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FABRICATION OF ALL PORCELAIN CANTILEVER BRIDGE RESTORATION IN CASES OF GINGIVA RECESSION USING ZIRCONIUM DIOXIDE MATERIAL WITH ADDITIONAL RETENSION

PEMBUATAN RESTORASI ALL PORCELAIN CANTILEVER BRIDGE PADA KASUS RESESI GINGIVA BERBAHAN ZIRCONIUM DIOXIDE DENGAN TAMBAHAN RETENSI

Case Study
Studi Kasus

Yobellivia Pauline , Eny Inayati *, Sianiwati Goenharto, Okti Setyowati, Endang Kusdarjanti, Sri Redjeki Indiani, Mia Laksmi LR.

Department of Health, Faculty of Vocational Studies, Universitas Airlangga, Surabaya, Indonesia

A B S T R A C T

Background: *Aesthetic and functional dental restoration is a hope for people who have lost teeth, especially in the anterior region. Missing tooth 13 with more than 2 mm gingival recession can be made into a cantilever bridge restoration with the addition of porcelain gingiva. Gingival recession is when the tooth root surface is exposed due to periodontal tissue loss. Zirconia is a dental restoration material often used because of its biocompatibility, strength, and aesthetics.* ***Purpose:*** *To determine the procedure for making all porcelain cantilever bridge restorations in cases of gingival recession using zirconia material.* ***Case analysis:*** *The dental laboratory received a dental cast model of a 39-year-old female patient missing tooth 13 and had gingival recession on tooth 14 of more than 2 mm. Order in the form of restoration of all porcelain cantilever bridges from zirconia.* ***Result:*** *The cantilever bridge coping was made from zirconium dioxide and then layered with feldspathic porcelain to achieve optimal strength and aesthetics. A rest is made on tooth 12 to provide additional retention.* ***Conclusion:*** *The procedure for making all porcelain cantilever bridge restorations includes making diagnostic wax-up, scanning, coping design, milling, sintering, fitting, sandblasting, layering, anatomy, and glazing. Things that must be considered are the design, thickness of the coping, and connectors to achieve a restoration that is strong, resistant to fracture, and has good aesthetics. Porcelain gingiva was added in the cervical area of tooth 14 restorations to cover the recession*

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Correspondence:
Eny Inayati

E-mail :
eny.inayati@vokasi.unair.ac.id

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A B S T R A K

Latar belakang: Restorasi gigi yang estetis dan fungsional menjadi harapan bagi orang yang kehilangan gigi terutama di regio anterior. Kehilangan gigi 13 dengan resesi *gingiva* lebih dari 2 mm dapat dibuatkan restorasi *cantilever bridge* dengan penambahan *gingiva porcelain*. Resesi *gingiva* adalah kondisi dimana terbukanya permukaan akar gigi dikarenakan kehilangan jaringan periodontal. Zirkonia merupakan bahan restorasi gigi yang sering digunakan karena biokompatibilitas, kekuatan, dan estetika yang baik. **Tujuan:** Untuk mengetahui prosedur pembuatan restorasi *all porcelain cantilever bridge* pada kasus resesi *gingiva* dengan bahan zirkonia. **Analisis kasus:** Laboratorium gigi menerima model gips gigi pasien perempuan berumur 39 tahun yang kehilangan gigi 13 dan adanya resesi *gingiva* pada gigi 14 sepanjang lebih dari 2 mm. Order berupa restorasi *all porcelain cantilever bridgedari* zirconia. **Hasil:** Dibuat *coping cantilever bridge* dari zirconium dioxide, selanjutnya layering dengan *feldspathic porcelain* dibuat rest pada gigi 12 untuk memberikan retensi tambahan. **Kesimpulan:** Prosedur pembuatan restorasi *all porcelain cantilever bridge* meliputi pembuatan *diagnostic wax- up*, *scanning*, *coping design*, *milling*, *sintering*, *fitting*, *sandblasting*, *layering*, pembentukan anatomi, dan glazing. Hal-hal yang harus diperhatikan adalah desain, ketebalan *coping*, dan konektor agar bisa mencapai restorasi yang kuat, tahan fraktur, dan mempunyai estetika yang baik. Ditambahkan *gingiva porcelain* di area servikal restorasi gigi 14 untuk menutupi resesi.

Kata kunci:
All porcelain restoration, *Cantilever bridge*, Resesi *gingiva*, *Zirconia dioxide*, Layering

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INTRODUCTION

Poor oral hygiene can lead to various diseases and complications in the teeth and periodontal tissues. One of them is the emergence of diseases of the periodontal tissues, such as periodontitis, gingivitis, lesions, and others. The clinical appearance of the gingiva is closely related and impacts on the beauty of a person's smile. One is gingival recession, a condition that can appear as if the teeth look longer. Gingival recession is a condition where the root surface is exposed due to migration of the marginal gingiva in an apical direction. This condition occurs due to periodontal attachment loss (Krismariono, 2014).

The incidence of gingival recession is often found, so many treatment efforts can be made to treat this case. Treatment of gingival recession can be done in restorative, orthodontic, and surgical ways (Mostafa and Fatima, 2022). In the case of a patient who wants to restore the aesthetic shape of the teeth, gingival recession, and missing teeth can be corrected by making a fixed denture restoration with the addition of porcelain gingiva. Porcelain denture restoration is the best dental prosthesis choice to restore the aesthetics and function of teeth. Ceramic laminates have adequate physical properties, excellent esthetics, and long life. They allow conservative treatment when necessary, primarily when associated with periodontal treatment (Ferrari *et al*., 2017). Generally, two types of porcelain restorations can be made for cases of gingival recession. Porcelain restorations can be made entirely of porcelain, mainly called all-porcelain, or have metal components, also known as porcelain fused to metal.

According to Sharma *et al*. (2012), a cantilever bridge denture is a restoration with one or more retainers at one end, while the other does not receive support from the retainer. Many materials can be used to make cantilever bridge restorations, including zirconia. Zirconia is a non-glass-based porcelain material, the main component of which is zirconium dioxide (ZrO_2). According to Della Bona *et al*. (2015), this material can be called steel porcelain because it has mechanical properties similar to steel and has excellent strength, durability, and biocompatibility. Zirconia can be used to make bridges, crowns, and implants. In the past, the most popular restoration was the *Porcelain Fused to Metal* (PFM) restoration. Still, as time passed, zirconia restorations were more frequently used than PFM because they have better aesthetics. Zirconia has good optical properties, especially on the cervical line of the restoration; there will be no visible black lines, which usually occur with PFM restorations because the primary material is metal (Nistor et *et al*., 2019).

A study conducted by Kern *et al*. (2017) regarding the durability of cantilever bridges with zirconia materials, and found data that cantilever bridge dental prostheses with zirconia materials can last for ten years with a durability rate of 98.2% and a success rate of 92.0%. Cantilever bridges made of zirconia are more elastic than other porcelain materials, such as alumina. Zirconia materials have a high flexural strength of around 900 to 1200 MPa, thus making this material have good resistance to posterior and anterior occlusal forces (Madfa *et al*., 2014). In addition, a cantilever bridge with zirconia material is a treatment option that minimally invades the teeth, especially for replacing a missing anterior tooth. It has the advantage of longevity and can provide patient satisfaction.

Computer-Aided Design/Computer-Assisted Manufacturing (CAD/CAM) technology advances have made it easier for clinicians and dental technicians to use zirconia in dentistry. CAD/CAM technology can create complex restoration shapes by milling zirconia blocks. According to Gargarie *et al*. (2015), making zirconia using CAD/CAM includes preparing a working model to be scanned with a scanner, then using computer software to design the restoration framework as desired, and milling the zirconia block. CAD/CAM systems automate fabrication procedures with standardized quality in a shorter period. This system has the potential to minimize inaccuracies in technique and reduce the danger of infectious cross-contamination. This allows the use of new high-strength materials with excellent biocompatibility combined with adequate mechanical strength, resulting in aesthetic design, precision of fit, and exceptional durability. However, the price of this tool is relatively high, so it requires high initial costs for the CAD/CAM system, and the operator requires additional training (Amudhalakshmi *et al*., 2016). This paper aims to determine the procedure for making an all-porcelain cantilever bridge restoration using zirconia material in cases of gingival recession and what to pay attention to when making the restoration.

CASE STUDY

The dental laboratory received a cast model of a 39 year old female patient who had lost tooth 13 and had gingival recession of more than 2 mm on tooth 14 can be seen in Figure 1 . The dentist asked to restore all porcelain cantilever bridges with an additional palatal rest on tooth 12 using zirconia dioxide. The type of pontic is a modified ridge lap. Restoration color A3 with shade guide Vita Classical (Ivoclar) and the 14 tooth retainer is in the form of full crown and gingiva porcelain with colors G1 and G2 (re. max ceram – Ivoclar) is added to the cervical part (Figure 2). The occlusion of the maxillary and mandibular teeth is normal.

Figure 1. The patient's tooth model received by the dental laboratory

Figure 2. All porcelain cantilever bridge (Gargari *et al*., 2015)

RESULT

Making an all-porcelain cantilever bridge restoration begins with creating a diagnostic wax-up to give the dentist and patient an idea of the final results they will get later (Figure 3). Then, the patient's cast model is scanned using a scanner to obtain a virtual model of the patient's teeth. Next, this virtual tooth model is sent to the CAD machine to design the cantilever bridge coping by pressing the available menu buttons until the coping design is perfect (Figure 4). The next step is to send the design to the CAM machine to be milled according to the design. After that, sintering was carried out for 7 hours, and the dentist fitted the patient's tooth model. Sandblasting and steam jet cleaning are carried out to clean the coping surface from adhering to dirt. The zirconia coping is ready to be layered (Figure 5) with feldspathic porcelain until the anatomy is perfect (Figure 6). The cervical portion of tooth 14 was layered with gingival porcelain (Figure 7). The gingival color of GI 2 is darker than that of G3, so the two colors are graded so that the gingival color looks more natural. The last step is glazing to polish the surface of the restoration (Figure 8). The final result can be seen in Figure 9 - 11.

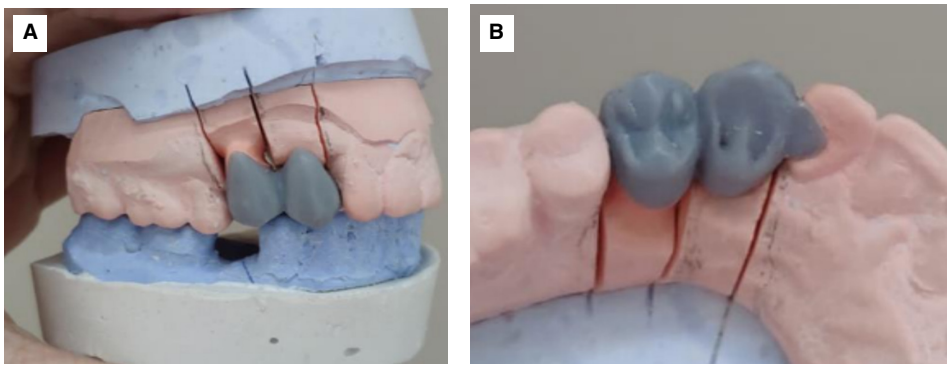

Figure 3. Diagnostic wax-up results seen from (A) Labial and (B) Occlusal

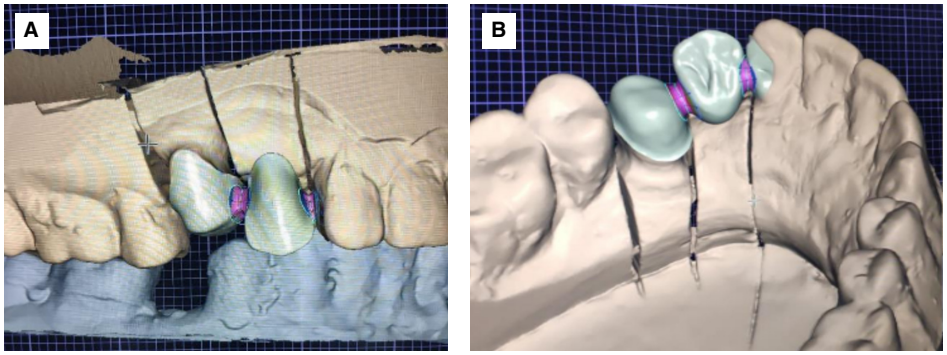

Figure 4. Bridge design using EXO-CAD seen from (A) Labial and (B) Occlusal

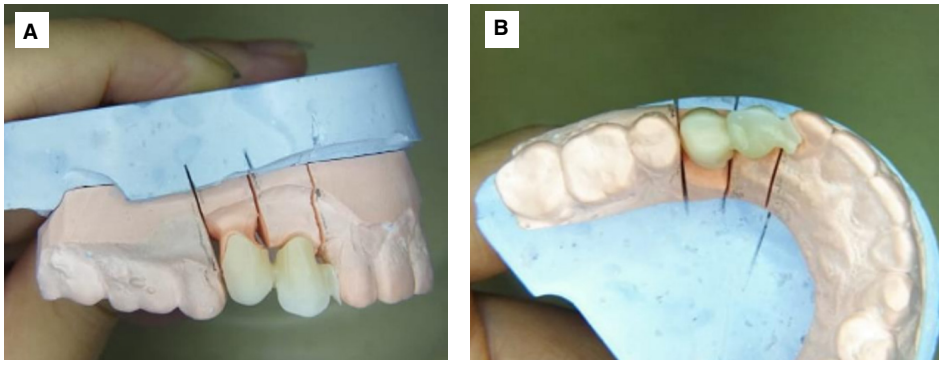

Figure 5. Results of zirconia coping after fitting seen from (A) Labial and (B) Occlusal

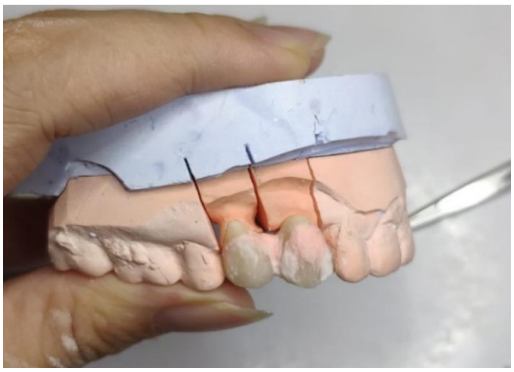

Figure 6. R2nd dentine layering

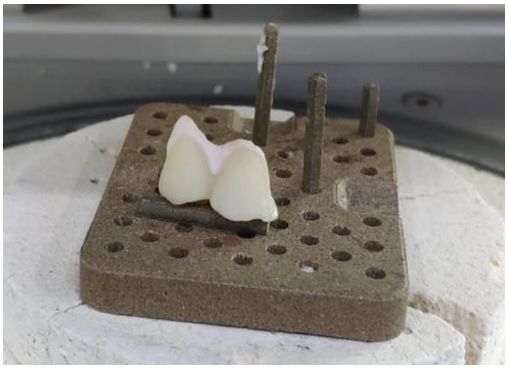

Figure 7. Gingival porcelain application

Figure 8. Glazing

Figure 9. Color matching of gingiva with IG 2 and G3 shade guide colors

Figure 10. Restoration color matching with shade guide A3

Figure 11. Final results

DISCUSSION

Recently, zirconia materials were introduced in prosthetic dentistry to manufacture crown restorations and fixed partial dentures using CAD/CAM. Zirconia has several advantages, including, according to Daou (2014). Zirconia (ZrO_2) restoration materials are placed well to meet aesthetic and functional requirements, and Zirconia can withstand physiological posterior forces. Zirconia is a zirconium crystalline oxide with good mechanical, optical, and biological properties (Bapat *et al*., 2022). Zirconia is a stable restorative biomaterial. Dental zirconia is resistant to acid erosion attacks in the mouth, although some erosive agents may harm surface roughness (Tanweer *et al*., 2022). Zirconia has the highest hardness among various dental restorative materials (Ban, 2021). There are several types of zirconia. In this case, the monochromatic zirconia type with A3 color is used because this material has good strength and matches the color of the patient's teeth.

According to Joós-Kovács *et al*. (2019), *Computer-Aided Design/Computer-Assisted Manufacturing* (CAD/CAM) is a system that can increase the opportunity for better accuracy and can reduce the error factor from human error. Extraoral digital scanning is used to scan and transfer information from the master cast (the dentist's model of the patient's teeth). Before scanning, the tooth model is checked first, and the tooth preparation and nodules are removed to produce an accurate scan. Next, a restoration design was made as a cantilever bridge coping. The thickness of the coping, in this case, is 0.7 mm, and the thickness of the connector is 2 mm (horizontal) x 3 mm (vertical). This is following the opinion of Kern *et al*. (2017). According to ESPE (2013), zirconia material has a minimum thickness requirement of 0.5 mm for posterior teeth and bridges and 0.3 mm for anterior crowns. According to Weigl *et al*. (2018), the connector thickness also needs to be more expansive if there are more bridge units. Suppose the thickness and connectors do not meet the specified minimum. In that case, the restoration will be susceptible to peeling and breaking because it is not strong enough to withstand the occlusal load. The designs produced with this CAD machine are checked to determine perfect results.

In this case, the zirconia restoration was made using a dry milling process and ground with a bur at a speed of 40000 - 60000 rpm. The dry grinding process is recommended because it is more efficient and productive and can provide accurate installation and high aesthetics according to patient needs (Brooks and Rolland, 2015). The milling results in pre-sintered zirconia are put into a sintering furnace to achieve a dense and mature zirconia restoration. According to Juntavee and Attashu (2018), the sintering process is carried out by sending heat to the surface of the zirconia material until it reaches its core through thermal conduction.

The resulting coping is then coated with porcelain to form a natural tooth anatomy. The bond between zirconia coping and feldspathic porcelain can be optimized by sandblasting the surface of the zirconia coping using aluminum oxide with a particle size of 30 µm to 50 µm with a pressure of 1.5-2.0 bar and sandblasting from a distance of 2 - 3 cm (Alex, 2021). According to Su *et al*. (2015), sandblasting can increase adhesion because aluminum oxide sand can rough the zirconia surface, resulting in mechanical retention. Apart from bonding the surface of the zirconia restoration, sandblasting also aims to help increase the cement bond strength on the internal surface of the zirconia coping (Karami Zarandi *et al*., 2020).

In this case, the porcelain material used to coat the zirconia coping is glass-based porcelain, namely the feldspathic type, which has a microstructure. Feldspathic porcelain veneers are indicated for cases requiring changes in tooth shape and slight discoloration. The advantages of treatment with this material include minimal tooth thickness reduction and satisfactory aesthetic results due to the material's properties (Federizzi *et al*., 2016). High-strength zirconia copings strengthen ceramic restorations and inhibit the formation of cracks that initiate on the internal surface of ceramic crowns (Ha *et al*., 2016). The porcelain coating applied to this zirconia frame has a minimum thickness of 2.0 mm. This is in line with de Matos *et al*. (2022) opinion. Because tooth 14 has a gingival recession of 2 - 3 mm and the preparation reaches the gingival margin, the zirconia coping is made to the extent of the preparation. This causes the cupping to appear longer. Therefore, the feldspathic porcelain veneer is made as natural as possible by making the cervical line parallel to the cervical of the adjacent tooth. Next, the lower cervical part is given porcelain gingiva.

In this case, the gingival recession is class I, so adding gingival porcelain layers is not done too much, only in the area near the cervix, around 2 - 3 mm. To achieve optimal color and aesthetics in gingival restorations, two colors are used during porcelain application to provide a more natural appearance of the gingiva. Porcelain gingival coating uses shade GI 2 (higher chroma) and G3 (lower chroma) according to the gingival shade guide from Ivoclar, from a technical perspective, this restoration has a level of difficulty in achieving a balance between the "white aesthetic" and "pink aesthetic." Dental technicians must be able to analyze the three-dimensional shape of the gingival anatomy, color, texture, smile components, the balance of "pink aesthetic" and "white aesthetic," as well as the correct position of the ceramic gingival prosthesis (Naik *et al*., 2015). After finishing, the porcelain coating, firing is carried out according to factory regulations. When the burning process is complete and the restoration is no longer hot, it can be continued with the stage of forming the correct anatomy, contour, and texture of the tooth, which is one of the requirements so that the tooth restoration can look natural by natural teeth.

The next stage is staining and glazing. In this case, staining is carried out to give additional character to the restoration surface, which is carried out simultaneously with zirconia glazing (Nistor *et al*., 2019). The glazing process, accompanied by staining (staining porcelain restorations), is commonly used in dental laboratories to achieve the desired color (Singh *et al*., 2021). Glazing improves aesthetics and reduces wear on opposing teeth, bacterial adhesion, and soft tissue inflammation. The glaze layer can minimize abrasion by closing the pores, smoothing the restoration surface, and keeping the color layer from staining (Toma *et al*., 2023). However, the coloring stage is carried out as necessary if a correction or lack of tooth color matches the shade guide. Likewise, with staining the porcelain gingival area, gingival staining is only done if correction is needed or to emphasize the color of the gingiva.

CONCLUSION

The thickness of the copings and connectors is a crucial consideration when designing an all-porcelain cantilever bridge restoration. This will ensure a robust and resistant-to-fracture restoration with pleasing aesthetics. Gingival porcelain can be applied to the cervical part of the restoration, which has a small amount of gingival recession, to close the recession.

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