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Comparison of periodontal response between subgingivally placed lithium disilicate and zirconium dioxide crown on endodontically treated anterior teeth

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ABSTRACT
The goal of the present study was to critically compare the impact of lithium disilicate and zirconium dioxide crowns on periodontal health. The findings of this study may assist in determining the relationship between periodontal health in precisely fabricated lithium disilicate and zirconium oxide crowns. In this circumstance, this might have therapeutic implications. This study will assist patients, doctors, researchers, and the community. Lithium disilicate and zirconium dioxide are newer aesthetic restorative materials. Lithium disilicate is more translucent than zirconium dioxide. Zirconium dioxide crown is superior for its strength and suitable for both anterior and posterior restorations where aesthetics are of the highest concern. Each dental restoration has a periodontal dimension which plays an important role in the long-term prognostic of the respective tooth. It is very important to know how the restoration contributes to the accumulation of plaque and periodontal disease Gingivitis develops or worsens as a result of poorly constructed restorations, which provide strong support for plaque formation. The ultimate evaluation of restorative therapy should include not only cosmetic and functional factors, but also how restoration may affect periodontal structures. Zirconium dioxide ceramic materials have been reported not to have potential toxic and genotoxic effects and to present satisfactory soft tissue response. A comparison of lithium disilicate and zirconium dioxide shows that lithium disilicate has more conducive to varying tissue reactions. Searching experiences, there are few numbers of studies in south-east Asia related to the following study. From this perspective, the present study has been designed to compare the periodontal response between lithium disilicate and zirconium dioxide crowns.

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I. Introduction

The fixed dental prosthesis is the restoration or replacement of teeth with artificial substitutes attached to natural teeth, roots, or implants and is not readily removable. The main goal of the fixed dental prosthesis is the restoration of function and maintenance of periodontal health. As well as maintenance of the form, prevention of the residual root fracture, aesthetics and retention of the final restoration. Different restorative materials along with margin placement affect the health of the periodontium. The success of a dental restoration depends upon several factors such as the material chosen and its mechanical properties, anatomical form, surface texture, translucency, and color. There are different types of extra coronal restoration, such as all metallic, porcelain fused to metal, fiber reinforced, and all-ceramic restorations. The most common aesthetic restorative material is porcelain fused to metal (PFM) because of its excellent mechanical properties[1]. But a metallic hue is seen in porcelain fused to metal restorations. So dental research focused on metal-free ceramic restorations to improve the aesthetic outcome[2]. The most superior aesthetic outcome of metal-free ceramic restoration has led to their increasing popularity, especially in the anterior regions of the mouth. There has been an enormous amount of advertising on different types of metal-free ceramic restorations such as zirconium dioxide and lithium disilicate[3]. Each material's properties make it suitable for a variety of applications. The clinician's opinion seems to be that they are both working much better than in previous ceramic restorations. That's why zirconium dioxide and lithium disilicate in dental clinical practice has been growing for some decades [4].

The higher cosmetic consequence of metal-free ceramic restorations has contributed to their rising popularity, particularly in the anterior parts of the mouth. To avoid the unattractive metallic tint exhibited in PFM restorations, dental research began to focus on metal-free ceramic restorations to enhance the cosmetic effect[5].

The porcelain-fused-to-metal (PFM) approach has been the standard way of improving the brittle characteristics of all ceramic systems since 2011[6]. Because the strength of PFM restoration is dependent on coping material, several investigations have been conducted to identify better-coping material. In recent years, zirconia has gained popularity as an esthetic material in the dentistry field.

A lithium disilicate crown is a type of all-ceramic crown that is preferred for its long-lasting, aesthetic that has been gathered for its hardness, durability, and opaque qualities, resulting in a highly-priced crown. The crown is considered the best match for its natural teeth. There is no metal inside the crown that's why it means no gray line around the gum line. Glass ceramics are particularly suitable for fabricating all ceramic crowns which have the potential to mimic natural teeth characteristics and achieve very pleasant, esthetic outcomes[7].

Lithium disilicate was introduced in 1998. This type of ceramic has a lithium-disilicate crystal content of 60% by volume that forms an interlocking structure after pressing which increases the strength and fracture toughness of the ceramic[8]. This serves as the underlying framework of the restoration. A veneering ceramic (sintered glass ceramic) forms fluroapatite crystals resembling natural enamel in shape and composition. This layer provides the natural wear compatibility and optical properties of the ceramic.

Oxide ceramics-based systems such as crystalline alumina and zirconia are superior to feldspathic ceramics concerning mechanical properties, making them a favorable choice for metal-free restorations in the posterior region[9]. The mechanical properties of zirconium dioxide are the highest, which has generated considerable interest in dental practice[10]. Zirconium dioxide is characterized by low thermal conductivity, low corrosion potential, good radiographic contrast, and good biologic compatibility, and it's a color similar to natural teeth. Zirconium has high loading strength, tensile strength, high fracture and chemical resistance with good tissue tolerability. It also creates strong cell adhesion under the epithelial conjunctive junction thus preventing bacterial accumulation. These properties made zirconium highly biocompatible[11].

Zirconia is a crystalline dioxide of zirconium. It has mechanical qualities similar to metals and a hue akin to teeth color. Fracture strength has progressively increased from glass ceramic (320MPa) to alumina (547MPa) to zirconia (900MPa) Zirconia has mechanical properties similar to those of stainless steel. Its traction resistance may reach 900 1200 MPa, and its compression resistance is around 2000 MPa. This material is also tolerated well with cyclic stress.

Biocompatibility is also important to restorative materials[12]. Since 1990, in vitro experiments have been conducted to learn more about cellular responses to zirconia. In vitro experiments have established that ZrO2 is not cytotoxic. Moreover, zirconium oxide creates a less floristic reaction in tissue than other restorative materials such as titanium. Another research corroborated this finding. In a study of peri-implant soft tissue around zirconia healing caps vs titanium ones, inflammatory infiltration and bacterial product levels were found to be greater on titanium than on zirconium oxide.

A biomaterial, here LS2, can be modified using simple surface changes in order to finely modulate soft tissue adhesion Gingival wound healing is aided by strong adhesion at the abutment and poor migration[13]. The same substance may be polished to lessen cell adhesion without significantly altering cell movement.

Prosthetic restorative dentistry is by far the most important factor for plaque accumulation. Poorly done restorations offer enough support for the plaque accumulation which allows gingivitis to develop or worsen. The final evaluation of restorative treatment should be judged not only by aesthetic and functional criteria but also anticipating the effect that restoration will have on periodontal structures. Each dental restoration has a periodontal dimension which plays an important role in the long-term prognostic of the respective tooth. Understanding how the restoration affects the development of plaque and periodontal disease is crucial.

The magnitude of probing depth and gingival inflammation effects associated with the presence of crowns indicates that changes associated with crowns suggest that modifications connected to crown receipt would be of interest to research[14].

Periodontal health and tooth repair are inextricably linked. Dental full restorations have been considered a major contributing factor in the etiology of periodontal diseases[15]. So appropriate materials should be considered to maintain good periodontal health with optimal fit and reduce possible periodontal damage[16]. The periodontal tissue damage was done either by bacterial retention and/or by direct irritation of the material itself [17]. Ill-fitting restoration affects the abutment teeth and supporting periodontium because oral bacteria can easily adhere which causes secondary caries and traumatic periodontal irritation [18].

The adequate thickness of restoration provides better marginal adaptation and prevents bacterial accumulation. The best restoration margin is one that is placed coronal to the marginal tissue. But if the restoration margins are placed in the gingival crevice it causes permanent tissue damage[19]. Different types of margin preparation are present for a fixed prosthesis such as supragingival, equigingival, and subgingival. It is usually assumed that the ideal biological location for a restorative margin is supragingival. Traditionally, equigingival margins were not prescribed since they were considered to retain more plaque than supragingival or subgingival edges and thus produce more gingival irritation. The greatest biologic risk occurs when placing subgingival or equigingival margins for finishing procedures[20]. But Subgingival margins are often required for biological, mechanical, or esthetic reasons. Subgingival margins are indicated in multiple clinical situations, including the presence of existing subgingival restorations, dental caries, tooth fracture, abfraction, abrasion, chemical erosion, tooth discoloration or to enhance retention and resistance and develop a ferrule effect. The esthetic benefits of subgingival margins are well established and contribute to a better crown contour and more natural gingival scalloping [21].

Irrespective of margin configuration, it is the baseline periodontal health that determines the long-term periodontal success of a fixed restoration[22]. Disagreement exists regarding the effects of the type of crown material on gingival health.

Contrary to the claim made by researchers did not find any effect of the alloy type on gingival health[23]. Even though the data is clear, some practitioners still favor sub-gingival margins. The aim of the study was to investigate the clinical effect of the crown margin positions and crown materials on periodontal health.

II. Materials And Methodology

This study was carried out in the Department of Prosthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh. The duration of the study was February 2019 to March 2021.

Different equipments were used to carry out the study which is listed below:

Name of the equipment
Caries probe
Dental mirror
Lithium disilicate crown
Zirconium dioxide crown
Williams periodontal probe
Acrylic stent (fixed reference point)

Table 1: Used equipment

Lithium disilicate crown is an all-ceramic type of permanent restoration that will be provided to the patient which crown will cover all the coronal tooth surfaces i.e. mesial, distal, buccal, lingual, palatal, and occlusal/incisal. The white crystalline oxide of zirconium is known as zirconium dioxide.. It is also an all-ceramic type of permanent restoration that will be provided to the patient which the crown will cover all the coronal tooth surfaces i.e. mesial, distal, buccal, lingual, palatal, and occlusal/incisal.

An acrylic stent made with auto-cure acrylic resin, 2 mm thick. It covers the incisal 1/3rd of the anterior teeth. Periodontal pocket depth (PPD) was recorded by measuring the distance from the fixed reference point to gingival sulcus depth at different sites with Williams periodontal probe. It was calculated by (Fixed reference point to the base of gingival sulcus) - (Fixed reference point to free gingival margin).

Initially, a structured data collection sheet was developed for interviewing the patients who were pre-tested and tested on 5 respondents for improvement and finalization before the actual study (Appendix-I and Appendix-II). For this study, a well-informed, voluntarily signed written consent was taken in an understandable local language from the study subjects after convincing them that their privacy and confidentiality were safeguarded. Proper treatment was provided if there was any injury occurred or complications developed because of this study. However, no monetary compensation was provided for the loss of working time.

The population of this study was those who need permanent restoration in endodontically treated anterior teeth. A consecutive sampling technique was used to select the cases for this study. All the available subjects were picked up who met the preset inclusion criteria set for this study till the desired sample size was reached. It ensured more representativeness of the selected sample. The total number of samples were twelve. This crown was fabricated with lithium disilicate considered Group A 6 and this crown was fabricated with zirconium dioxide considered Group B 6.

Different criteria's were adopted and the study was carried out by considering the numerous internal as well as external criterias.

Sample selection criteria's	
Inclusion criteria's	Exclusion criteria's
Age above 18 years	Periodontally compromised tooth.
Adequate clinical crown height, at least 4-5mm.	Extensive caries.
Endodontically treated tooth with healthy periodontal tissue.	Congenitally malformed tooth.
Tooth with a good apical seal, no exudates, no pain, no mobility	Grossly decayed tooth.
	Tooth with short clinical crown, <4 mm
	Medically compromised patients e.g. diabetes mellitus, malignancy.
	Inability or unwillingness to return for follow-up visits.

Table 2: adopted criteria's (inclusion&exclusion)

Before starting the tooth preparation, baseline periodontal condition was registered on the parameters of (i) plaque index (PI) and (ii) The gingival index, rounding at the highest score; (iii) periodontal probing depth (PPD), at six different facial sites (mesial, midpoint, distal) with the utilization of a periodontal probe, an acrylic stent (fixed reference point), rounding the measurements to the nearest millimeter and (iv) bleeding on probing (BOP) were evaluated. Patients were recalled at 1 and 3 months after the cementation of the restorations.

To carry out the study, 12 samples having endodontically treated anterior teeth were selected by thorough medical and dental history and clinical examination (Appendix-1) as per the inclusion and exclusion criteria set for this study. Having the patient seated on the dental chair, the position of the chair and patient was adjusted as per standard rules. The selected endodontically treated teeth were examined and isolated to follow standard principles of tooth preparation for Group A and Group B.

Before starting the tooth preparation, baseline periodontal condition was registered to round at the highest score on the parameters of (i) plaque index (LeoH, 1967), Grade I-(0-1.5), Grade II-(1.51-2.5), Grade III-(2.51-3.5), Grade IV-(3.51-4.5) (ii) gingival index (LeoH, 1967), Grade I-(0-1.5), Grade II-(1.51-2.5), Grade I-(0-1.5), Grade II-(1.51-2.5), Grade III-(2.51-3.5), Grade IV-(3.51-4.5 Grade III-(2.51-3.5), Grade IV-(3.51-4.5 (iii) periodontal pocket depth (Caranza, 2006) and (iv) bleeding on probing (Saxer and Muhlemann, 1975), Grade I-(0-.5), Grade II-(.51-1), Grade III-(1-1.5), Grade IV-(1.51-2).

At first oral hygiene, and prophylaxis was performed and foundation restoration at the abutment tooth was done with light cure composite resin as the mouth preparation phase of treatment.

Tissue displacement was commonly obtained for adequate access to the prepared tooth to expose all necessary surfaces. This was achieved by mechanical means i.e., looping the retraction cord around the tooth

and gently pushing it into the sulcus with a cord packer before the tooth preparation. After preparation, if needed the second (larger diameter) cord was used saturating with astringent which was placed on top to achieve lateral tissue displacement. The latter was removed immediately before impression making.

A flat-end short shank tapered diamond was used for the establishment of guiding grooves during incisal reduction. Approximately 1.3 mm deep three depth grooves were placed in mid-incisal and at the junction of each proximal surface. These grooves were connected and extended into the mesial and distal marginal ridge. The guiding grooves were removed by flat end tapered diamond. On completion 2 mm clearance was established for all ceramics in all excursive movements of the mandible. The clearance was measured by using a putty index.

The facial reduction was performed by placing approximately 0.8 mm deep three-depth orientation grooves. One depth groove was placed in the middle of the facial wall and one each in the mesiofacial and distofacial line angle using the flat end tapered diamond. The reduction was done in two planes. One plane within the gingival half was parallel to the long axis and the incisal plane followed the facial contour. These grooves were connected and extended into the facioproximal line angle. Then the facial surface was reduced by 1 mm for ceramic thickness using flat end tapered diamond.

Approximately 0.8 mm guiding grooves for lingual reduction were placed in the middle of the cingulum wall and parallel to the path of insertion. On completion 1 mm clearance was established to ensure adequate room for ceramic by flat end tapered diamond. This time 0.5 mm subgingivally shoulder margin was prepared and extended proximally to meet the facial preparation using flat end tapered diamond. The lingual fossa was reduced by 1 mm by a football-shaped diamond. Clearance was checked using a putty index. Sufficient tooth structure was removed to provide a distinct, smooth, continuous shoulder of about 1 mm width supporting the gingival tissue. Finishing of the preparation was done by refining the line angles and point angles to rounded and smoothened.

An elastomeric impression material e.g., polyvinyl siloxane in its single-step double mix technique was used here. This perforated full arch stock tray after verifying its fit in the patient's mouth was chosen. A syringe material (light body) and tray material (heavy body) were mixed simultaneously on separate pads by dispersing an equal amount of base and accelerator. Removing the gingival retraction cord, the lighter material was injected from the filled syringe around the tooth preparation. Then the filled tray was inserted in the patient's mouth and seated over the syringe material which had been extruded on hard and /or soft tissue. The tray material forced the syringe material to adapt to the prepared tissue. The manufacturer's recommendation for maximum working time and minimum setting time was followed.

After being removed from the patient's mouth, the impression was immediately rinsed with tap water and disinfected by dipping in 2% glutaraldehyde and delayed 10 minutes for pouring. Properly adjusted provisional restoration was luted to the prepared tooth. The cast was poured with type III die stone. Die was prepared with the standard laboratory method and trimming was done.

After completion of the laboratory procedure of lithium disilicate and zirconium dioxide crowns, these crowns were tried in the patient's mouth for fit in all aspects. After that cementation was done with appropriate procedures. For cementation, the fitting surface of lithium disilicate crowns was etched with 15% hydrofluoric acid, rinsed, and dried. Zirconium dioxide crowns were not etched. Ceramic primer or silane coupling agent was then applied and allowed to dry for one minute. A regular bonding agent was then applied, and light-curing was avoided. The prepared tooth was then etched with 37% phosphoric acid and a bonding agent was applied. Again, light curing was avoided. The adhesive resin cement was mixed, applied to the fitting surface of the crown, and seated on the prepared tooth. For dual-cure cement, light curing was done for 5 seconds after which the excess cement was removed. The margins were then light-cured for 1 minute. Occlusion was checked and corrected after cementation.

Then, oral hygiene instructions were given to the patients, including the use of dental floss and proxy brushes. Avoidance of hard food such as bone, sugarcane, betel nut, etc., and also for recall visits as instructed.

Appendix-I
History sheet
Dept. of Prosthodontics
Faculty of Dentistry, BSMMU

Title: Comparison of periodontal response between subgingivally placed lithium disilicate and zirconium dioxide crown on endodontically treated anterior teeth.

Patient's particulars:

Patient's Name:			
Age:		Reg. No:	
Sex:		Phone No:	
Occupation:		Address:	
Chief complaints:			
Dental history:			
Endodontic treatment:		Previous restoration or prosthesis:	
Surgery:		Orthodontic treatment:	
Personal history:		Medical history:	

Extra-oral examination:			
Facial form: Square/Tapering/Ovoid			
Facial symmetry:			
TMJ:			
Lips:			
Intra-oral examination: (Periodontal examination)			
Gingival index:	Plaque index:	Periodontal pocket depth**:**	Bleeding on Probing:
Grade-1= Normal gingival	Grade-1= No plaque	Grade-1= Normal depth of sulcus 1-2 mm	Score-0= No bleeding
			Score-1= A Single discreet bleeding point

Grade-2= Mild inflammation	Grade-2= A thin film of plaque accumulation	Grade-2= 2-3 mm sulcus depth	Score-2= Several isolated bleeding points
Grade-3= Mode rate inflammation	Grade-3= Moderate accumulation	Grade-3= 3-4 mm sulcus depth	Score-3= The interdental triangle fills with blood shorts after probing.
Grade-4= Severe inflammation	Grade-4= Abundant	Grade-4= >4 sulcus depth	Score-4= Profuse bleeding after probing

Appendix II
Data Collection Sheet
Assessment of individual tooth at baseline/1 month follow up

Variables	Mesio facial	Mesio Lingual	Facial	Disto facial	Disto lingual	Lingual	Average	Grade
Gingival index								
Plaque index								
Periodontal pocket depth								
Bleeding on probing								

Appendix-IV
Illustration

Basic instruments

Fig. 1: Clinical Examination Instruments

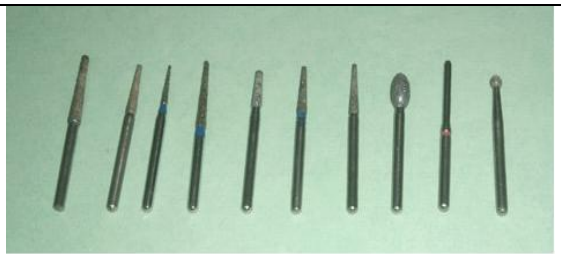

Fig. 2.1: Coarse Diamond points

Fig. 2.2: Fine Diamond points

Fig. 3: Retraction Cord with Cord Packer

Fig. 4: Impression Materials

Fig. 5: Cementing Materials

Fig. 6: Initial and final figure for zirconium dioxide crown

Fig. 7: Initial and final figure for lithium disilicate crown

Fig. 8.1: Tooth Preparation for zirconium dioxide crown

Fig. 8.2: Tooth Preparation for lithium disilicate crown

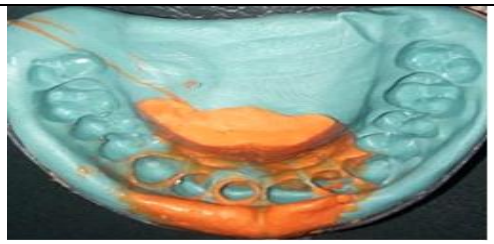

Fig. 9.1: Impression for zirconium dioxide crown

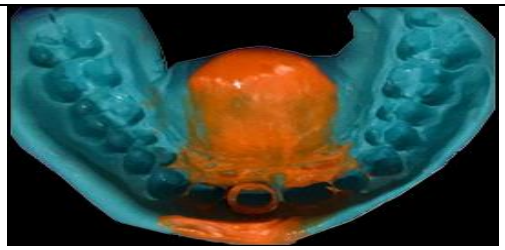

Fig. 9.2: Impression for lithium dioxide crown

Fig. 10.1: Palatal view of cast for zirconium dioxide crown

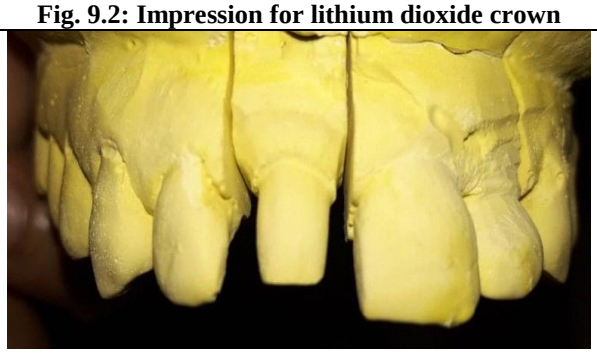

Fig. 10.2: Facial view of cast for zirconium dioxide crown

Fig. 10.2: Facial and palatal view of cast for lithium disilicate crown

Cementation Procedure of lithium disilicate crown

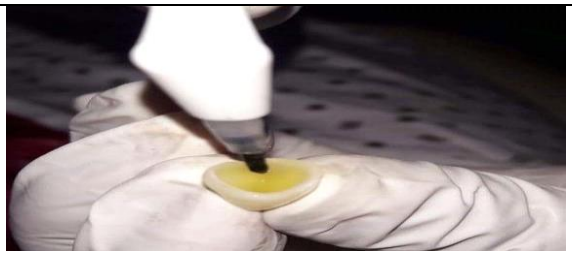

Fig. 11.1: Lithium disilicate crown etch with hydrofluoric acid

Fig. 11.2: Application of silane

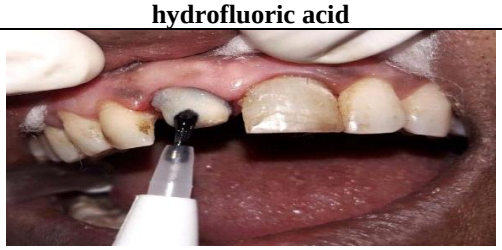

Fig. 11.3: Etching tooth

Fig. 11.4: Application of bonding agent

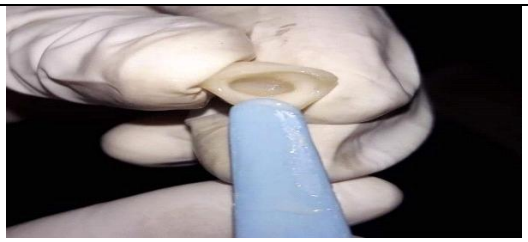

Fig. 11.5: Adhesive resin cement mixed and loaded on crown

Fig. 11.6: Light curing

Fig. 11.7: Cemented lithium disilicate crown

Cementation Procedure of zirconium dioxide crown

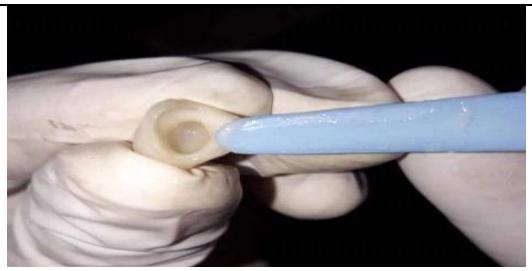

Fig. 12.1: Adhesive resin cement mixed and loaded on crown

Fig. 12.2: Cemented zirconium dioxide crown

Fig. 13: Gingival index in zirconium dioxide crown

Fig. 14: Gingival index in lithium disilicate crown

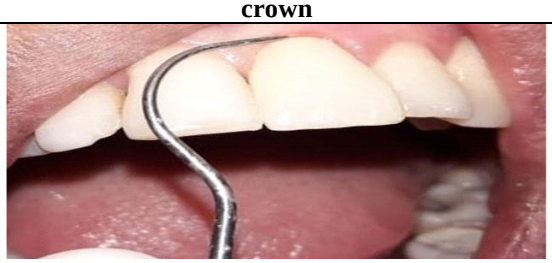

Fig. 15: Plaque index in zirconium dioxide crown

Fig. 16: Plaque index in lithium disilicate crown

Fig. 17: Periodontal pocket depth in zirconium dioxide crown with acrylic stent

Fig. 18: Periodontal pocket depth in lithium disilicate crown with acrylic stent

Fig. 19: Bleeding on probing in zirconium dioxide crown

Fig. 20: Bleeding on probing in lithium disilicate crown

Appendix-V

Work Plan

Activity of the period	February 2019 to February 2020	December 2020 to January 2021	February 2021	March 2021	March 2021
Selection of topic					
Literature review					
Planning and designing					
Questionaire preparation					
Protocol submission & approval					
Data collection					
Data coding					

Data analysis & interpretation					
Report writing					
Submission					

Appendix-VI
Statistical Formulae

1. Mean
Where, = Summation of individual observations
n= Number of observations

2. Standard Deviation (SD)
SD =
Where, = Summation of individual observations
n= Number of observations

3. Unpaired student's 't' test

t =
Where,
m_1 = Mean of the first sample.
m_2 = Mean of the second sample.
SE_1 = Standard error of first sample.
SE_2 = Standard error of second sample.

Appendix-VII

বঙ্গবন্ধু শেখ মুজিব মেডিক্যাল বিশ্ববিদ্যালয়
Bangabandhu Sheikh Mujib Medical University
রেজিস্ট্রার অফিস Office of the Registrar
NO. BSMMU/2020/1999 *Date:11-02-2020*

Dr. Kamrun Nahar
MS (Prosthodontics) Phase-B, Resident
Department of Prosthodontics
Bangabandhu Sheikh Mujib Medical University
Shahbag, Dhaka-1000

Sub: **Institutional Review Board (I.R.B) Clearance.**

With reference to your application on the above mentioned subject, this is to inform you that your Research Proposal entitled **"Comparison of periodontal response between subgingivally placed lithium disilicate and zirconium dioxide crown on endodontically treated anterior teeth"** has been reviewed and approved by the Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University in its 196th meeting held on 18 January 2020.

You are requested to follow the Institutional Review Board (IRB) guidelines.

Expected Examination date July' 2021.

(Dr. Ferdous Alam)
Member Secretary
Institutional Review Board
BSMMU, Shahbag, Dhaka

ব্লক বি (৩য় তলা), শাহবাগ, ঢাকা-১০০০, বাংলাদেশ, টেলিফোন ঃ ৫৫১৬৫৭৬০-৯৪, ফ্যাক্স ঃ ৮৮০-২-৫৫১৬৫৬০৯, E-mail : registrar@bsmmu.edu.bd
Block B (2nd Floor), Shahbag, Dhaka-1000, Bangladesh, Tel : 55165760-94, Fax : 880-2-55165609, E-mail : registrar@bsmmu.edu.bd

Appendix-VIII

ESTIMATED BUDGET:

Name of the Item or Material	Unit	Unit Cost	Total estimated budget(In Tk.)
1. Dental mirrors and probes etc	120	500/-	60,000/-
2. Impression materials, radiographs, Impression pouring materials, Impression taking instrument.			2,90,000/-
3. Internal work, literature search and purchase of article or reference paper	-	-	15,000/-
4. Stationeries. Paper files, staplers etc.	-	-	10,000/-
5. Printing and reproduction	-	-	15,000/-
6. Thesis writing, computer compose etc	-	-	15,000/-
7. Thesis binding	-	-	3,000/-
8. Miscellaneous	-	-	8,000/-
Total	-	-	4,16,000/-

Appendix-IX
Raw Data Sheet

gin_1m	plaq_base	plaq_1m	ppd_base	ppd_1m	bleed_base	bleed_1m
1.17	2.17	2.17	1.58	1.83	0.17	0.50
2.17	2.00	2.17	1.58	2.25	0.17	0.50
2.33	2.50	2.17	1.67	1.91	0.50	0.67
1.17	2.33	2.00	1.50	1.50	0.67	0.17
1.33	1.33	1.33	1.58	1.67	0.33	0.50
1.17	1.17	1.50	1.67	1.67	0.17	0.33
1.00	3.00	2.00	1.45	1.33	0.67	0.33
1.33	2.33	2.33	1.72	1.67	0.33	0.50
1.17	1.33	2.00	1.67	1.50	0.50	0.50
1.33	1.33	2.00	1.67	1.42	0.33	0.50
1.00	1.33	1.33	1.80	1.75	0.33	0.17
1.00	2.00	1.67	1.70	1.67	0.17	0.17

id	group	name	age	sex	Occupation	tooth	gin_base
1	1	Raju	24	1	1	1	1.33
2	1	Raju	24	1	1	2	1.17
3	1	Akash	24	1	2	1	1.17
4	1	Hayder	48	1	1	1	1.00
5	1	Shifat	25	1	2	1	1.00
6	1	Shifat	25	1	2	1	1.17
7	2	Raihan	25	1	3	1	1.00
8	2	Shukrana	52	1	1	3	1.17
9	2	Maya	38	2	3	1	1.00
10	2	Maya	38	2	3	1	1.00
11	2	Shafiqul	35	1	3	1	1.33
12	2	Jakir	30	1	3	1	1.00

III. RESULT AND DISCUSSION

The present study was carried out to compare the periodontal response between subgingival placed lithium disilicate and zirconium dioxide crown. The study included 12 samples having endodontically treated anterior teeth. The comparison of periodontal response between lithium disilicate and zirconium dioxide crowns was evaluated in terms of gingival index, plaque index, periodontal pocket depth, and bleeding on probing by using the chi-square test at 1 and 3 months. The findings obtained from the research study are presented in different tables on the following pages.

Table 3: Comparison of a gingival index between Group A and Group B (n=12)

Gingival index	Group A (Lithium Disilicate crown) (n=6) No. (%)	Group B (Zirconium Dioxide crown) (n=6) No. (%)	χ^2-value	p-value
At 1st month				
Grade I	5(83.3%)	6(100.0%)	1.091	0.296ns
Grade II	1(16.7%)	0(0.0%)		
At 3rd month				
Grade I	4(66.7%)	6(100.0%)	2.40	0.121 ns
Grade II	2(33.3%)	0(0.0%)		

Data were expressed as frequency and percentage
Chi-square analysis was used to compare the two groups.
S= significant, ns= not significant
P value <0.05 was considered as statistically significant

Table 3 shows the gingival index between the two groups. During 1st month Grade I was (83.3%) in Group A and Grade I (100%) in Group B, Grade II was (16.7%) in Group A, and Grade II (0%) in Group B. At 3rd month Grade I was (66.7%) in Group A and Grade I (100%) in Group B, Grade II was (33.3%) in Group A and Grade II (0%) in Group B. In this study, comparing the gingival index between two groups was statistically not significant (p-value>0.05) at 1st month and 3rd-month follow-up. Clinically group B (zirconium dioxide) was better but the difference between the two groups was statistically not significant. Both lithium disilicate and zirconium dioxide have low tissue irritation properties, probably this may be responsible for this insignificant finding. Polycrystalline ceramic-like zirconium dioxide has a favorable biological response in soft tissue[24]. Polished zirconia showed a better integration with soft tissue compared to lithium disilicate[25]. Consequently, lithium disilicate can be considered a suitable material even for subgingival restorations[26]. Human gingival fibroblast produces different cytokines and chemokines like IL-B which are responsible for gingival inflammation[27]. Human gingival fibroblasts' cellular response may reflect variability in soft tissue reaction to different surface materials for prosthetic restorations[28]. The presence of all-ceramic restorations did not induce inflammatory reactions in periodontally healthy patients; no differences between gingival reactions to lithium disilicate and zirconium dioxide restorations could be shown[29].

Table 4: Comparison of a Plaque index between Group A and Group B (n=12)

Plaque index	Group A (Lithium Disilicate crown) (n=6) No. (%)	Group B (Zirconium Dioxide crown) (n=6) No. (%)	χ^2-value	p-value
At 1st month				
Grade I	2(33.3%)	1(16.7%)	0.444	0.505ns
Grade II	4(66.7%)	5(83.3%)		
At 3rd month				
Grade I	1(16.7%)	4(66.7%)	3.086	0.079 ns
Grade II	5(83.3%)	2(33.3%)		

Data were expressed as frequency and percentage
Chi-square analysis was used to compare two groups
S= significant, ns= not significant
P value <0.05 was considered as statistically significant

Table 4 shows the plaque index between the two groups. During 1st month Grade I was (33.3%) in Group A and Grade I (16.7%) in Group B, Grade II was (66.7%) in Group A, and Grade II was (83.3%) in Group B. In the 3rd month Grade I was (16.7%) in Group A and Grade I (66.7%) in Group B, Grade II was (83.3%) in Group A and Grade II was (33.3%) in Group B. Chi-square test was done, and comparing the plaque index between two groups was statistically not significant (p-value>0.05) at 1st month and 3rd-month follow-up. So, the results fail to reveal any significant differences between lithium disilicate and zirconium dioxide crown at 1st and 3rd-month follow-up. Zirconium dioxide appears to adhere a minimum number of bacterial colonies than lithium disilicate and it is possible because with daily tooth brushing zirconium dioxide crowns may not be susceptible to adhere to any bacteria for short time. Researchers performed scanning electron microscopy (SEM) and found zirconia surface appeared less colonized by bacteria and biofilm adhering to the zirconia surface was less uniform and less compact[30]. On the other hand, it is found that lithium disilicate crowns are less susceptible to adhere bacteria for plaque formation[31]. Conflicting findings from different studies may be attributed to several factors such as variance in the time period of crown clinical services as well as the possibility that the condition of the surfaces of the crowns may have changed with time[32]. Patients who were instructed and motivated to take adequate measures of self-performed plaque control, plaque level, and gingival inflammation were not significantly different[33]. In the present study self-awareness of patients may play a vital role to reduce plaque formation in both groups up to 3 months follow-up.

Table 5: Comparison of periodontal pocket depth between Group A and Group B (n=12)

Periodontal pocket depth	Group A (Lithium Disilicate crown) (n=6) No. (%)	Group B (Zirconium Dioxide crown) (n=6) No. (%)	χ^2-value	p-value
At 1st month				
Grade I	1(16.7%)	3(50.0%)	1.50	0.221ns
Grade II	5(83.3%)	3(50.0%)		
At 3rd month				
Grade I	2(33.3%)	5(83.3%)	3.086	0.079 ns
Grade II	4(66.7%)	1(16.7%)		

Data were expressed as frequency and percentage
Chi-square analysis was used to compare two groups.
S= significant, ns= not significant
P value <0.05 was considered as statistically significant

Table 5 shows the periodontal pocket depth between the two groups. During 1st month Grade I was (16.7%) in Group A and Grade I (50%) in Group B, Grade II was (83.3%) in Group A and Grade II (50%) in Group B. In the 3rd month Grade I was (33.3%) in Group A and Grade I (83.3%) in Group B, Grade II was (66.7%) in Group A, and Grade II was (16.7%) in Group B. Here at 1st and 3rd-month, follow-up shows no significant difference between the two groups. Poor marginal adaptation, deeper infraclavicular margin

placement, and over-contoured restorations are responsible for periodontal inflammation. In the current study these deteriorating factors were carefully avoided during the fabrication of lithium disilicate and zirconium dioxide crowns, as a result, the current study showed no significant differences in regard to periodontal pocket depth. Subgingival margins may lead to inflammation at the margins of the restoration and cause unfavorable periodontal responses[34]. When the gingival margins of crowns are placed in the subgingival region it may hinder oral self-care[35]. Campbell et al. Anterior teeth crown margins could be placed about 0.5mm subgingivally to avoid violation of the biological width, reduced periodontal problems, and achieve better aesthetics[36]. Furthermore, the success of lithium disilicate and zirconium dioxide crowns was achieved by giving adequate oral hygiene instructions to the patients, and without violating the biological width. These two factors were also considered in the present study during subgingival preparation. That's why the response of periodontal pocket depth up to 3 months was not statistically significant between the two groups.

Table 6: Comparison of bleeding on probing between Group A and Group B (n=12)

Bleeding on probing	Group A (Lithium Disilicate crown) (n=6) No. (%)	Group B (Zirconium Dioxide crown) (n=6) No. (%)	χ^2-value	p-value
At 1st month				
Grade I	5(83.3%)	6(100.0%)	1.091	0.296
Grade II	1(16.7%)	0(0.0%)		
At 3rd month				
Grade I	4(66.7%)	6(100.0%)	2.40	0.121
Grade II	2(33.3%)	0(0.0%)		

Data were expressed as frequency and percentage
Chi-square analysis was used to compare two groups.
S= significant, ns= not significant
P value <0.05 was considered as statistically significant

Table 6 shows the bleeding on probing between the two groups. During 1st month Grade I was (83.3%) in Group A and Grade I (100%) in Group B, Grade II was (16.7%) in Group A, and Grade II was (0.0%) in Group B. In 3rd month Grade I was (66.7%) in Group A and Grade I (100.0%) in Group B, Grade II was (33.3%) in Group A, and Grade II was (0.0%) in Group B. No significant differences in bleeding on probing between lithium disilicate and zirconium dioxide crowns after 10 years of follow-up[37]. Periodontal tissue damage and bleeding on probing is more in subgingival margin preparation for lithium disilicate and zirconium dioxide crowns. The dissimilarities between the above findings may be related to the number of years that had passed since their patients had been rehabilitated with crown, involving external factors, for example, motivation and level of commitment of the patients to maintain proper oral hygiene. The present study also reflected no significant differences between lithium disilicate and zirconium dioxide crowns during bleeding on probing after 1st and 3rd-month follow-up because of maintaining proper oral hygiene. Attention should be given that 3 months were not enough for the development of periodontal inflammation which may lead to bleeding on probing.

IV. Conclusion

The main achievement of this study is, it was an unbiased study. All data were checked for inadequacy, irrelevancy, and inconsistency. Previous studies have focused on the other clinical performance of lithium disilicate and zirconium dioxide crowns. These studies did not clearly differentiate the periodontal response between lithium disilicate and zirconium dioxide crowns. For the long-term survival of restorations, both functionally and esthetically, certain biological considerations are very critical to preserve the health of the periodontium and thus must be given due importance in clinical practice. So that the present study has been designed to compare the periodontal response between subgingivally placed lithium disilicate and zirconium dioxide crowns on endodontically treated anterior teeth performed in a general dental practice.

References

[1]. Zarone, F., Russo, S., & Sorrentino, R. (2011). From porcelain-fused-to-metal to zirconia: clinical and experimental considerations. Dental materials, 27(1), 83-96.
[2]. Manicone, P. F., Iommetti, P. R., & Raffaelli, L. (2007). An overview of zirconia ceramics: basic properties and clinical applications. Journal of dentistry, 35(11), 819-826.
[3]. Dolidze, T., & Bitarova, I. (2017). Advantages and dısadvantages of E-max and Zırconıa crowns. Eur Sci J, 12, 465-468.

[4]. Gardell, E., Larsson, C., & von Steyern, P. V. (2021). Translucent zirconium dioxide and lithium disilicate: a 3-year follow-up of a prospective, practice-based randomized controlled trial on posterior monolithic crowns. Int J Prosthodont, 34(2), 163-172.

[5]. Malament, K. A., Goldstein, R. E., Stappert, C. F., Taheri, M., & Sing, T. (2018). Crown Restorations. Ronald E. Goldstein's Esthetics in Dentistry, 498-540.

[6]. Zarone, F., Russo, S., & Sorrentino, R. (2011). From porcelain-fused-to-metal to zirconia: clinical and experimental considerations. Dental materials, 27(1), 83-96.

[7]. Höland, W., Schweiger, M., Watzke, R., Peschke, A., & Kappert, H. (2008). Ceramics as biomaterials for dental restoration. Expert review of medical devices, 5(6), 729-745.

[8]. Wen, G., Zheng, X., & Song, L. (2007). Effects of P2O5 and sintering temperature on microstructure and mechanical properties of lithium disilicate glass-ceramics. Acta materialia, 55(10), 3583-3591.

[9]. Örtorp, A., Kihl, M. L., & Carlsson, G. E. (2009). A 3-year retrospective and clinical follow-up study of zirconia single crowns performed in a private practice. Journal of dentistry, 37(9), 731-736.

[10]. Ramesh, T. R., Gangaiah, M., Harish, P. V., Krishnakumar, U., & Nandakishore, B. (2012). Zirconia Ceramics as a Dental Biomaterial--An Over view. Trends in Biomaterials & Artificial Organs, 26(3).

[11]. Jafari, Z., Bigham, A., Sadeghi, S., Dehdashti, S. M., Rabiee, N., Abedivash, A., ... & Makvandi, P. (2021). Nanotechnology-Abetted Astaxanthin Formulations in Multimodel Therapeutic and Biomedical Applications. Journal of medicinal chemistry, 65(1), 2-36.

[12]. Schmalz, G. (1998). Concepts in biocompatibility testing of dental restorative materials. Clinical oral investigations, 1(4), 154-162.

[13]. Brunot-Gohin, C., Duval, J. L., Verbeke, S., Belanger, K., Pezron, I., Kugel, G., ... & Egles, C. (2016). Biocompatibility study of lithium disilicate and zirconium oxide ceramics for esthetic dental abutments. Journal of periodontal & implant science, 46(6), 362-371.

[14]. Ercoli, C., & Caton, J. G. (2018). Dental prostheses and tooth-related factors. Journal of periodontology, 89, S223-S236.

[15]. Kapila, Y. L. (2021). Oral health's inextricable connection to systemic health: Special populations bring to bear multimodal relationships and factors connecting periodontal disease to systemic diseases and conditions. Periodontology 2000, 87(1), 11-16.

[16]. Gendreau, L., & Loewy, Z. G. (2011). Epidemiology and etiology of denture stomatitis. Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry, 20(4), 251-260.

[17]. Diab, H. (2018). Effect of Full Ceramic Crown Versus Ceramic Fused to Metal Crown on Periodontal Tissues Health. EC Dental Science, 17, 1041-1046.

[18]. Dhingra, K. (2012). Oral rehabilitation considerations for partially edentulous periodontal patients. Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry, 21(6), 494-513.

[19]. Shenoy, A., Shenoy, N., & Babannavar, R. (2012). Periodontal considerations determining the design and location of margins in restorative dentistry. Journal of interdisciplinary dentistry, 2(1), 3.

[20]. Khuller, N., & Sharma, N. (2009). Biologic width: Evaluation and correction of its violation. J Oral Health Comm Dent, 3(1), 20-5.

[21]. Allen, E. P. (1993). Surgical crown lengthening for function and esthetics. Dental Clinics of North America, 37(2), 163-179.

[22]. Nayer, A., Rayyan, M. M., Osman, E., & Badr, S. B. Y. (2012). An update on the effect of crown margin locations and materials on periodontal health. Dental journal, 58(3639), 3644.

[23]. Jameel, A., Hasan, A., & Rashid, S. (2011). An evaluation of association between crown margins & materials with the periodontal health. JPDA, 20(03).

[24]. Abd El-Ghany, O. S., & Sherief, A. H. (2016). Zirconia based ceramics, some clinical and biological aspects. Future Dental Journal, 2(2), 55-64.

[25]. Tete, S., Zizzari, V. L., Borelli, B., De Colli, M., Zara, S., Sorrentino, R., ... & Zarone, F. (2014). Proliferation and adhesion capability of human gingival fibroblasts onto zirconia, lithium disilicate and feldspathic veneering ceramic in vitro. Dental Materials Journal, 33(1), 7-15.

[26]. [26] Zarone, F., Ferrari, M., Mangano, F. G., Leone, R., & Sorrentino, R. (2016). "Digitally oriented materials": focus on lithium disilicate ceramics. International journal of dentistry, 2016.

[27]. [27] Tawfig, N. (2016). Proinflammatory cytokines and periodontal disease. Journal of Dental Problems and Solutions, 3(1), 012-017.

[28]. [28] Tete, S., Zizzari, V. L., Borelli, B., De Colli, M., Zara, S., Sorrentino, R., ... & Zarone, F. (2014). Proliferation and adhesion capability of human gingival fibroblasts onto zirconia, lithium disilicate and feldspathic veneering ceramic in vitro. Dental Materials Journal, 33(1), 7-15.

[29]. [29] Srimaneepong, V., Heboyan, A., Zafar, M. S., Khurshid, Z., Marya, A., Fernandes, G. V., & Rokaya, D. (2022). Fixed prosthetic restorations and periodontal health: a narrative review. Journal of Functional Biomaterials, 13(1), 15.

[30]. [30] Al-Radha, A. S. D., Dymock, D., Younes, C., & O'Sullivan, D. (2012). Surface properties of titanium and zirconia dental implant materials and their effect on bacterial adhesion. Journal of dentistry, 40(2), 146-153.

[31]. [31] Matalon, S., Safadi, D., Meirowitz, A., & Ormianer, Z. (2021). The effect of aging on the roughness and bacterial adhesion of lithium Disilicate and Zirconia ceramics. Journal of Prosthodontics, 30(5), 440-446.

[32]. Al-Wahadni, A. M., Mansour, Y., & Khader, Y. (2006). Periodontal response to all-ceramic crowns (IPS Empress) in general practice. International journal of dental hygiene, 4(1), 41-46.

[33]. Ercoli, C., & Caton, J. G. (2018). Dental prostheses and tooth-related factors. Journal of periodontology, 89, S223-S236.

[34]. Bader, J. D., Rozier, R. G., McFall Jr, W. T., & Ramsey, D. L. (1991). Effect of crown margins on periodontal conditions in regularly attending patients. The Journal of prosthetic dentistry, 65(1), 75-79.

[35]. Bader, J. D., Rozier, R. G., McFall Jr, W. T., & Ramsey, D. L. (1991). Effect of crown margins on periodontal conditions in regularly attending patients. The Journal of prosthetic dentistry, 65(1), 75-79.

[36]. Samer, M. S., Ali, T. T., & Abdullah, H. (2018). Clinical outcomes of lithium disilicate single crowns after a mean duration of 3 years-a retrospective study. Oral Hlth Prev Dent, 16, 249-57.

[37]. Wolfart, S., Eschbach, S., Scherrer, S., & Kern, M. (2009). Clinical outcome of three-unit lithium-disilicate glass–ceramic fixed dental prostheses: up to 8 years results. Dental materials, 25(9), e63-e71.