

Effects of Modified Crown Contour on Periodontal Health

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Abstract

Original Research Article

Introduction: The contour of artificial crowns has and continues to be highly controversial. Much of the controversy centers on whether the gingival sulcus is really in need of protection from buccal and/or lingual convexities, or whether a flatter emergence profile affords "self-cleansing" muscle action. Evidence is reviewed in this part which suggests that over-contoured crown is probably more detrimental to gingival health than under-contoured crown.

Objective: The purpose of this study was to evaluate the effects of modified crown contour (over-contoured and under-contoured) on periodontal health. **Methods:** This study was conducted in the department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh for the duration of one and half year to find out the successful artificial crown contour that is harmonious with the periodontium. Selected mandibular molar teeth were prepared for full veneer crown. 50 patients (Group-A) whose full veneer crown was fabricated with under-contouring form and another 50 patients (Group-B) whose full veneer crown was fabricated with over-contouring form and cemented on respected teeth. Clinical examination and evaluation were done after three (3) weeks, six (6) weeks, three (3) months, and six (6) months of post prosthesis follow up period. Data were collected on the basis of following parameters like gingival index, periodontal index, periodontal pocket depth, and gingival recession in a predesign data collection sheet. Statistical analysis (Chi- Square Test and unpaired t-test) was done to find out the significance value ($P < 0.05$). **Results:** It is observed that the result was highly significant ($p < .001$) between two groups regarding Gingival index and Periodontal index but not significantly difference regarding Periodontal pocket depth or Gingival recession.

Conclusion: This study revealed that under-contoured restoration does not produce any significant changes in the health of gingiva but over-contoured restoration produces detrimental effect on periodontal tissue.

Keywords: Over-contoured crown, under-contoured crown, periodontal health.

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INTRODUCTION

When a tooth structure is destroyed by any means it needs to be restored by using restoration. Full veneer crown is one of the best options of restoration used in fixed prosthodontics in recent decades, as they serve as an excellent means to protect a weakened tooth structure and to improve esthetics and functions. Many factors influencing the long-term biological success of the full veneer crowns such as the location of crown margin, marginal adaptation and the contour of the crown. There is a direct cause-and-effect relationship between crown contour and bacterial plaque accumulation and calculus deposition around tooth margin. There cannot be possible healthy mouth with a diseased periodontium. Plaque and calculus deposition around tooth is the main cause of periodontal tissue destruction. If the tooth itself is sound but its

periodontal tissue is affected by any diseased condition so the tooth may be lost in spite of having healthy coronal structure. The contour of the tooth may cause plaque/ calculus accumulation along the gingival margins, so the design of the coronal contour of a full veneer crown should be in such a way that it will not causes any plaque accumulation that follow unhygienic oral condition.

Reduction of bacterial plaque accumulation is effected by the elimination of surface convexities that prevent rubbing action of the lips, cheeks, and tongue; this action aids in debriding the surface of a tooth and its gingiva [1]. During mastication food bolus comes on the occlusion surfaces by propelling action of lips, cheeks and tongue. The confining walls of the buccal and lingual surfaces are the hard tooth on one side and a free movable soft tissue curtain on the other side and

the frictional contract depend on the buccal and lingual surface configuration of tooth. If the tooth surfaces are bulge or over-contour in these areas the frictional contract will be less but if the surfaces are flat or under-contour the frictional contract will be more that cause more self-cleaning action [2]. Natural crown contour with a maximum cervical bulge is inadequate protection against an impaction mechanism. For example, the lingual tilt of mandibular posterior teeth cancel the effect of the bulge on the buccal surfaces of the teeth. For this reason, the lingual areas are the most common site for plaque and calculus deposition but opposite scenarios on the buccal region [4]. Although the natural protection from the crown makes the gingival crevice readily accessible to food, the crevice is not easily entered. The free gingival tissue is held firmly against the crown by the supra-alveolar connective tissue fiber system. This evidence by the meticulous care required to purposely impact impression material into the crevice as far as the finishing line when making an impression. Furthermore, an outward current of serum flushes foreign matter from the gingival crevice. The flow of serum is increased by heavy muscular action and hard foods. The freely moving tissues of the lip, cheek, and tongue constantly pass over the gingival margin, molding, massaging, and cleansing the tissue at the same time. When variations in tooth position and contour prevent this intimate contact, the gingivae tend to grow longer and thicker, and food particles tend to remain. The food is not impacted but rather shifts into the space and remain stagnant, out of reach of muscular action [5]. The embrasure presents a different situation because of its hard, confining proximal borders. An open contact leads to food impaction, which becomes worse when hard foods are involved. Embrasure contours are possibly even more important than buccal or lingual contours. The embrasure is a sheltered space at best and responds to over-contouring with a rapid dramatic response. The papilla becomes inflamed and hyperplastic. Variation in the shape of contact or embrasure dimensions that prevents intimate soft tissue contact with the gingival margin results in gingival thickening, food retention, and inflammation. An embrasure with adequate height and width, but over-contouring at the Bucco-proximal line angles, is frequently produced even a careful dentist. The error is usually the result of an inadequate preparation, and ill shaped restoration effectively blocks off muscular action. In many clinical and experimental studies indicate that over-contouring restoration causes gingival inflammation, plaque and calculus accumulation as well as periodontal involvement. The contour may vary in different mouths, in different part of the same mouth, or the same tooth. If such contours do not protect against food impaction but rather permit free muscular flow, the final shape of those surfaces will range from flat to the most subtle of convexities. The forms are truly comparable to natural curves and will most likely preserve gingival health [6]. Some studied the histologic effects of crown contour on human gingiva

[7]. They found that there was an increase in inflammation adjacent to bulbous artificial crowns but that properly contoured artificial crowns exhibited no such increase at the adjacent gingiva [8]. Total clinical crown contour is related to gingival health. The subgingival convexity of a tooth or a restoration should extend facially or lingually no more than one half of the thickness of the gingiva. This protects the gingival crevice and promotes a knifelike free gingival margin, important in plaque control. The facial and lingual surface contours should have gradual curvatures in all directions to facilitate the rubbing and cleansing function of the lips, cheeks, and tongue. The interproximal contour of adjacent teeth contacts areas, and of the teeth in relation to the gingival papilla must be such that moving tissues can rub or the patient can perform oral hygiene easily. So, the present study was designed to find out the actual axial contour of artificial crown that is physiologic to periodontal tissue.

METHODS

This prospective comparative experimental study was conducted in the department of Prosthodontics, Bangabandhu Sheik Mujib Medical University, Dhaka, Bangladesh for the duration of one and half year to find out the successful artificial crown contour that is harmonious with the periodontium. Total 100 patients were examined who were candidate for full veneer crown on their mandibular molar tooth. 50 patients (Group-A) whose full veneer crown were fabricated with under-contoured restoration and another 50 patients (Group-B) whose full veneer crown were fabricated with over-contoured restoration. After proper evaluation of the patient a primary impression was made with alginate impression materials followed by preparation of diagnostic cast with die stone. Diameter of the tooth to be prepared was measured at the maximum bulging area and recorded. The tooth preparation was done by maintaining the basic principles of tooth preparation (Biologic, Mechanical and Esthetics consideration). The following sequential steps of tooth preparation were followed like occlusal reduction, buccal and lingual reduction, interproximal reduction and finally finished all the prepared surfaces. Supra-gingival chamfer finish line was prepared for all teeth. Final impressions were made by using medium body silicone impression material (Zetaplus, Zhermack Clinical, Italy) with perforated stock tray. Die stone (Dent America, USA) was used to prepare the laboratory cast. Metal ceramic full veneer crowns were fabricated for all the study population. For group-A, the restorations were fabricated in such a manner that the diameter of restoration were 10% less than the diameter of the tooth is prepared buccal and lingual contour of the restoration were flat, proximal contact was produced on occlusal third and buccal to the central fossa. But in case of group-B the diameter of the full veneer crowns was 10% more than the diameter of the tooth is prepared. All the crown were cemented to their respected tooth with resin cement. Similar oral hygiene

instructions were given to each and every patient. Clinical examination and evaluation were done after three (3) weeks, six (6) weeks, three (3) months, and six (6) months of cementation. Data were collected in terms of different variables like gingival index, periodontal index, periodontal pocket depth, and gingival recession

in a predesign data collection sheet. Statistical analysis (Chi- Square Test and unpaired t-test) were done to find out the statistical significance ($P < 0.001$).

RESULTS

Table-I: Distribution of the patients by gingival index in different follow up visits.

Follow up Visit	Gingival Condition	Group A		Group B		P-value
		n=50	%	n=50	%	
After (3) weeks	Grade I	48	96.0	45	90.0	0.414
	Grade II	2	4.0	4	8.0	
	Grade III	0	0.0	1	2.0	
	Grade IV	0	0.0	0	0.0	
After (6) Weeks	Grade I	47	94.0	41	82.0	0.135
	Grade II	3	6.0	7	14.0	
	Grade III	0	0.0	2	4.0	
	Grade IV	0	0.0	0	0.0	
After (3) Months	Grade I	48	96.0	26	52.0	0.001*
	Grade II	2	4.0	22	44.0	
	Grade III	0	0.0	2	4.0	
	Grade IV	0	0.0	0	0.0	
After (6) Months	Grade I	46	92.0	16	32.0	0.001*
	Grade II	3	6.0	18	36.0	
	Grade III	1	2.0	12	24.0	
	Grade IV	0	0.0	4	8.0	

Statistical analysis was done by chi-square (X^2) test. Group A = Under-contour Restoration, Group B = Over-contour Restoration. Gingival Index are: Grade-I: Normal gingival, Grade-II mild inflammation, Grade-III- moderate inflammation, Grade- IV- Severe inflammation. * = Significant ($P < 0.05$), n = Number of subjects.

Table- II: Distribution of the patients by periodontal index in different follow up visits

Follow up Visit	Periodontal Condition	Group A		Group B		P-value
		n=50	%	n=50	%	
After (3)weeks	Grade I	50	10.0	42	84.0	0.003*
	Grade II	0	0.0	8	16.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(6)Weeks	Grade I	50	10.0	38	76.0	0.001*
	Grade II	0	0.0	12	24.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(3)Months	Grade I	47	94.0	32	64.0	0.001*
	Grade II	3	6.0	13	26.0	
	Grade III	0	0.0	5	10.0	
	Grade IV	0	0.0	0	0.0	
After(6)Months	Grade I	46	92.0	23	46.0	0.001*
	Grade II	4	8.0	21	42.0	
	Grade III	0	0.0	6	12.0	
	Grade IV	0	0.0	0	0.0	

Statistical analysis was done by chi-square (X^2) test. Group A = Under-contour Restoration, Group B = Over-contour Restoration. Periodontal index is: Grade I – Physiological tooth mobility (up to 0.5mm of movement in a horizontal direction), Grade II- 0.5 to 1 mm of movement in a horizontal direction, Grade III -greater than 1 mm of movement in a horizontal direction, Grade IV- excessive horizontal movement as well as vertical movement. * = Significant ($P < 0.05$) n = Total number of subjects.

Table III: Distribution of patients by Periodontal pocket index in different follow up visits.

Follow up Visit		Group A		Group B		P-value
		n=50	%	n=50	%	
After (3)weeks	Grade I	50	10.0	50	100.0	-----
	Grade II	0	0.0	0	0.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(6)Weeks	Grade I	50	10.0	47	94.0	0.079
	Grade II	0	0.0	3	6.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(3)Months	Grade I	48	96.0	41	82.0	0.070
	Grade II	2	4.0	9	18.0	
	Grade III	0	0.0	2	0.0	
	Grade IV	0	0.0	0	0.0	
After(6)Months	Grade I	47	94.0	36	72.0	0.013*
	Grade II	3	6.0	13	26.0	
	Grade III	0	0.0	1	2.0	
	Grade IV	0	0.0	0	0.0	

Statistical analysis was done by chi-square (X²) test. Group A = Undercontour Restoration, Group B = Overcontour Restoration. Grade I – (Score-0)-Normal depth of the sulcus-1-2mm, Grade I – (Score-1)-2-3mm sulcus depth, Grade I – (Score-2)- 3-4 mm sulcus depth, Grade IV- (Score-3)- Above 4mm sulcus depth. NS= not significant (P>0.05) * = Significant. N = Total number of subjects.

Table-IV: Distribution of patients by gum recession in different follow up visits.

Follow up Visit	Gum recession	Group A		Group B		P-value
		n=50	%	n=50	%	
After (3)weeks	Grade I	50	100.0	50	100.0	-----
	Grade II	0	0.0	0	0.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(6)Weeks	Grade I	50	100.0	47	94.0	0.079
	Grade II	0	0.0	3	6.0	
	Grade III	0	0.0	0	0.0	
	Grade IV	0	0.0	0	0.0	
After(3)Months	Grade I	48	96.0	44	82.0	0.292
	Grade II	2	4.0	5	18.0	
	Grade III	0	0.0	1	0.0	
	Grade IV	0	0.0	0	0.0	
After(6)Months	Grade I	48	94.0	38	72.0	0.015*
	Grade II	2	6.0	11	26.0	
	Grade III	0	0.0	1	2.0	
	Grade IV	0	0.0	0	0.0	

Statistical analysis was done by chi-square (X²) test. Group A = Under-contour Restoration, Group B = Over-contour Restoration. Grade-I: No recession, Grade-II: Less than 1mm recession, Grade-III- 1-2mm recession, Grade-IV: more than 2mm recession. * = significant (P<0.05), n =Total number of patients.

DISCUSSION

Regarding gingival condition it is found that 3 weeks and 6 weeks after cementation of restoration, there was no significantly differences between two groups (P>0.05). But the 3 months and 6 months of follow up period the outcome of group-A was significantly better than group-B (P < 0.001). The under-contoured crown maintains better gingival health than over-contoured crown. An experimental study conducted on six mongrel dogs, they remodeled mandibular teeth with full veneer crown [8]. Removing

tooth structure either buccal, or lingual surfaces. Over-contouring of the buccal surfaces was done with self-Cured acrylic resin which was not contact with the gingiva. The results showed that Under-contouring caused no apparent gingival pathoses whereas over-contouring give rise first to inflammation and later to collection of debris, hyperplasia and engorgement of marginal gingiva, scant keratinization, and deterioration of the fibers of the gingival collar. Regarding periodontal status, after 3 weeks of study the result was not significantly difference between two groups but latter after 3 weeks of study the results were highly

significant ($P < 0.001$) between two groups. The teeth restored with under-contoured crown shows good periodontal condition but on the other hand the periodontal condition of the over-contoured crowns was deteriorated (table-II). Regarding gingival recession, initial 3 months of study the results were not significantly differences between the groups ($P > 0.05$) but after 6 months the result was significantly better in Under-contouring restoration than over contouring restoration. Some study conducted on facial and lingual contour of artificial complete crown restorations and their effects on the periodontium [9]. The result of the study was a significant number of patients reported gingival recession in over-contouring restoration. A study stated that the cervical bulge of crown over protects the microbial plaque [10].

Early diagnosis and treatment are essential for successful long-term prognosis in patients with aggressive periodontitis. The role of the orthodontist in diagnosis and referral to periodontal treatment is crucial since most orthodontic patients are adolescents in which aggressive periodontitis mostly affects. They also stated that to promote accessibility of oral hygiene, final fixed restoration should not follow the original anatomic crown but should recreate the normal contours of root portion. By flattening the buccal and lingual contours of tooth would reduce unnecessary at the gingival third of tooth.

Regarding the periodontal parameters, such as Periodontal debridement and margin to the bottom of the gingival pocket, it could be observed that the Periodontal debridement in the control group remained stable but increased in the crowned treatment groups. The crowned groups showed higher Periodontal debridement values compared to the control group after 5 months. In contrast to the increasing Periodontal debridement, the margin to the bottom of the gingival pocket s decreased for the test groups. This indicates a coronal migration of the periodontal attachment. Baseline measurements occurred one month after dental impressions using retraction cords. It is known that the placement of retraction cords leads to the damage of the gingival and periodontal attachment which in turn results in increased loss of margin to the bottom of the gingival pocket values. But it has been shown that the soft tissue may heal completely over time [11-16].

There was no significant periodontal pocket formed among the study population. To make a comment regarding pocket formation the study should continue two to three years post prosthesis evaluation.

Limitation of the Study

This was a prospective comparative experimental study with a small sized sample. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION

The contour of the restoration should not produce unfavorable periodontal environment. Sufficient space for the restorative materials should be created by an adequate preparation, and thus it possible to create an ideal contour. At the end of the study, it is concluded that axial tooth surface with under contouring restoration did not produce any significant changes in the circumscribed gingiva in health but over-contouring restoration causes gingival inflammation, gingival recession and periodontal pocket formation.

RECOMMENDATION

This study can serve as a pilot to a much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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