

Research Report

Cervical end preparation design on collarless metal ceramic crown to the decrease of bacterial colony

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ABSTRACT

Background: Cervical end preparation design is an important procedure in fixed partial denture. If the cervical end preparation design is inadequate, dental plaque will easily be formed and this may indicate the beginning of periodontal disease. **Purpose:** This study was aimed to analyze the effect of cervical end preparation design on collarless metal ceramic crown towards the decrease of bacterium colony number. **Methods:** This study was quasi-experimental study applying pre and post test on a control group involving 48 subjects with shoulder, bevel shoulder, and deep chamfer cervical end preparation. The bacterium colonies were examined on the 1st, 7th, and 21st days after the insertion of collarless metal ceramic crown. **Results:** The study showed that bacterium colony increased significantly in deep chamfer and bevel shoulder preparation design between the treatment group and the control group ($p < 0.05$). In shoulder preparation there was not significant different between the treatment group and the control group ($p > 0.05$). **Conclusion:** Compared to the bevel shoulder and deep chamfer, shoulder design is the best design for collarless metal ceramic crown restoration.

Key words: Cervical end preparation design, bacterial colonization, collarless metal ceramic crown

ABSTRAK

Latar belakang: Desain preparasi tepi servikal merupakan suatu tahap yang sangat menentukan dalam pembuatan gigi tiruan cekat. Apabila desain preparasi tepi servikal tidak adekuat dapat menyebabkan pembentukan plak gigi pada daerah tersebut. Keadaan ini merupakan tahap awal terjadinya penyakit periodontal. **Tujuan:** Untuk menganalisis pengaruh desain preparasi tepi servikal yang dibuat pada mahkota collarless metal ceramic untuk mengurangi jumlah bakterium koloni. **Metode:** Penelitian ini adalah penelitian eksperimental semu dengan metode pre and post test dan kelompok kontrol terhadap 48 subyek penelitian. Dilakukan preparasi gigi dan pembuatan akhiran preparasi tepi servikal shoulder, bevel shoulder, dan deep chamfer pada subyek penelitian. Pemeriksaan koloni bakteri dilakukan pada hari ke-1, 7, dan 21 setelah pemasangan mahkota collarless metal ceramic. **Hasil:** Menunjukkan bahwa terjadi, peningkatan jumlah koloni bakteri yang bermakna antara kelompok perlakuan dengan kelompok kontrol ($p < 0,05$) pada desain preparasi deep chamfer dan bevel shoulder. Sedangkan pada desain preparasi tepi servikal shoulder tidak ada perbedaan yang bermakna antara kelompok perlakuan dengan kelompok kontrol ($p > 0,05$). **Kesimpulan:** Desain shoulder adalah desain tepi preparasi yang terbaik bagi mahkota collarless metal ceramic dibandingkan bevel shoulder dan deep chamfer.

Kata kunci: Desain tepi servikal, koloni bakteri, mahkota collarless metal ceramic

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INTRODUCTION

Collarless metal ceramic restorations were the best esthetic quality of porcelain fused to metal crown. The

conventional metal ceramic restoration is a metal collar on the buccal surface, that provides good fitting and gingival contour. However, it may esthetically be unacceptable and probably the patient become disappointed.¹ The use of

porcelain fused to metal restorations has become unpopular because of the disadvantages on the buccal metal collar. The advantages of porcelain fused to metal restorations is on the esthetic aspect and on the excellent biocompatibility of the glazed porcelain, and also on the fabrication of this type of restoration.² The disadvantages of collarless metal ceramic restorations are related to the sensitivity technique of the operator that required skilled and meticulous care of the operator with the risk of producing restoration on the poorer marginal adaptation compared to the metal restoration.^{1,2}

Bacteria associated with the periodontium exist in an extremely complex arrangement, and often involved sites mix bacteria from normal sites. Plaque is having similar microbial compositions derived from pooled dental plaque and infectious plaque potential.

Supragingival plaque is usually more abundant and more easily removed than subgingival plaque. Plaque bacteria are varied and modulated by host factors resulting in disease progression during period of exacerbation. Disease activity periods may have caused contribution of pathogen bacteria to make a lesion. Some bacteria have been identified as main pathogens bacteria in periodontal disease. Many types of dental plaque bacteria deposit on tooth surface above and below gingival margin.

The first stage of plaque forming is a form of flimsy coat on the teeth or on the denture that called acquired pellicle. The pellicle is a flimsy coat with 0.1–0.8 micrometer, translucency, soft, uncolored, and irregular shape. Shortly after teeth brushing, acquired pellicle does formed again on the surface of the teeth. The pellicle is not only give a protection to the surface of the teeth, but also become a medium for supporting an early attachment of bacterium plaque.^{3,4} Bacterium needs not the form of pellicle, but attaches and build a colony shortly after plaque is formed. The structure of the oral cavity, tongue, cheek, saliva, teeth, and gingival sulcus is an ideal places for bacterium colony. The bacteria are predominantly *Streptococcus mutans* and its variants. Bacterium in the saliva attach to the inorganic pellicle of the teeth. Some bacteria will attach to the pit and fissure of the teeth and margin of the denture. Others attach interactively to the pellicle surface.⁵

The bacterium attachment support *pilli* or *fimbriae*. Adhesin is a group of protein molecule on the bacterium surface cell that can be recognize and relate to the pellicle glycoprotein. It will increase the attachment to the pellicle and eventually form a plaque. Bacterium also attaches easily with the support of kation such as free calcium ion and saliva that connects negative content on the surface teeth with the bacterium cells.^{3,6}

The plaque accumulation increases due to the saliva acidity and also increase during sleep while saliva flow decreasing. In the supragingival plaque, the anaerob bacterium form the inner part of the plaque, while the aerobic bacterium is found on the surface and facultative bacterium is disseminated in the whole plaque mass.³ Final composition of the plaque depends on the bacterium, the

environment, and the host factor. Such factors as the place in oral cavity, time, saliva composition, systemic disease, oral hygiene, the use of control plaque agent, diet, as well as the patient's age, gender, and ethnic background influence the pattern and degree of plaque formation.^{4,6}

Marginal adaptation is a critical factor for the success of dental restoration and marginal cervical preparation design. If the fitness restoration is inadequate or there is poor marginal adaptation, there will be marginal leakage and encourage the place of plaque and bacterium.⁷ The restored cervical end area is an important area of the fixed partial denture restoration and very susceptible for the attachment of bacterium plaque. Accurate selection of preparation design for fixed partial denture restoration is very helpful for obtaining closed restoration in the cervical area and preventing gingivitis. If the restoration adaptation is not adequate there will be a gap in the cervical restoration.⁵

This study was aimed to analyze the effect of cervical end preparation design on collarless metal ceramic crown towards the decrease of bacterium colony number.

MATERIALS AND METHODS

This study is a quasi experimental research applying the pre and post test with a control group, conducted at the Faculty of Dentistry, Hasanuddin University, Makassar, in 2009. This study compared the influence of three kinds marginal cervical end preparation of porcelain fused to metal crown on the incidence of gingivitis.

There were 24 subject students who were willing to become volunteer of the Faculty of Dentistry, Hasanuddin University. The students criteria were: a) subject must had healthy periodontal tissue, free from calculus, gingivitis, and periodontal disease, b) subject had caries on the proximal site of the upper central incisor and need crown treatment, c) subject was not smoking, d) the age of the subject were between 20 to 27 years of old, e) subjects were male or female students.

The study involved 24 subjects divided in 3 kinds of marginal cervical end preparation design of deep chamfer, bevel shoulder, and shoulder (Figure 1). Each design consisted of 8 subjects. The treatment groups were central upper incisor preparation of shoulder, bevel shoulder, and deep chamfer. The control groups were the opposite side of the central upper incisor without caries and or treatment. Those subjects were given dental health education and counseling, an explanation of the working procedures and signing informed consent letter. After that, gingival retraction, temporary crown was made, and permanent crown was inserted by using glass ionomer cement.

Obtaining bacterium colonies was done before treatment and on the 1st, 7th, and 21st days after fitting the collarless metal ceramic crowns. Bacterium colonies were spread on the paper point from the marginal cervical edge of the collarless metal ceramic crowns and further drawn on the blood agar medium. It was stored on the instrument with

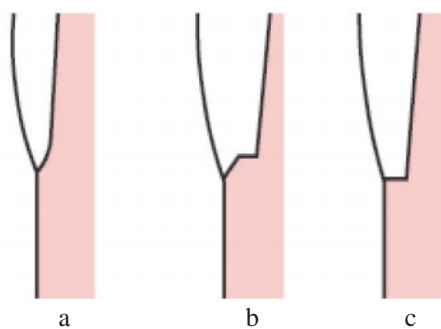


Figure 1. Cervical end preparation design: a) deep chamfer, b) bevel shoulder, c) shoulder.³

the incubation temperature of 37° celcius for 24 hours, and then the number of bacterium colonies was counted.

RESULTS

This study of the marginal cervical end preparation design on collarless metal ceramic crown was aimed to choose which design has the less number of bacterium colony. The alteration number of bacterium colony after collarless metal ceramic crown was inserted at the 1st, 7th, and 21st days and the difference number of bacteria colony between the treatment groups and control groups can be seen on table 1.

There was an alteration number of bacterium colony at the 1st, 7th, and 21st days in bevel shoulder and deep chamfer marginal cervical end preparation design, whereas the

Table 1. The number of bacterium colonies before and after insertion of collarless metal ceramic crown (CFU/ml)

Design	Days	Mean	SD	p
Deep chamfer	1	161.25	64.68	0.058
Control	1	95.00	70.10	
Bevel Shoulder	1	162.50	62.96	0.052
Control	1	95.00	70.10	
Shoulder	1	145.00	59.76	0.054
Control		81.25	65.34	
Deep chamfer	7	182.5	81.55	0.058
Control	7	95.00	70.10	
Bevel Shoulder	7	217.50	90.99	0.027
Control	7	95.00	70.10	
Shoulder	7	160.00	71.51	0.059
Control	7	81.25	65.34	
Deep chamfer	21	196.25	87.33	0.047
Control	21	95.00	70.10	
Bevel Shoulder	21	228.75	115.07	0.037
Control	21	95.00	70.10	
Shoulder	21	178.75	87.41	0.055
Control	21	81.25	65.34	

SD: Standard deviation, P: Probability

increasing number in shoulder design was not significant. There was a significant increase in the number of bacterium colony between the treatment groups with control groups in bevel shoulder and deep chamfer marginal cervical end preparation design. Meanwhile the shoulder design had no significant increase in the number of bacterium colony.

DISCUSSION

Fixed partial denture is one of the popular prosthodontic restoration. The reason of use the fixed partial denture as one of an alternative tooth restoration because it is smaller, simpler, more comfortable, and has more esthetic, Moreover, it gives more confidence to the patient compared to removable denture. Fixed denture restoration still have problem related to periodontal health. Selected of preparation design and material will determine the success of fixed partial denture treatment.^{6,8}

There are some choices of fixed restoration materials porcelain fused to metal (PFM) and all porcelain. The development of porcelain fused to metal restoration is the modification of collarless metal ceramic crown in order to obtain the esthetic aspect and the metal material biocompatible to the oral mucous. Porcelain restorations require some thickness on the material to prevent a crack or fracture on the cervical end margin. The recommended marginal cervical end preparation are shoulder, bevel shoulder, and deep chamfer.^{2,8,9}

Choosing a wrong marginal cervical end preparation design will cause marginal crack, since the density of the marginal preparation lines with the material edge can not be tightly adaptive. Many studies reported that the marginal gaps were suitable location for the growth and development of dental plaque bacteria which had an important role on inflammation of periodontal tissue. The designs on the marginal cervical end preparation such as feather edge, bevel, deep chamfer, shoulder, shoulder with bevel not all are suitable for collarless metal ceramic crown.^{8,9,10}

In this study, the design of marginal cervical end preparation were shoulder, bevel shoulder and deep chamfer. They were selected because collarless metal ceramic crown for the marginal cervical end was made of porcelain which need material thickness due to the fragile nature of porcelain. Porcelain material thickness was determined by the marginal cervical end preparation so that the marginal cervical line is suitable with porcelain material. Shoulder marginal end preparation design enables operator to determine how much tooth tissue should be removed. This shoulder width is necessary to hold the incisor or occlusal force and an appropriate preparation for collarless metal ceramic crown restoration.

On table 1, in shoulder preparation design, the total number of bacteria decreased on the 1st, 7th, and 21st day after collarless metal ceramic crown was inserted. The marginal cervical end preparation was well adapted with the cervical end finish line of collarless metal ceramic

crown, and prevented plaque to adhere on that location. This could happen because the shoulder preparation design is sharp and firm on the cervical end line and had sufficient thickness. The design was different from the design on bevel shoulder and deep chamfer, the marginal cervical end were thinner. Hence, it was not so clear which could cause a leak on the cervical end restoration, it could also be broken easily, and dental plaque has a better place to develop in the mouth.^{8,10,11}

The marginal cervical end on deep chamfer had finish line design less confined tissue removal, and has more adequate cervical adaptation than the marginal cervical end on shoulder. Bevel shoulder finish line preparation was made to prevent a poor cervical adaptation, but bevel placement which was made between 0.5–1.0 mm at the cervical area could cause debris entrapment and plaque formation. Design and marginal cervical end preparation placement remarkably affected gingival tissue health. Therefore, to obtain a good result and durable restoration in the mouth, despite of the esthetic and functional aspect, periodontal health aspect also supported treatment success. Healthy periodontal tissue can make the restoration durable in the mouth.

The edge proximity greatly affected the success of a fixed denture restoration. In adequate edge proximity may facilitate the accumulation of plaque that can generate dental caries and periodontal disease.⁶ Edge proximity can be detected with Scanning Electron Microscope (SEM); however, in this research it was detected from the existence of dental plaque at cervical area restoration. The cervical edge deep chamfer preparation design also had the same thickness as the shoulder preparation design, yet with a slight inclination in the preparation. The inclination of the preparation in the cervical part would cause friction of cervical restoration if occlusal pressure resulted in marginal gap.^{10,11}

Dental plaque or bio film is a slack deposit containing a various group of micro-organism on the tooth or denture surface.¹⁰ Dental plaque is a complex aggregate of micro-organism attaching and multiplying on the surface of hard surface and soft tissue oral cavity, containing one or more species micro-organism that can stick with the help of glicocalics.^{11,12}

The plaque formation process on the teeth or denture surface covers three phases: a) The absorption of saliva protein and glycoprotein form a thin layer on the teeth or denture surface known as pellicle (acquired pellicle); b) The colonization of bacteria in the pellicle attached on the denture or tooth enamel is an initial colonization of bacteria (*Streptococcus oralis*, *Streptococcus mitis*, *Streptococcus sanguis*, *Actinomyces* and *Naisseria*); c) The secondary colonization resulting from the interaction between bacteria in the pellicle and other bacteria in the buccal cavity increases the bacterium species and eventually causes matriculation of the plaque on the tooth surface.¹³

Denture attached near by the orifice will have a contact with the saliva, absorb a number of saliva molecules, and

form a thin layer called pellicle. Pellicle contain protein that can tie micro-organisms in the buccal cavity so that they attach on the denture surface, colonize with other micro-organisms and multiply to form dental plaque.^{8,13}

The bevel shoulder and deep chamfer preparation design in this research were the designs that could increase the number of bacterium colonies, since they had inadequate restoration edge adaptation. Both design were compared to the shoulder preparation design whose edge proximity was not closely adapted to the periphery of the cervical edge restoration that enabled dental plaque to develop and live in these areas.¹⁴

The result of this research indicates that the shoulder preparation design has good edge proximity since this cervical edge shoulder preparation design did not show any significant increase in the number of bacteria colonies ($p > 0.05$) from the 1st up to 21st day after the insertion of collarless metal ceramic crown. The bevel shoulder and deep chamfer preparation designs had unfavorable cervical edge proximity since there was a significant increase in the number bacterium colonies ($p < 0.05$), as the effect of marginal gap, which was an ideal habitat for dental plaque.^{7,14}

It is concluded that shoulder preparation design is the best design for crown porcelain restoration. It has sufficient thickness to prevent the cervical end restoration from being broken. Shoulder preparation design has a clear and firm preparation edge line. The solidity of the restoration edge is more reliable compare to bevel shoulder and deep chamfer.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to the Post Graduate Program of Hasanuddin University Makassar, The Health Laboratory of the South Sulawesi Province, Prof. drg. Dharmautama, Ph.D., Sp.Pros (K), and Prof. Dr. drg. Arifzan Razak, M.Sc., Sp.Pros (K) for grant the opportunity and support to conduct this research.

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