance and consistent plaque control, sandblasted SSCs were moderate, and conventional SSCs required stricter hygiene. Children and parents were instructed on proper oral hygiene to minimize gingival inflammation associated with poorly adapted crowns.[16]

Gingival bleeding and inflammation were assessed at 1, 3, and 6 months using the Gingival Bleeding Index and Modified Gingival Index (MGI). Kruskal-Wallis tests showed no significant differences among Group I (TiNC), Group II (Sandblasted SSC), and Group III (Conventional SSC) at any time point, and Friedman tests confirmed stable intragroup scores over time ($p > 0.35$). Mean ranks for bleeding and MGI remained nearly unchanged, indicating consistent, favorable gingival responses to all crown types.

These findings suggest that none of the crowns induced significant inflammation or bleeding, likely due to proper marginal adaptation, standardized cementation, and effective oral hygiene. The results align with previous studies showing well-contoured SSCs rarely cause gingival issues (Seale & Randall, 2015; Roberts et al., 2005)[17] and support the biocompatibility of TiN coatings, which reduce bacterial adhesion, enhance surface smoothness, and limit inflammatory responses (Bamadadian et al., 2019; Sfondrini et al., 2002; Mathew et al., 2014).[12,18,19]

Parental satisfaction with three crown types was evaluated at 1, 3, and 6 months using a five-point Likert scale. Intergroup analysis (Kruskal–Wallis) showed no significant differences ($p > 0.05$), though mean ranks varied. At one month, sandblasted SSCs ranked highest, while TiN-coated crowns were lowest, contrasting with Vundela et al. (2021)[20] and Prasanna et al. (2022),[21] who reported high satisfaction with TiN crowns due to esthetics and durability. Intragroup analysis (Friedman) revealed significant improvement for TiN crowns ($p = 0.03$) and sandblasted SSCs ($p = 0.00$), but not for conventional SSCs ($p = 0.09$). Rising acceptance of TiN crowns supports findings by Bamdadian et al. (2019)[12] and Mathew et al. (2014),[19] while temporary dips with sandblasted crowns resolved over time. These trends are consistent with Innes et al. (2015)[22] and Seale & Randall (2015),[17] who emphasized functional success and child comfort as key drivers of long-term satisfaction. Sfondrini et al. (2002)[18] and Walia et al. (2014) further highlighted TiN's biocompatibility and plaque resistance, supporting improved parental perception over time.

Occlusion, assessed using criteria from Ram et al. (1998),[24] Connel et al. (1999),[25] and Donly et al. (2005),[26] showed no significant intergroup differences among TiNC, sandblasted SSC, and conventional SSCs ($\chi^2 = 2.00$, $p = 0.36$). All crowns maintained vertical dimension, cusp alignment, and occlusal contacts. Intragroup analysis (Friedman test) confirmed stable occlusion over time ($p > 0.05$), reflecting effective tooth preparation, occlusal reduction (1–1.5 mm), interocclusal wax verification, and crown contouring. These findings align with Holsinger et al. (2016)[27] emphasizing that proper anatomical preparation ensures occlusal stability regardless of crown type.
Interproximal contacts, assessed using dental floss (Donly et al., 2005),[26] showed no significant intergroup differences at 1, 3, or 6 months ($p > 0.4$), indicating comparable contact adaptation across all crown types. Intragroup analysis revealed significant improvement over time: Group I (1.43 → 2.53, $\chi^2 = 16.54$, $p < 0.01$), Group II (1.63 → 2.43, $\chi^2 = 12.25$, $p < 0.01$), and Group III (1.73 → 2.23, $\chi^2 = 7.60$, $p = 0.02$), likely due to functional forces, minor tooth movement, and soft tissue remodeling, consistent with Seale & Randall (2015).

Crown durability over six months showed that Group I (TiN-coated) initially performed best (mean rank 25.00) but declined from three months onward (mean rank 38.00, p = 0.00), indicating wear, fractures, or reduced retention. Intragroup analysis confirmed significant deterioration for Group I (1.13 → 2.43, p = 0.00), while Groups II and III remained stable (mean rank 2.00). TiN coatings may chip or delaminate under masticatory stress (Subramaniam et al., 2020),[28] contrasting with studies reporting coating stability (Kim et al., 2021; Vundela et al., 2023).[29,20] Conventional and sandblasted SSCs maintained high retention and fracture resistance, consistent with Seale & Randall (2015)[17]

Opposing tooth wear showed no significant intergroup differences (p > 0.06). Intragroup analysis revealed significant wear increases in Groups I (TiN, p = 0.01) and II (sandblasted SSC, p = 0.00), likely due to surface hardness or roughness, while Group III (conventional SSC) showed minimal change (p = 0.22). These results align with prior studies noting increased antagonist wear with coated/textured crowns and favorable wear with conventional SSCs (Subramaniam et al., 2020; Seale & Randall, 2015).[28,17] Conventional SSCs demonstrated the most predictable durability and minimal opposing tooth wear, whereas TiN and sandblasted crowns require cautious long-term use.

Crown alignment was assessed over six months (0 = normal, 1 = rotated, 2 = maligned). Intergroup comparison (Kruskal-Wallis) showed identical mean ranks (23.00) with no significant differences, indicating crown material or surface modification did not affect positioning. Intragroup analysis (Friedman test) confirmed stable alignment over time (mean rank 2.00), with no rotation or malalignment observed. These results reflect effective tooth preparation, crown selection, and seating, aligning with Seale & Randall (2015),[17] Waggoner (2002),[30] and Roberts et al. (2001),[31] who reported that properly adapted stainless steel crowns maintain long-term positional stability.

Staining was evaluated from criteria given by Dong et al(2005)[26] minimal in all groups. Mean ranks were similar at one and three months (23.00) and slightly higher for TiN-coated and sandblasted SSCs at six months (23.50 vs. 22.00 for conventional SSC), with no significant differences (p = 0.36). Friedman tests confirmed intra-group stability, indicating clinically acceptable surface coloration without progression to Gamma-level staining, consistent with Subramaniam et al. (2020).[28]

Marginal adaptation was evaluated from criteria given by Dong et al(2005)[26] remained clinically acceptable for all crowns. Intergroup comparisons showed no significant differences at one, three, or six months (p > 0.31). Intragroup analysis revealed a slight, significant decline for TiN-coated crowns (mean rank 1.73 → 2.13, p = 0.01), while sandblasted and conventional SSCs remained stable (p > 0.22). All crowns stayed within Alpha–Beta limits, reflecting adequate crimping, seating, and flexibility, in line with Seale & Randall (2015)[17] and Roberts et al. (2005).[31]

Radiographic evaluation revealed stable alveolar bone levels across all groups. Mean ranks remained 2.00 at all time points, with no inter- or intragroup variation, indicating no adverse biological response, bone resorption, or periapical pathology, corroborating prior reports (Roberts et al., 2005; Seale & Randall, 2015).[31,17]
Chair-side time differed significantly (ANOVA, p = 0.01), with TiN-coated crowns taking the longest (40.73 ± 6.22 min), conventional SSCs intermediate (38.67 ± 3.94 min), and sandblasted SSCs the shortest (35.20 ± 4.49 min), reflecting material handling and adjustment requirements, consistent with Seale & Randall (2015)[17] and Chisini et al. (2018).[32]

Author Recommendations:-

Within the limitations of a six-month follow-up and modest sample size, the following recommendations may be drawn:

- **Conventional stainless steel crowns** remain the most reliable option for endodontically treated primary molars due to superior durability, minimal opposing tooth wear, and predictable clinical performance.
- **Sandblasted stainless steel crowns** may be considered when improved retention is desired, provided meticulous polishing and oral hygiene are ensured.
- **Titanium nitride–coated crowns** offer acceptable short-term performance and increasing parental acceptance but should be used cautiously until further long-term evidence supports coating durability and antagonist wear behavior.

Future studies with longer follow-up periods and larger sample sizes are recommended to further evaluate the longevity, coating integrity, and cost-effectiveness of titanium nitride–coated crowns in pediatric dentistry.

Conclusion:-

Within the limitations of this randomized clinical trial and a six-month follow-up period, titanium nitride-coated crowns, sandblasted stainless steel crowns, and conventional stainless steel crowns demonstrated satisfactory clinical, functional, and biological performance in endodontically treated primary molars. Conventional stainless steel crowns exhibited superior durability, retention, and minimal opposing tooth wear, reaffirming their role as the gold standard. Sandblasted stainless steel crowns showed comparable outcomes, while titanium nitride-coated crowns demonstrateed acceptable early performance and increasing parental acceptance, warranting further long-term evaluation. Successful outcomes were influenced primarily by appropriate case selection, standardized tooth preparation, and effective oral hygiene maintenance.

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