



Clinical Assessment of Stainless-Steel Crowns and Preformed Zirconia Crowns in Primary Molars: An Observational Study.

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Abstract

Background: Full-coronal restorations are frequently indicated for primary molars with extensive caries, structural loss, or previous pulp therapy. Stainless-steel crowns provide reliable durability, whereas preformed zirconia crowns offer improved appearance.

Objectives: To compare the 12-month clinical performance, placement time, and parental satisfaction associated with stainless-steel crowns and preformed zirconia crowns in primary molars. **Methods:** This prospective observational study included 50 children treated at ARK Dental Hospital, Hyderabad, Telangana, India, from March 2024 to December 2025. One primary molar per child was evaluated. Twenty-five teeth received stainless-steel crowns, and 25 received preformed zirconia crowns. Retention, marginal adaptation, gingival health, secondary caries, structural defects, placement time, and parental satisfaction were assessed at 6 and 12 months. Continuous and categorical variables were analysed using appropriate parametric and categorical tests. **Results:** The mean age was 5.9 ± 1.3 years, and 56.0% of participants were boys. At 12 months, complete retention was observed in 96.0% of stainless-steel crowns and 92.0% of preformed zirconia crowns. Overall clinical success was 92.0% and 84.0%, respectively, without a significant difference. Mean placement time was lower for stainless-steel crowns than for preformed zirconia crowns (12.6 ± 3.1 versus 18.4 ± 4.2 minutes; $p < 0.001$). High aesthetic satisfaction was more frequent with preformed zirconia crowns (96.0% versus 72.0%; $p = 0.049$). **Conclusion:** Both restorations demonstrated favourable short-term clinical performance. Stainless-steel crowns required less chairside time and showed numerically higher success, whereas preformed zirconia crowns achieved greater parental satisfaction with appearance.

Keywords: Primary molars; stainless-steel crowns; preformed zirconia crowns; paediatric dentistry; clinical success; parental satisfaction.



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INTRODUCTION

Dental caries in the primary dentition remains a common reason for pain, infection, impaired mastication, and premature tooth loss. Primary molars with extensive multisurface lesions often retain insufficient tooth structure for predictable intracoronal restoration. Full-coronal coverage protects the remaining tissues, restores proximal contacts and occlusal form, and supports function until physiological exfoliation. Stainless-steel crowns have consequently occupied a central role in paediatric restorative dentistry, particularly for teeth with extensive caries, developmental defects, fracture, or previous pulp therapy.¹⁻³

Stainless-steel crowns are preformed metal restorations with well-established mechanical durability. Their circumferential coverage, relatively low technique sensitivity, and ability to tolerate challenging moisture-control conditions contribute to dependable clinical survival. Reviews comparing crowns with conventional fillings have reported fewer major failures and less need for replacement when preformed crowns are used for severely affected primary molars.^{4,5} Nevertheless, their metallic appearance is conspicuous, and some parents perceive this feature as an important disadvantage, especially when restorations are visible during smiling or speaking.

Growing expectations regarding dental appearance have encouraged the use of tooth-coloured preformed paediatric crowns. Zirconia-based restorations provide a smooth surface, colour stability, favourable biocompatibility, and a more natural appearance. A systematic review of aesthetic preformed crowns reported encouraging gingival and structural outcomes but also highlighted limited comparative evidence and short follow-up periods.⁶ Unlike stainless-steel crowns,

rigid zirconia restorations cannot be crimped or substantially adjusted; therefore, they generally require greater circumferential tooth reduction and precise passive seating.

Clinical selection should balance retention, marginal adaptation, periodontal response, secondary caries, chairside efficiency, structural integrity, and family preference. Systematic evidence suggests high survival for stainless-steel crowns, while comparative studies have shown improved gingival parameters and lower plaque accumulation around zirconia crowns.^{7,8} Stainless-steel crowns have also demonstrated greater longevity than multisurface composite restorations.⁹ Conversely, smoother zirconia surfaces have been associated with reduced *Streptococcus mutans* adhesion and gingival inflammation.¹⁰

Prospective comparisons have generally found acceptable success for both crown types, although differences in retention, preparation requirements, and aesthetic acceptance persist.¹¹⁻¹⁴ Evidence from Indian private dental settings remains limited, and treatment decisions are frequently influenced by cost, parental preference, and the child's cooperation. These practical considerations warrant evaluation under routine clinical conditions, where operator time and family-centred outcomes are relevant alongside biological success. Therefore, the present study aimed to compare stainless-steel crowns and preformed zirconia crowns in primary molars over a 12-month period. The objectives were to assess crown retention, marginal adaptation, gingival health, secondary caries, structural complications, overall clinical success, placement time, and parental satisfaction with appearance and function.

MATERIALS AND METHODS

Study design and setting: This prospective comparative observational study was conducted at ARK Dental Hospital, Hyderabad, Telangana, India, from March 2024 to December 2025. Participant enrolment and crown placement were completed at the beginning of the study period, followed by clinical reviews at 6 and 12 months.

Participants and sampling: Children aged 3-8 years who attended the hospital and required full-coronal restoration of one primary molar were screened consecutively. Fifty eligible children were included, with one tooth assessed per participant to avoid clustering of outcomes. Twenty-five teeth received stainless-steel crowns and 25 received preformed zirconia crowns. The restoration was selected through shared clinical decision-making involving the treating dentist and parent, based on tooth condition, available occlusal clearance, aesthetic preference, and treatment affordability. No random allocation was performed.

Eligibility criteria: Children were included when they had a restorable primary first or second molar with multisurface caries, a completed pulp-therapy procedure requiring definitive coverage, or a developmental enamel defect compromising coronal integrity. Teeth required adequate remaining root length, absence of pathological mobility, and no clinical or radiographic evidence of acute infection. Children with known metal allergy, uncontrolled systemic illness, poor likelihood of follow-up, severe uncooperative behaviour preventing safe treatment, non-restorable teeth, advanced physiological root resorption, furcation pathology, or anticipated exfoliation within 12 months were excluded.

Clinical procedure: Baseline demographic and tooth-related information was recorded. Caries removal and pulp therapy, when indicated, were completed before crown placement. Stainless-steel crowns were prepared, selected, contoured, crimped, and cemented using conventional clinical principles.^{1,3} Preformed zirconia crowns were placed after circumferential and occlusal reduction sufficient to permit passive seating, without forceful adaptation or crimping.^{6,11} Occlusion, proximal contacts, crown stability, and marginal seating were checked after cementation. Placement time was measured from the start of tooth preparation to completion of cement cleanup and occlusal verification.

Outcome assessment: Clinical reviews were undertaken at 6 and 12 months. Outcomes included complete retention, acceptable marginal adaptation, satisfactory gingival health, absence of secondary caries, fracture or surface chipping, and overall clinical success. Overall success required the crown to remain functional without loss, clinically important marginal defect, recurrent caries, significant gingival pathology, or structural failure. Parental satisfaction with appearance and function, and willingness to select the same restoration again, were recorded using structured responses.

Statistical analysis: Data were analysed using standard statistical software. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the independent-samples t-test. Categorical variables were summarised as frequencies and percentages and compared using the Chi-square test or Fisher's exact test when expected cell counts were small. A two-sided p-value <0.05 was considered statistically significant.

Ethical considerations: Written informed consent was obtained from each parent or legal guardian, with age-appropriate assent from children whenever feasible. Participant confidentiality was maintained throughout data collection and analysis.

RESULTS

A total of 50 children requiring full-coronal restoration of a primary molar were included in the study. Complete baseline and 12-month follow-up data were available for all participants. The mean age of the children was 5.9 ± 1.3 years, ranging from 3 to 8 years. Twenty-eight (56.0%) participants were boys, while 22 (44.0%) were girls.

Among the 50 restored primary molars, 31 (62.0%) were mandibular molars and 19 (38.0%) were maxillary molars. The mandibular first primary molar was the most frequently restored tooth, accounting for 17 (34.0%) cases. Restoration after pulp therapy was the principal indication for restoration in 28 (56.0%) teeth, followed by multisurface dental caries in 16 (32.0%) teeth and developmental enamel defects in 6 (12.0%) teeth. Stainless-steel crowns were placed in 25 teeth, while preformed zirconia crowns were placed in the remaining 25 teeth. The baseline characteristics were comparable between the two restoration groups (Table 1).

Table 1. Baseline characteristics of the study participants and restored primary molars (N = 50)

Characteristic	Stainless-steel crown group (n = 25)	Preformed Zirconia crown group (n = 25)	Total, n (%)	p-value
Age, years, mean $\pm$ SD	5.8 ± 1.2	6.0 ± 1.3	5.9 ± 1.3	0.575
Boys	15 (60.0)	13 (52.0)	28 (56.0)	0.569
Girls	10 (40.0)	12 (48.0)	22 (44.0)	
Maxillary molars	9 (36.0)	10 (40.0)	19 (38.0)	0.771
Mandibular molars	16 (64.0)	15 (60.0)	31 (62.0)	
First primary molars	15 (60.0)	13 (52.0)	28 (56.0)	0.569
Second primary molars	10 (40.0)	12 (48.0)	22 (44.0)	
Restoration after pulp therapy	14 (56.0)	14 (56.0)	28 (56.0)	1.000
Multisurface caries	9 (36.0)	7 (28.0)	16 (32.0)	0.544
Developmental enamel defect	2 (8.0)	4 (16.0)	6 (12.0)	0.667

At the 6-month assessment, complete retention was observed in all 25 stainless-steel crowns and in 24 (96.0%) preformed zirconia crowns. Acceptable marginal adaptation was recorded in 24 (96.0%) stainless-steel crowns and 23 (92.0%) preformed zirconia crowns. Healthy gingival tissues or only mild gingival changes were observed around 23 (92.0%) stainless-steel crowns and 22 (88.0%) preformed zirconia crowns. No secondary caries was detected in either group at six months.

At 12 months, 24 (96.0%) stainless-steel crowns and 23 (92.0%) preformed zirconia crowns remained fully retained. Acceptable marginal adaptation was found in 23 (92.0%) and 22 (88.0%) restorations, respectively. Gingival health was satisfactory in 22 (88.0%) teeth restored with stainless-steel crowns and 21 (84.0%) teeth restored with preformed zirconia crowns. Secondary caries occurred in one tooth in each group. Two cases of minor surface chipping were observed in the preformed zirconia crowns group, whereas no crown fracture or perforation was identified in the stainless-steel crown group. None of these differences reached statistical significance (Table 2).

Table 2. Clinical outcomes at 6 and 12 months according to restoration type

Clinical outcome	Stainless-steel crown group, n (%)	Preformed zirconia crown group, n (%)	p-value
Six-month assessment			
Complete crown retention	25 (100.0)	24 (96.0)	1.000
Acceptable marginal adaptation	24 (96.0)	23 (92.0)	1.000
Satisfactory gingival health	23 (92.0)	22 (88.0)	1.000
Absence of secondary caries	25 (100.0)	25 (100.0)	1.000
Twelve-month assessment			
Complete crown retention	24 (96.0)	23 (92.0)	1.000
Acceptable marginal adaptation	23 (92.0)	22 (88.0)	1.000
Satisfactory gingival health	22 (88.0)	21 (84.0)	1.000
Absence of secondary caries	24 (96.0)	24 (96.0)	1.000
Crown fracture or surface chipping	0 (0.0)	2 (8.0)	0.490
Overall clinical success	23 (92.0)	21 (84.0)	0.667

The mean time required for tooth preparation and crown placement was significantly shorter for stainless-steel crowns than for preformed zirconia crowns, at 12.6 ± 3.1 minutes versus 18.4 ± 4.2 minutes, respectively ($p < 0.001$). In contrast, parental satisfaction with the appearance of the restoration was higher in the preformed zirconia crowns group. High aesthetic satisfaction was reported by 24 (96.0%) parents in the preformed zirconia crowns compared with 18 (72.0%) parents in the stainless-steel crown group, representing a statistically significant difference ($p = 0.049$). Satisfaction with function and chewing ability remained high in both groups (Table 3).

Table 3. Procedural characteristics and parental satisfaction

Assessment	Stainless-steel crown group (n = 25)	Preformed zirconia crown group (n = 25)	p-value
Placement time, minutes, mean $\pm$ SD	12.6 ± 3.1	18.4 ± 4.2	<0.001
High satisfaction with appearance	18 (72.0)	24 (96.0)	0.049
High satisfaction with function	23 (92.0)	23 (92.0)	1.000
Willingness to select the same restoration again	22 (88.0)	24 (96.0)	0.609

Overall clinical success at the end of 12 months was documented in 44 of the 50 restorations, resulting in an overall success rate of 88.0%. The success rate was 92.0% for stainless-steel crowns and 84.0% for preformed zirconia crowns. Although stainless-steel crowns demonstrated a numerically higher clinical success rate and required less placement time, the difference in overall clinical success between the groups was not statistically significant. Preformed zirconia crowns provided significantly greater parental satisfaction regarding crown appearance.

DISCUSSION

The present study found favourable 12-month performance for both stainless-steel crowns and preformed zirconia crowns in primary molars. Overall clinical success reached 92.0% with stainless-steel crowns and 84.0% with preformed zirconia crowns. Although the numerical difference favoured stainless steel, it was not statistically significant. This pattern supports the established durability of full-coverage restorations and agrees with earlier evidence showing high survival of stainless-steel crowns in extensively restored primary molars.^{4,5,7,9}

Retention remained high in both groups, with complete retention in 96.0% of stainless-steel crowns and 92.0% of preformed zirconia crowns at 12 months. The slightly higher retention of stainless-steel crowns is clinically plausible because these crowns can be contoured and crimped to improve cervical adaptation. Zirconia crowns are rigid and depend on accurate tooth reduction, passive fit, and cementation. Taran and Kaya similarly reported complete retention of stainless-steel crowns with occasional decementation of zirconia crowns.⁸ Prospective clinical trials have also demonstrated acceptable performance for both materials, while identifying retention as a relevant consideration for zirconia crowns.¹¹

Marginal adaptation and gingival health were satisfactory in most teeth. The differences between groups were small and statistically non-significant. Previous investigations have linked zirconia crowns with lower plaque accumulation and improved gingival indices because of their polished, smooth surfaces.^{10,14} The present findings did not demonstrate a significant gingival advantage, possibly because oral-hygiene instruction, careful crown placement, and the limited sample reduced between-group variation. Secondary caries occurred in one tooth in each group, indicating that both restorations provided effective coronal coverage during the observation period.

Two preformed zirconia crowns showed minor surface chipping, while no stainless-steel crown fractured or perforated. This difference was not statistically significant, but it illustrates the contrasting mechanical behaviour of metal and ceramic restorations. Stainless steel tolerates deformation and adjustment, whereas ceramic materials resist wear but can develop localised surface defects under occlusal stress. Reviews of aesthetic crowns have similarly emphasised the need to consider fracture resistance, preparation design, and antagonist wear when choosing a restoration.^{6,12,13}

The mean placement time was significantly shorter for stainless-steel crowns. Their adjustable margins and comparatively conservative preparation permit faster clinical completion. Zirconia crowns require greater reduction and repeated verification of passive seating, which can extend chairside time. In contrast, parental aesthetic satisfaction was significantly higher with preformed restorations. This finding reflects the tooth-coloured appearance of zirconia and is consistent with comparative studies reporting strong parental acceptance of aesthetic crowns.¹¹⁻¹³ Functional satisfaction was high and identical in both groups. Therefore, restoration selection should remain individualised: stainless-steel crowns offer efficiency and predictable retention, whereas preformed zirconia crowns provide superior appearance with comparable short-term function.

Limitations

This study had a modest sample size, was conducted at a single private dental centre, and followed restorations for only 12 months. Restoration selection was not randomised, creating potential selection and preference bias. Operator blinding was not feasible, and radiographic outcomes, plaque indices, and child-reported satisfaction were not evaluated. These factors restrict external validity and prevent conclusions regarding long-term comparative survival.

CONCLUSION

Stainless-steel crowns and preformed zirconia crowns provided satisfactory clinical outcomes for full-coronal restoration of primary molars during 12 months of follow-up. Stainless-steel crowns showed a numerically higher success rate, excellent retention, absence of structural fracture, and significantly shorter placement time. Preformed zirconia crowns achieved comparable retention and marginal performance while producing significantly greater parental satisfaction with crown appearance. Functional satisfaction remained high with both restorative options. Crown selection should therefore consider the extent of tooth destruction, occlusal conditions, child cooperation, chairside time, aesthetic expectations, and family preference. Larger multicentre studies with random allocation, calibrated assessors, radiographic evaluation, and longer observation are required to establish comparative longevity and failure patterns.

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