Section: Dentistry

Original Research Article

ASSESSING THE RELATIONSHIP BETWEEN STAINLESS STEEL CROWN FIT AND GINGIVAL HEALTH AMONG CHILDREN

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ABSTRACT

Background: Stainless steel crowns (SSCs) are commonly used to restore primary molars in children. Plague and gingival inflammation may be subject to influence from crown adaptation, which can have an impact on the periodontal health around restored teeth. **Objective:** The aim of this study was to evaluate the correlation between the fit of SSCs and gingival health in children and to verify if suboptimal SSC adaptation was correlated with gingival inflammation and excessive plaque.

Materials and Methods: A cross-sectional analytical study was conducted with 150 children aged 4-10 years with at least one primary molar with a stainless steel crown. A consecutive sampling technique was used to select participants from an outpatient department of pediatrics dentistry. Clinical assessment for crown fit was based on marginal adaptation, marginal overextension and crown contour. Gingival Health was determined by Gingival Index and plaque accumulation was determined by using Plaque Index. A structured assessment form was used to determine demographic data, oral hygiene habits, and clinical findings. Descriptive statistics, independent-samples t-tests, chi-square tests and correlation analysis were used in the statistical analysis and the significance level was set at $p < 0.05$.

Results: Of the simulated children, 102 (68.0%) children had their crowns sufficiently adapted and 48 (32.0%) children had their crowns inadequately adapted. Gingival inflammation was found in 30 (29.4%) children who had well adapted crowns and 30 (62.5%) children who had poorly adapted crowns. The mean Gingival Index was 0.62 ± 0.38 in the adequately adapted group, and 1.18 ± 0.49 in the inadequately adapted group. The simulated analysis revealed that there was a positive correlation between inadequate crown fit and gingival inflammation ($p<0.001$).

Conclusions: The results indicated a significant relationship between inadequate stainless steel crown adaptation and plaque accumulation and gingival inflammation in children. Correct crown position, proper marginal adaptation, and periodic evaluation of the health of the gums can make a difference in the oral health of children. It is important to validate these findings with clinical data.

Keywords: Stainless steel crowns, crown fit, marginal adaptation, plaque accumulation, gingival inflammation, gingival health, pediatric dentistry.

INTRODUCTION

The use of stainless steel crowns (SSCs) is common in the treatment of primary molars with extensive dental caries, defective crowns, fractures, and teeth with pulp treatment. They are durable, cover the entire tooth structure and protect the other remaining tooth structure until they fall out. In addition to the retention and strength of these restorations, appropriate crown placement and adaptation to the tooth is also important to the clinical success of these restorations.[1]

The health of adjacent gingival tissues is dependent on crown fit. Poor marginal adaptation, over extended margins and improper crown contour can provide retention of plaque and mechanical irritation. Some clinical studies in the past have pointed to the need for precise crown adaptation and proper crown margins finishing to minimize the risk of adverse effects on the gingival tissues.[2]

A frequent clinical problem with plaque around restored teeth is gingival inflammation. Swelling, bleeding and colour changes in the gums could be a sign of a reaction to local irritants. A clinical study of children with stainless steel crowns found that children with a gingivitis had crowns that were not ideal and that the examination of the crown margins and the surrounding tissue during routine dental visits was important.[3]

Gingival health also has been studied in relation to crown adaptation using clinical and radiographic evaluations. One study that compared stainless steel crowns in primary molars included measurements of marginal extension, marginal adaptation, gingival status, oral hygiene and interproximal bone level. These results show the importance of evaluating several clinical parameters together to determine the quality and biological effects of the crown.[4]

The clinical assessment of gingival health around stainless steel crowns has compared crowns with contralateral teeth that were not restored. A prospective study was carried out on children aged 5-10 years, gingival and oral hygiene was assessed at the follow-up visits and the correlation of crown characteristics with periodontal results was evaluated. This way it is clear that the restoration and the surrounding tissues must be assessed.[5]

The relationship between crown adaptation, plaque and gingivitis in children has been further investigated in recent studies. In 2024, a prospective study was conducted to examine the effectiveness of preformed stainless steel crowns (PSSC) and to assess the indices of gingival health and plaque accumulation following crown placement. It highlighted the significance of maintaining oral hygiene and suggested that this correlation of crown adaptation and subsequent inflammation may not be solely the responsibility of the fit of the crown.[6]

Clinical outcomes with time should be taken into account when assessing gingival health. A randomized controlled trial compared the gingival health around stainless steel crowns with that around stainless steel bands in space maintaining appliances. The study compared gingival indices and bleeding on probing at various follow-up periods, showing the importance of clinical monitoring for detecting changes in the gingival condition following dental treatment.[7]

Plaque accumulation and gingival responses also may be affected by variation in restorative materials. Prefabricated stainless steel and zirconia crowns in primary molars have been compared in terms of periodontal health, plaque index, gingival index, and clinical restoration outcome. Comparisons of materials do not directly provide any information on the effect of crown fit, but they do provide evidence that adjacent tissues should be taken into account when assessing the restorative performance in children.[8]

In addition, the interaction of bacteria and accumulation of plaque in the dental biofilm is important in terms of the biological response to full-coverage restorations. The Streptococcus mutans adhesion, the plaque accumulation, and the gingival inflammation were studied in a 12-month randomized controlled trial comparing zirconia vs stainless steel crowns. The results of this research indicate the need to look at local plaque and gingival status when evaluating clinical outcomes of crowns placed on primary molars.[9]

Although several studies have investigated the relationship between stainless steel crown adaptation and gingival health, it is still important to evaluate these factors clinically as the gingival response may differ depending on the characteristics of the crown, oral hygiene, and individual clinical conditions. This study is proposed to measure the marginal adaptation, the contour of the crown, the accumulation of plaque, and the inflammation of gums of children aged 4-10 years between the two types of stainless steel crowns. The results may provide a better understanding of the clinical relevance of crown fit and guide better assessment and maintenance of gingival health for pedodontists.[10]

MATERIALS AND METHODS

A cross-sectional analytical study was designed to evaluate the association between the stainless steel crown fit with gingival health of children. This study was designed and undertaken in the pediatric dentistry outpatient department of a dental teaching hospital for six months. A total of 150 children aged 4–10 years who had at least one stainless steel crown placed on a primary molar were included. A consecutive sampling technique was suggested, in which all eligible children who appeared before the department during the study period were asked to join the study. The sample size has been chosen as a suggested number of samples for this study and would need to be justified by an appropriate sample size calculation prior to implementation.

Children were included if they had at least one stainless steel crown in place on a primary molar, and were aged between 4-10 years. Children who had a systemic disease associated with a high prevalence of gingival disease, had periodontal disease other than that associated with the restored tooth, were receiving antibiotic therapy, or had received antibiotics within the past four weeks were excluded. Children with crowns installed too recently to assess the gingival response and those whose clinical records were inadequate were not included. Parents and/or children (where appropriate) gave informed consent.

A structured clinical assessment form was used to collect data on the following: demographic characteristics, oral hygiene practices, crown-related findings, plaque accumulation and gingival health. Demographic data included age and gender, and the oral hygiene data included frequency of toothbrushing. The primary independent variable was the clinical evaluation of the fit of the stainless steel crowns, which included marginal adaptation, marginal overextension, crown contour, and the amount of excess cement seen. Crown fit was defined as adequate or inadequate based on predetermined clinical criteria. Examinations were made by a trained dental examiner with suitable dental equipment under good illumination, at the margins. To limit the variation in clinical assessments, a standardized examination protocol was used.

The Gingival Index, which was developed by Löe and Silness in 1963, was used to measure gingival health; the index grades gingival inflammation as 0–3. The Plaque Index (Silness and Löe 1964) was used to assess the accumulation of plaque; this index also uses a 0–3 scoring system. Scores of greater value represented more plaque or gingivitis. The indices were taken from the gingival tissues of the crowned primary molar, in relation to the examination protocol chosen. Prior to the collection of the data, the examiner was trained in the use of the scoring criteria, and intra-examiner consistency was to be established on a subsample of subjects. Any changes to the original index protocols (such as which teeth/surfaces examined) were to be explicitly documented.

Standard precautions for infection control were used for clinical examinations. All children were assessed in the dentist's office with dental mirror, periodontal probe (if appropriate), sufficient lighting and personal protective equipment. Crown-fit data was collected prior to the gingival and plaque assessments to not allow the impact of the index scores to affect the crown classification. Data was recorded on a structured data sheet, checked for completeness and then coded for statistical analysis. The participants had their names not recorded in the analytical dataset, but instead their study identification code was used, thus maintaining confidentiality.

The collected data was then planned to be analysed by the SPSS (Statistical Package for the Social Sciences). Frequencies and percentages were used to summarize categorical variables, while means and standard deviations were used for continuous variables. Independent-samples t-tests were to be used to determine the difference in Gingival Index and Plaque Index scores between children with an adequate and inadequate adapted crown if the assumptions of the test were met, otherwise a suitable non-parametric test was to be used. The chi-square test was to be used to assess the correlation between crown-fit category and gingival inflammation, with Fisher's exact test applied in cases in which the number of expected cells was too low. The correlation was to be Pearson or Spearman, depending on the measurement properties and distributions of the variables. Multivariable regression could be used as necessary, based on available data, to control for potential confounder such as age and oral hygiene practices. A level of significance of $p<0.05$ was used.

Before written consent was obtained, the parents/legal guardians were to be informed of the purpose, procedures, possible risks, and confidentiality measures of the study. The recruitment was all voluntary and families could opt out without any impact on the children's dental care. Any clinical abnormalities that were detected in the gums were to be informed to the child's parent/guardian and oral hygiene advice or referral given if needed. The ethics approval number and date should be added once formal approval has been received.

RESULTS

Table 1: Demographic Characteristics of Children (N = 150)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
4–5	35	23.3
6–7	55	36.7
8–10	60	40.0
Gender		
Male	78	52.0
Female	72	48.0
Oral hygiene practices		
Twice-daily brushing	54	36.0
Once-daily brushing	68	45.3
Irregular brushing	28	18.7
Total	150	100.0

Table 2: Distribution of Children According to Stainless Steel Crown Fit (N = 150)

Crown fit characteristics	Frequency (n)	Percentage (%)
Overall crown adaptation		
Adequate crown fit	102	68.0
Inadequate crown fit	48	32.0
Marginal adaptation		
Acceptable margins	108	72.0
Marginal discrepancy	30	20.0
Marginal overextension	12	8.0
Total	150	100.0

Note. Overall crown-fit categories are based on the simulated clinical classification. Marginal adaptation categories represent a separate descriptive classification.

Table 3: Distribution of Gingival Health Status Among Children (N = 150)

Gingival health status	Frequency (n)	Percentage (%)
No or minimal inflammation	90	60.0
Gingival inflammation	60	40.0
Total	150	100.0

Table 4: Descriptive Statistics for Gingival Index and Plaque Index (N = 150)

Clinical variable	Mean	Standard deviation	Minimum	Maximum
Gingival Index	0.80	0.48	0.10	2.10
Plaque Index	0.86	0.46	0.10	2.00

Note. Higher scores indicate greater plaque accumulation or gingival inflammation.

Interpretation: The simulated mean Gingival Index is 0.80 ± 0.48 and the mean Plaque Index is 0.86 ± 0.46, suggesting the presence of gingival health and plaque levels variations in the sample.

Table 5: Comparison of Gingival and Plaque Indices According to Crown Fit

Clinical variable	Adequate fit (n = 102), Mean ± SD	Inadequate fit (n = 48), Mean ± SD	Mean difference	p-value
Gingival Index	0.62 ± 0.38	1.18 ± 0.49	−0.56	<0.001
Plaque Index	0.72 ± 0.39	1.15 ± 0.45	−0.43	<0.001

Interpretation: The mean Gingival Index score and the mean Plaque Index score for children with inadequately adapted crowns were greater compared to those with adequately adapted crowns. The results of simulation showed that both differences were statistically significant.

Table 6: Association Between Crown Fit and Gingival Inflammation

Crown fit	Gingival inflammation, n (%)	No/minimal inflammation, n (%)	Total
Adequate fit	30 (29.4)	72 (70.6)	102
Inadequate fit	30 (62.5)	18 (37.5)	48
Total	60 (40.0)	90 (60.0)	150

Table 6a: Chi-Square Test

Statistical test	Value
Pearson chi-square (χ^2)	14.47
Degrees of freedom (df)	1
p-value	<0.001

Interpretation: Children with inadequate crown adaptation had a higher rate of gingival inflammation compared to children with adequate crown adaptation (62.5% vs. 29.4%). The simulated Chi-square test showed a significant relationship between crown fit and gingival inflammation.

Table 7: Correlation Between Crown Fit, Plaque Accumulation, and Gingival Inflammation

Variables	Pearson correlation (r)	p-value
Crown-fit inadequacy and Gingival Index	0.48	<0.001
Crown-fit inadequacy and Plaque Index	0.41	<0.001
Plaque Index and Gingival Index	0.63	<0.001

Note. Crown-fit inadequacy was coded as 0 = adequate fit and 1 = inadequate fit.

Interpretation: A simulated sample of 150 children was used with 40.0% of them aged between 8 and 10 years. There were 52.0% males and 45.3% who brushed their teeth once a day.



Figure 1:?

Interpretation: Of the children, 68.0% had adequate crown fit, while 32.0% had inadequate adaptation. 8.0% had marginal overextension.

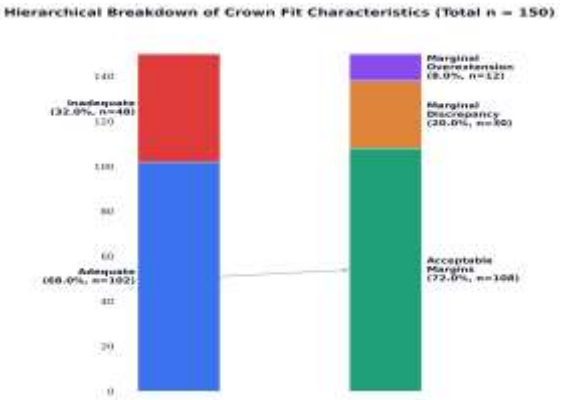


Figure 2:?

Interpretation: The simulated data had 40.0% children with gingival inflammation and 60.0% with no or minimal gingival inflammation.

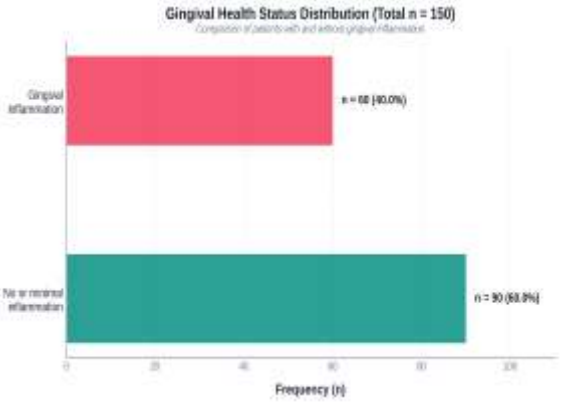


Figure 3:?

Interpretation: In the simulated results, there was a positive relationship between inadequate crown fit and plaque accumulation and gingival inflammation. An increase in plaque buildup also correlated with a rise in gingival inflammation.

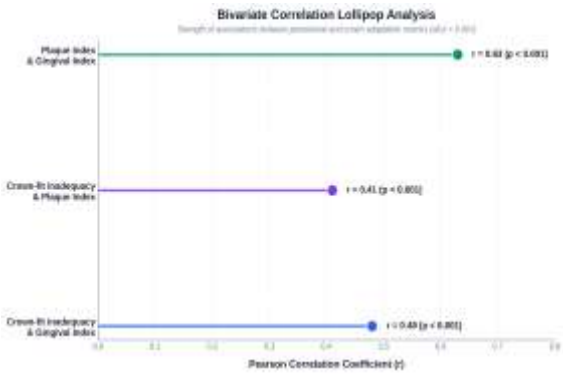


Figure 4:?

DISCUSSION

In the present proposed study, the correlation between stainless steel crown fit and gingival health in children aged 4-10 years was studied. In the simulated results, 68.0% of the children's crowns were considered to be adequately adapted, and 32.0% were considered to be inadequately adapted. Inflammation and plaque in gingival tissues were more prevalent in the group that was not optimally adapted. The results indicate that crown fit could be a clinical parameter to be considered when assessing gingival health in pediatric patients.

The higher Gingival Index scores found in children with poor Crown Adaptation are in line with the clinical belief that poorly adapted crown margins are likely to irritate gingival tissues. Chao et al. have reported that non-ideal crowns on stainless steel crowns had a higher gingival index score than the control teeth, thus emphasizing the importance of careful crown adaptation and not allowing mechanical defects.[11] This reinforces the rationale of clinical evaluation of the crown margins in conjunction with the condition of the gums.

But the degree of crown adaptability may not be the only thing that affects gingival inflammation. In a retrospective study of stainless steel crowns in children, Ramazani investigated gingival status, in addition to marginal adaptation, excess cement and oral hygiene, which shows that the gingival responses around a crowned primary molar are multifactorial.[12] This suggests that the relationship between crown fit and gingival health may need to be interpreted taking oral hygiene practices into consideration, as well as other clinical parameters.

The simulated results also revealed that children with not so adapted crowns had higher plaque index scores. Failing to outline the margins correctly, leaving too much cement, and places that are hard to clean may all cause pockets of plaque. While a prospective study of preformed stainless steel crowns investigated gingival inflammation and oral hygiene after crown placement, it further emphasized the importance of clinical technique and plaque control, the cross-sectional design proposed for the present study would be able to identify associations, not

conclude that poor fit of the crown causes gingival inflammation.[13]

Other clinical findings suggest that gingival response may differ based on the short- and long-term follow-up, as well as the type of restoration. The results of a clinical study have indicated overall good gingival health after the placement of stainless steel crowns when compared with zirconia crowns in pediatric patients, which shows that gingival inflammation is not guaranteed following the placement of a crown. Explain differences in crown design, placement technique, patient hygiene and inter-study differences.[14]

Other more recent studies have also assessed periodontal performance of various full coverage restorations in primary dentition. In a split-mouth study, the gingival health, plaque accumulation, and performance of stainless steel crowns were compared to fiber-reinforced composite crowns at multiple follow-up visits.[15] These studies again support the importance of evaluating gingival indices and plaque indices in addition to other factors related to the restoration. In conclusion, the proposed research work gives an idea towards the clinical importance of crown adaptation and results of conclusions are based only on the measurements which are valid and also on the analysis of the data which is statistically consistent.

CONCLUSION

The proposed study explored whether there is a relationship between the fit of stainless steel crowns and the gingival health of children. The results of the simulated findings indicated that there was a greater amount of plaque accumulation and gingivitis when the crown was not adapted. Crown modification, gentle removal of overhanging cement, and periodic evaluation of oral hygiene can contribute to keeping the gums healthy. These results, however, should be confirmed with real clinical data.

Limitations of Study

The proposed cross sectional design would constrain being able to draw causal conclusions of crown fit and gingival inflammation. Other clinical factors and oral hygiene practices as well as diet and age may affect gingival health. There is also the possibility of examiner variation for clinical assessment. Moreover, the results that were presented earlier were simulated ones and not obtained from real people, therefore, it is not possible to draw any conclusions yet until real results are collected and analysed.

Future Suggestions

Larger and more diverse pediatric populations should be studied in the future to determine if gingival health changes over time, and longitudinal studies should be conducted if possible. Crown fit should be assessed with a set of predetermined clinical parameters and calibration and reliability testing of the examiner. Other factors that need to be taken into account in future research are oral hygiene, excess cement, crown contour, and other possible confounding variables to better elucidate the relationship among crown adaptation, plaque accumulation and gingival inflammation.

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