ORIGINAL RESEARCH

Clinical Evaluation of Maneuverability and Durability of Titanium Nitride-coated Preformed Crown on Primary Molar Teeth: A Randomized Controlled Trial

Rajashekar R Vundela[1], Nisha Gupta[2], Balamurugan Suba Ranjana[3], Nagalakshmi Chowdhary[4], Mahesh K Karuppaiah[5], Thirumagalanuraaga Annadurai[6]

Abstract

Background: The management of multisurface carious primary molar is challenging. Currently, the ideal choice for the management of extensive multi-surface carious primary molar is the placement of a preformed stainlesssteel crown (SSC)/preformed zirconia crown. Unfortunately, conventional preformed SSCs are frequently refused by parents for esthetic reasons, while the preformed zirconia crown has its own disadvantages like high cost and excessive tooth preparation.

Aim: To evaluate the maneuverability and durability of titanium nitride-coated crowns on primary molar teeth and to assess the child–parent satisfaction of titanium nitride-coated gold-colored preformed crowns over metal-colored preformed SSC on primary molar teeth.

Materials and methods: Randomized controlled trial conducted on children between the age-groups of 6- and 9-year-old children. Group I for titanium nitride-coated preformed crown and group II for preformed SSC (control group) were allotted with a simple random technique. The maneuverability of the titanium nitride-coated crowns was evaluated in comparison with preformed SSC in terms of the level of difficulty while trimming, contouring, crimping, and wearing out of titanium nitride coating while manipulating. Participants of group I were recalled for follow-up in the 1st, 6th, and 12th months to evaluate the durability of the titanium nitride coating on the preformed crowns.

Results: There were no failures at the 12-month follow-up in terms of the durability of the titanium nitride coating, and there was no significant difference seen in terms of the maneuverability of both crowns. Overall, child–parent satisfaction was good with gold-colored titanium nitride-coated crowns.

Conclusion: The study concluded that titanium nitride-coated gold crowns could be a boon to pediatric dentistry and serve as an alternative to metal-colored SSCs.

Keywords: Child–patient satisfaction, Durability, Maneuverability, Stainlesssteel crowns, Titanium nitride crowns.

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Introduction

Dental caries is typically linked to detrimental effects on health, well-being, and quality of life, including discomfort, pain, and functional impairment that affects growth and development.[1] The management of multi-surface carious primary molar is challenging to the clinician. There are a variety of materials utilized to reconstruct such teeth over the past many years, including amalgam, composites, and stainlesssteel crowns (SSCs). SSCs were first used in dentistry in 1947 by the Rocky Mountain Company, which was first reported by Humphrey and Engel. It had been used for restoring decayed teeth and was mainly advised where pulpotomies or pulpectomies were performed since there was less microleakage than with amalgam-restored teeth.[2] Currently, the ideal choice for the management of extensive multisurface carious primary molar is the placement of a preformed SSC/preformed zirconia crown.[3] Unfortunately, conventional preformed SSCs are frequently refused by parents for esthetic reasons, while the preformed zirconia crown has its own disadvantages like high cost and excessive tooth preparation.[4]

Recently, Shinhung Company Ltd, a kids crown manufacturer, has suggested a titanium nitride-coated crown, giving it a golden and yellow appearance. This coating helps in strengthening the hardness of the surface. Since the introduction of these crowns, there is no literature on clinical evaluation of the same.

Hence, the study was undertaken to assess and compare the maneuverability and durability of titanium nitride-coated preformed crown on primary molar teeth.

[1,3–6]Department of Pedodontics & Preventive Dentistry, Sri Siddhartha Dental College & Hospital, Sri Siddhartha Academy of Higher Education (Deemed to be University), Tumakuru, Karnataka, India

[2]Department of Pedodontics & Preventive Dentistry, Banglore Institute of Dental Sciences and Hospital, Bengaluru, Karnataka, India

Corresponding Author: Rajashekar R Vundela, Department of Pedodontics & Preventive Dentistry, Sri Siddhartha Dental College & Hospital, Sri Siddhartha Academy of Higher Education (Deemed to be University), Tumakuru, Karnataka, India, Phone: +91 9035894944, e-mail: drvrajashekarreddy@gmail.com

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Materials and Methods

Written informed consent was obtained from the parent/guardian after being informed about the study. The Institutional Ethics and Review Committee, Sri Siddhartha Academy of Higher Education, has given the ethical clearance for the study. The study population consists of patients visiting the Department of Pediatric and Preventive Dentistry, Sri Siddhartha Dental College and Hospital.

Cooperative and healthy children between 6 and 9 years who underwent pulpectomy or pulpotomy-treated teeth with two-thirds of the root present without any more internal/external resorption were included in the study. The exclusion criteria were children with special health care needs, and tooth mobility, developmental anomalies. A total of 42 children were included in the study who fulfilled the criteria. A simple random technique was done to allow the case for group I (titanium nitride-coated crown) and group II (SSC, controlled group). A single operator placed all crowns with a new set of burs for each procedure.

Maneuverability of the titanium nitride-coated preformed crowns was evaluated in comparison with preformed SSCs in terms of difficulty level while trimming, contouring, and crimping for seating on the tooth and also wore out of titanium nitride coating was scored while manipulating. Type I glass ionomer cement (GIC) (GC Corp, Japan) is used to cement all the crowns. Patients were given postoperative instructions. The child-parental satisfaction was evaluated by making both groups I and II participants participate in the questionnaire survey after the placement of the crown. Parents were given the opportunity to rate the criteria like size, shape, color, and overall satisfaction, with a score of 1 being very dissatisfied and a score of 5 being very satisfied using a 5-point Likert scale. Later, group I participants were recalled on the 1st, 6th, and 12th months to evaluate and check the durability of the titanium nitride coating on the preformed crown.

On follow-up, durability was evaluated in terms of wear out of the titanium nitride coating on the preformed crowns; any surface wear out of the titanium nitride coating, irrespective of the size. Variables for maneuverability and durability were scored using the below-mentioned customized scoring criteria.

S. no.	*Criteria*	*Score*
1	Maneuverability	Score 1: easy Score 2: average Score 3: hard
2	Durability • Wear resistance during manipulation of the crown. • Wear resistance after the placement of the crown on follow-up.	Score 0: no wearing of titanium coating Score 1: wear out of titanium coating from one surface Score 2: wear out of titanium coating from the multi-surface

Results

Statistical Analysis

For statistical analysis, the obtained data were coded and entered into Statistical Package for the Social Sciences (IBM version 23). Frequency and percentages are included in the descriptive statistics. The Chi-squared test for comparison is a component of the inferential statistics. A 95% confidence interval was used to define the level of significance at 0.05.

A total of 42 children between 6 and 9 years were included by simple random sampling. The results of maneuverability are summarized in Table 1 and Figure 1. There was no statistical significance in terms of maneuverability of SSCs and titanium nitride-coated preformed crowns.

Table 2 and Figure 2 represent the durability of titanium nitride coating during trimming, contouring, and crimping (manipulation). There was no significant difference in terms of wear out of titanium nitride coating.

Table 3 represents the durability of titanium nitride coating on follow-up, which showed no wear out on any surface at the 1st, 6th, and 12th months (Figs 3 and 4) during follow-up in group I.

Discussion

Full coronal restorations have become a common procedure for the treatment of children suffering from early childhood caries, which is the most common disease. Several options have been tested, with each having varying clinical results.[5] The restoration was a prime consideration previously rather than esthetic appearance, but recent demand for esthetic appearance has increased in both children and parents. Esthetic acceptance, durability, and

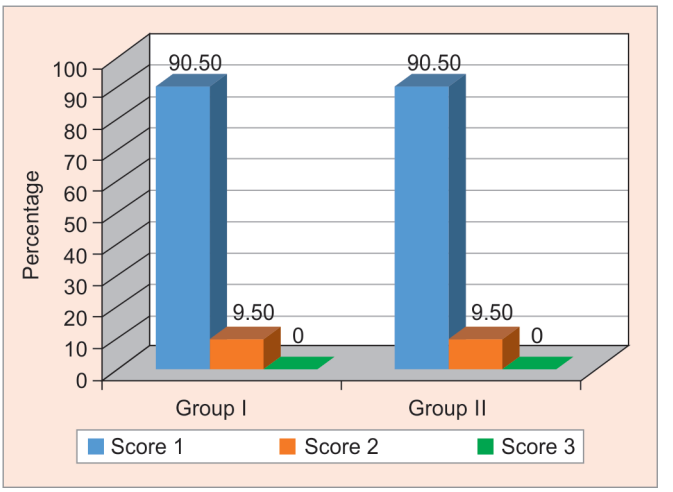

Fig. 1: Maneuverability during crown manipulation in both groups

Table 1: Maneuverability during crown manipulation in both groups

	Maneuverability				
	Score 1	*Score 2*	*Score 3*	*Chi-square value*	*Significance*
Group I	19 (90.5)	2 (9.5)	0 (0)	0.000	1.000 [nonsignificant (NS)]
Group II	19 (90.5)	2 (9.5)	0 (0)		
	Mean	*Standard deviation*		*t*	*Significance*
Group I	1.0952	0.30079		0.000	1.000 (NS)
Group II	10952	0.30079			

Table 2: Durability during crown manipulation in group I

	Score 0	*Score 1*	*Score 2*	*Chi-square value*	*Significance*
Before crown manipulation	21 (100)	0 (0)	0 (0)	3.231	0.232 (NS)
During crown manipulation	18 (85.7)	0 (0)	3 (14.3)		
	Mean	*Standard deviation*		*t*	*Significance*
Before crown manipulation	0.000	0.0000		−1.826	0.075 (NS)
During crown manipulation	0.2857	0.71714			

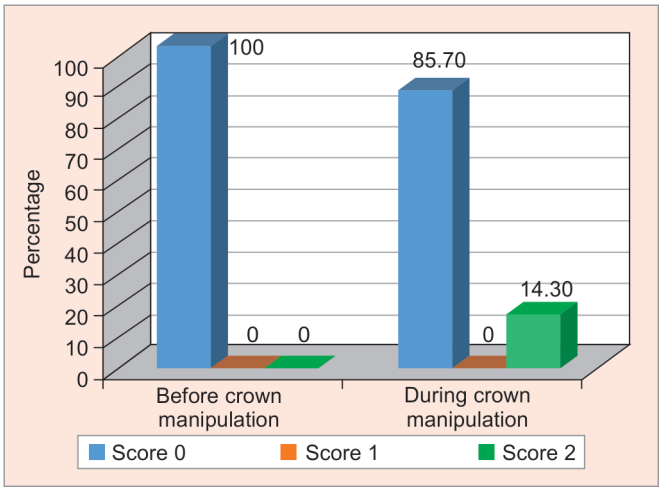

Fig. 2: Durability during crown manipulation in group I

Fig. 3: At 6-month follow-up

Table 3: Durability after crown placement in follow-up visits in group I

Group I	*Durability after crown placement*	*Frequency (%)*
1st-month follow-up	Score 0	21 (100)
	Score 1	0 (0)
	Score 2	0 (0)
6th-month follow-up	Score 0	21 (100)
	Score 1	0 (0)
	Score 2	0 (0)
12th-month follow-up	Score 0	21 (100)
	Score 1	0 (0)
	Score 2	0 (0)

Fig. 4: At 12-month follow-up

cost-effectiveness are important factors that should be taken into consideration.[6]

In terms of demand for esthetic appearance and mechanical qualities for primary molars, full coverage crowns are available in a variety of forms in the market, including SSCs, resin-veneered crowns, and zirconia crowns. Since the introduction of SSC by Engel in 1950, it has outnumbered other materials such as amalgam, GIC, and composite in terms of their durability for multi-surface caries restorations. For years, most practitioners have adopted SSC in clinical practice, but poor esthetic appearance is one of the drawbacks.[7]

Ever since the concept of esthetics gained interest among parents and children, preformed zirconia crowns have become much more popular. A study done by Murali et al. showed poor acceptance of SSCs and 100% satisfaction with zirconia crowns. However, zirconia crowns have a few drawbacks, such as aggressive tooth preparation, which includes subgingival reduction as well as passive fit by the manufacturer. SSCs, on the other hand, give snap-fit with lesser tooth preparation.[6,8] But with limited literature available, higher cost, and more tooth reduction, the choice of restoration is still questionable.

Recently, titanium nitride-coated crowns have been introduced as new full-coverage crowns manufactured by KIDS crowns (Shinhung company), and there was no clinical data to date on the durability of the titanium nitride coat of the crowns. The golden and yellow look is due to coating done on the crown, and coating plays an important role in strengthening the hardness of the surface. The manufacturer claims that titanium nitride coating is created by using titanium nitride rather than the SiO_2 coating that is typically applied over SSCs. According to Jonsson and Hogmark, the coating

has been utilized more frequently to enhance mechanical qualities, corrosion resistance, and esthetics. The chemical composition of the raw material for titanium nitride-coated crowns and SSCs and the type of coating are listed below.[9]

Raw material		*Coating*	
Element	*Composition (wt%)*	*Titanium nitride crown*	*SSC*
C (Carbon)	≤0.03	TiN	SiO_2
Si (Silicon)	1.0		
S (Sulfur)	0.03		
Mn (Manganese)	2.0		
P (Phosphorus)	0.045		
Ni (Nickel)	9.0–13.0		
Cr (Chromium)	18.0–20.0		
Fe (Iron)	Balance		

Zimmerman et al., in their study, showed the attitude of parents toward the material and method for restoration of primary teeth and concluded that most parents were reluctant toward treatment due to esthetics, cost, toxicity, and durability.[10] Titaniun nitride-coated (TiNCs) differ from SSCs in part because of their distinctive color. Parents and kids prefer TiNCs over SSCs because of their shiny, golden appearance. Fishman et al. showed that children nowadays demand more esthetics for the treatment of their posterior teeth due to the influence of media and television.[11] In the present study, when parents were asked about their choice in the future, 100% of the patients would like to continue with the same crown in group I. Whereas in group II, 60% of the parents opted for titanium nitride-coated crowns in the future. The reason is that they were more attracted to the shiny gold colour than the metal-colour crown, and high acceptability was seen among parents as well.

In terms of the maneuverability of both crowns, not much difference was noted. Crowns were easier to manipulate, which decreases the chairside time compared to other crowns, unlike zirconia, which requires extra time and extra preparation.[12] However, fewer crowns showed difficulty during maneuverability in the first primary molars. This may be due to the less surface area for manipulation, and wear out during manipulation was seen in three (14.3%) patients; overall, the results did not show any statistically significant difference.

The present study shows very good results in terms of the durability of color coating in a 12-month follow-up. No wear out was noticed on any surface of the crown. Although in previous studies comparing zirconia with SSCs, zirconia has higher patient acceptance and a higher success rate than SSCs.[9] However, greater occlusal forces are present for a longer period of time in cases of bruxism or clenching habits. Considering the normal occlusal force, approximately 150 N, and in the case of bruxism, 400 N, which would later lead to peeling of the coating. In the present study, children with no habits were considered. The titanium nitride-coated crowns have a thicker layer (4–6 ym) than SSCs (1 ym), which is an important consideration when making a decision on the longevity of the golden-colored titanium nitride-coated crowns, and it has shown good results.

Most of the children and parents were satisfied with the new titanium nitride-coated crowns because of the lustrous gold color. However, during festooning and crimping, wear out of the coating was noticed at the cervical margins. So, clinicians should keep this in mind while crimping and contouring as the golden coating may wear off. In this study, parental satisfaction with the crowns was obtained through a survey with a set of questions and a 5-point Likert scale adopted from other studies.[12] The results obtained with respect to color, size, and shape showed satisfaction in both groups. Overall, satisfaction with titanium nitride-coated crowns was better compared to SSCs.

The introduction of new titanium nitride-coated crowns is thought to be meaningful and expanded the choices for restoring posterior teeth by keeping the advantage of SSCs for clinical procedures. Titanium nitride-coated crowns could be a better choice since they are more cost-effective than zirconia crowns. As titanium nitride-coated crowns are new in pediatric dentistry, no clinical study has been reported in terms of the maneuverability and durability of both crows so far. Hence, further studies should be conducted in a large population with a longer follow-up.

Conclusion

Both stainlessssteel and titanium nitride-coated crowns are an excellent choice for restoring posterior teeth with full coronal restoration. However, the new titanium nitride-coated crowns broaden the vistas of options for treatment in terms of posterior primary teeth. Both crowns have similar costs and can be considered a viable option when the cost is considered, as the color sustainability of the crown is the most important criterion for choosing this crown. Both crowns have shown similar maneuverability and the durability of titanium nitride-coated crowns at a 12-month follow-up with good results. However, long-term follow-up is required in order to evaluate the durability of titanium nitride-coated crowns for long-term use.

Orcid

Rajashekar R Vundela https://orcid.org/0000-0002-0209-6646
Mahesh K Karuppaiah https://orcid.org/0000-0003-1326-8121

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