Comparison of Internal and Marginal Adaptation of Posterior Zirconia Fixed Partial Dentures Performed by Conventional Versus Digital Impression

Nagaviroj N Triwatana P* Powichean P***

Abstract

The aim of this study was to compare internal and marginal adaptation of posterior zirconia fixed partial dentures (FPDs) performed by conventional and digital impression techniques. A cobalt-chromium model (Co-Cr model) with abutments 14 and 16, and edentulous area at 15 was prepared. Two groups of the three-unit zirconia FPDs (n=5) were fabricated by two different impression techniques. In Group 1: Conventional impression technique, the Co-Cr model was conventionally duplicated by the putty-wash technique, using polyvinyl siloxane dual-viscosity impression materials. Gypsum models were then fabricated and scanned with a laboratory scanner. In Group 2: Digital impression technique, the Co-Cr model was digitally scanned by an intraoral scanner. All FPDs of both groups were then designed and fabricated on the digital models. Marginal and internal gap widths of each abutment were investigated using micro-computer tomography. Mean marginal gap widths were not significantly different between two groups (P>0.05). However, in terms of internal gap widths, significant difference between both groups was found. The internal gap width at occlusal surface of abutment 14 (Group2) showed the highest value (154.54±9.39 µm).

Keywords: *Marginal adaptation/ Iinternal adaptation/ Micro-CT/ Zirconia fixed partial dentures*

Received: *Jun 10, 2021*
Revised: *Sep 29, 2022*
Accepted: *Oct 25, 2022*

Introduction

One of the most critical steps in the fabrication of fixed prostheses is the capture of an accurate oral structure.[1] Traditionally, a conventional impression technique has been used to capture intraoral structures. However, this technique has many disadvantages such as a risk of gag reflex during impression procedures, discomfort (by odor or taste), the need for disinfection and storage of the impression materials and trays, and distortion due to mixing of the impression materials and variable temperatures.[2] Digital impression systems have been developed to overcome these disadvantages. Digital impressions eliminate several time-consuming steps in the dental office including tray selection, dispensing and setting of materials.[3] The transfer of digital information does not require disinfection, and transportation, or fabrication of a gypsum model for articulation. Thus, the potential for dimensional inaccuracies is eliminated or at least reduced.[4]

The accuracy of impression in the fabrication of fixed prostheses resulting in the success of the restorations.[4,5] Marginal and internal adaptation are crucial factors in increasing the longevity of the restoration.[6] When the marginal gap is large, the surface of the cement is exposed causing dissolution of the cement.[7] An inadequate fit does not only lead to plaque accumulation which increases the risk of carious lesions, but also lead to endodontic inflammations and periodontal diseases especially in those with subgingival margins.[8-15]

The purpose of this study was to investigate the effect of different zirconia FPDs impression techniques on internal and marginal adaptation.

Materials and Methods

* Department of Prosthodontics, Faculty of Dentistry, Mahidol University, Bangkok.
** Residency, Training Program in Prosthodontics, Faculty of Dentistry, Mahidol University, Bangkok.

A Co-Cr model representing a maxillary second premolar (tooth 15) and a maxillary second molar (tooth 17) as abutments for the fabrication of zirconia three-unit FPD was prepared (Figure 1). The finish line of both abutments was 1 mm wide circumferential chamfer. The angle of total occlusal convergence (TOC) was 8 degrees. The height of both abutments was 4 mm and all sharp edges were rounded. (Figure 1)

Two groups of three-unit zirconia FPDs were fabricated by two different impression techniques (Figure 2); a conventional impression technique (n=5) and digital impression technique (n=5).

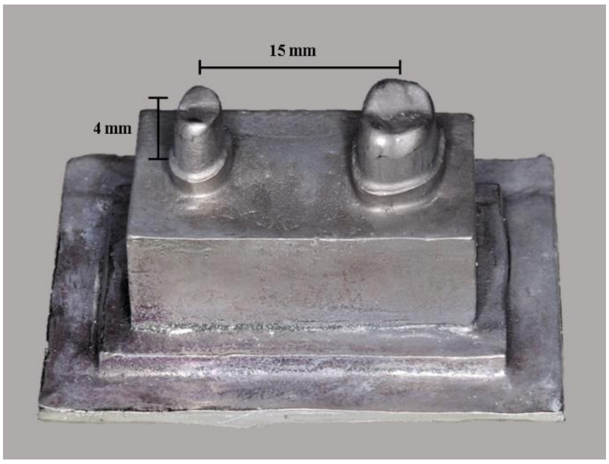

Figure 1 A Co-Cr model representing a maxillary second premolar (tooth15) and a maxillary second molar (tooth17) as abutments of three-unit zirconia fixed partial denture

Figure 2 A Co-Cr model with the three-unit zirconia fixed partial denture

Conventional impression technique The Co-Cr model was duplicated by a double mix-double impression technique (putty-wash technique), using polyvinyl siloxane dual-viscosity impression materials (Silagum, DMG, Germany) in a customized Co-Cr special tray. Five impressions of the Co-Cr model were performed at room temperature by one investigator. To ensure adequate polymerization, the impressions were allowed to polymerize according to the manufacturer's recommendations. The impressions were poured by *Smartmix* vacuum-mixing machine (Amann Girrbach, Germany) with dental stone type IV *(*GC FujiRock® *(*Pastel Yellow*)*, GC, USA*).* Each poured model was then scanned with a laboratory scanner *(*inEos X5®; Sirona dental, AG. Germany*)* by the same investigator.

Digital impression technique Five digital impressions of the Co-Cr model were made with the intraoral scanner (CEREC Omnicam, Sirona dental, AC,Germany). Each digital file (.STL) was used to fabricate each zirconia FPD.

Computer-aided-design and Computer-aided-manufacturing (CAD/CAM) The FPDs were designed using CAD software of Cerec software 16.1 (Sirona dental systems). The inCoris TZI Zirconia blocks 40/19 size 40x19x15 mm (Sirona, Germany) were milled in the milling machine (inLab MC X5, Sirona, Germany). The milled FPDs were sintered by the sintering furnace (inFire HTC Speed; Sirona, Salzburg, Germany).

Micro-computer tomography (Micro-CT) Prior to the micro-CT measurements, the optimal seating of all zirconia FPDs on the Co-Cr model was inspected by an experienced operator. The micro-CT measurements of marginal and internal gaps of FPDs without cementation were performed using Skyscan Micro-CT (Skyscan 1173; Bruker, Kontich, Belgium). The scanning parameters were as follows: 130 kV voltage, 61 μA current and 0.25 mm brass filter. The specimens were scanned for 360 degrees (1 complete rotation) at 7 frames per rotation step of 0.1 degree. The average scanning time of each specimen was approximately 4 hours and 48 minutes. The x-ray was irradiated perpendicular to the preparation long axis, and the image size was 15.14 μm. The x-ray projections were reconstructed using SkyScan's volumetric reconstruction software (SkyScan NRecon 1.6.8.0, Kontich, Belgium). The reconstruction settings were level 20 ring artifact correction and 20% beam hardening artifact correction. Then, the DataViewer software V 1.5.4.6 (Kontich, Belgium) was used to generate 3 image views: coronal (x-z plane), sagittal (y-z plane), and transaxial (x-y plane). These views were used to locate the mesiodistal and buccolingual positions of the FPD.

Gap measurements After computerized reconstruction of the images, the CTAn software (CTAn 1.13; Bruker, Kontich, Belgium) was used to locate a point of measurement. All measurements were performed manually by an experienced operator because the presence of small radiographic artifacts precluded the use of any automatic tools. Ten measuring points were used to determine the gap width between the FPD and the model, starting from the most distal point from the pontic for the maxillary first premolar and first molar.[16,17] Point 1 and point 10 refer to a site of marginal gap; while, point 2 to point 9 refer to a site of internal gap. Each site was measured three times and the average value was recorded. (Figure 2)

Statistical analysis was performed using SPSS Statistics Software (SPSS, 23.0, SPSS Inc., Armonk, NY, USA). Symmetrical distribution of the gap widths was analyzed by Shapiro-Wilk test. The equality of variances of two experimental groups was performed by Levene's test. The difference between the mean gap widths of two experimental groups was analyzed using t-test and Mann Whitney U test at a significance level of 0.05.

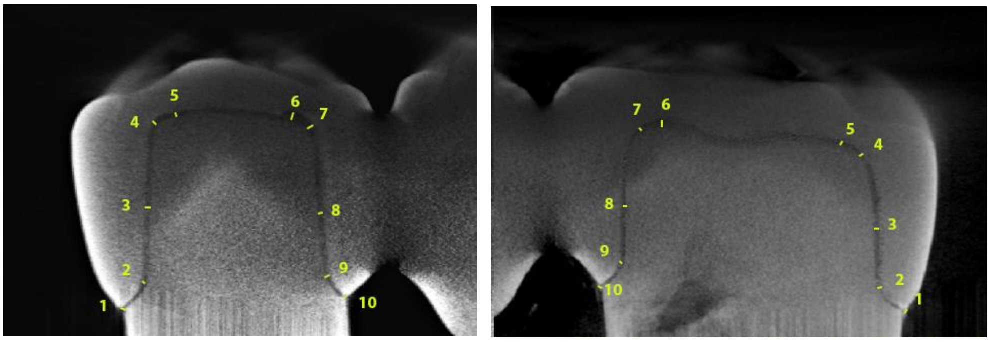

Figure 2 Measuring points selected for gap width measurements: (A) Ten measuring points of abutment tooth 14, (B) Ten measuring points of abutment tooth 16 Point 1 – marginal gap: perpendicular measurement from the internal surface of the restoration to the finish line of the abutment, Point 2 – chamfer area: 800 μm vertically occlusal to the finish line of the abutment, Point 3 – axial wall: A half of distance from occlusal area to the finish line of the abutment, Point 4 – axio-occlusal transition area: transition from the occlusal plateau to the axial wall, Point 5 – occlusal area: 500 μm horizontally away from the axio-occlusal transition area in the direction of the center of the occlusal plateau, Point 6, 7, 8, 9 and 10 were the contralateral points of point 5, 4, 3, 2, and 1, respectively, on the same abutment.

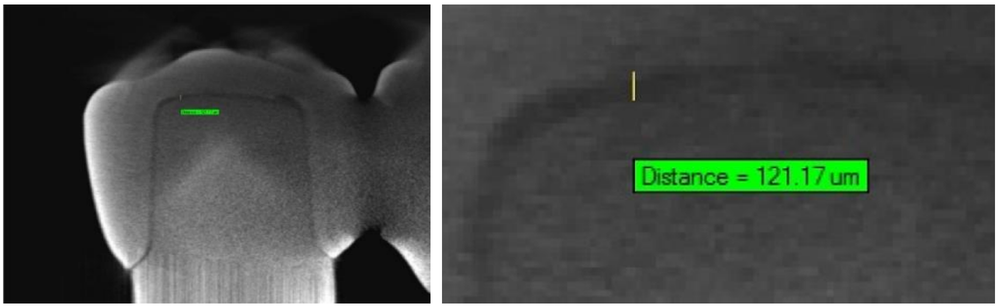

Figure 3 Gap width measurements: (A) One measuring point of abutment tooth 14, (B) A magnification of measuring point of (A)

Results

The mean values of marginal and internal gap widths of two groups are summarized in Table1. For digital impression technique, the highest internal gap width was 154.54±9.39 μm at point 6 of the premolar and the highest marginal gap width was 68.56±8.42 μm at point 10 of the premolar; while, the lowest internal gap width was 71.65±11.11 μm at point 9 of the molar and the lowest marginal gap width was 60.20±11.94 μm at point 10 of the premolar. For conventional impression technique, the highest internal gap width was 134.31±3.22 μm at point 5 of the molar and the highest marginal gap width was 79.65±8.74 μm at point 1 of the molar; while, the lowest internal gap width was 92.97±9.76 μm at point 2 of the premolar and the lowest marginal gap width was 72.42±11.52 μm at point 10 of the premolar.

No significant difference of marginal gap width (point 1 and point 10) between two impression techniques in the same tooth was found. For other measuring points, significant difference at point 4, 6, 8 and 9 was found in the first maxillary premolar, while in the maxillary first molar, only three measuring points (point 2, 5 and 9) showed significant difference. Within the same impression technique, no significant difference was found between both abutment teeth at all measuring points.

Table 1 Gap widths in μm (mean ± SD) at ten measuring points based on impression techniques and abutment teeth

		Digital	Conventional	p-value
Point 1	Premolar	65.95 ± 5.15	72.42 ± 11.52	0.29
	Molar	61.03 ± 6.90	79.65 ± 8.74	0.06
	p-value	0.24	0.30	
Point 2	Premolar	82.44 ± 9.90	92.97 ± 9.76	0.13
	Molar	73.68 ± 6.83	95.66 ± 3.55	0.01*
	p-value	0.14	0.58	
Point 3	Premolar	94.04 ± 9.79	104.16 ± 12.45	0.10
	Molar	92.25 ± 5.51	102.68 ± 14.85	0.34
	p-value	0.73	0.84	
Point 4	Premolar	131.51 ± 7.98	114.38 ± 6.74	0.01*
	Molar	120.57 ± 12.35	117.23 ± 4.08	0.22
	p-value	0.14	0.44	
Point 5	Premolar	147.28 ± 11.39	133.98 ± 7.12	0.06
	Molar	136.15 ± 12.58	134.31 ± 3.22	0.01*
	p-value	0.18	0.93	
Point 6	Premolar	154.54 ± 9.39	133.14 ± 9.68	0.01*
	Molar	149.24 ± 14.06	128.68 ± 5.35	0.76
	p-value	0.50	0.55	
Point 7	Premolar	133.71 ± 10.18	120.18 ± 11.05	0.08
	Molar	133.02 ± 15.59	122.64 ± 6.56	0.59
	p-value	0.94	0.68	
Point 8	Premolar	90.41 ± 10.76	106.26 ± 2.66	0.03*
	Molar	96.66 ± 6.20	101.92 ± 9.79	0.18
	p-value	0.29	0.55	
Point 9	Premolar	83.05 ± 7.63	102.16 ±15.80	0.01*
	Molar	71.65 ± 11.11	94.63 ± 2.98	0.01*
	p-value	1.00	0.69	
Point 10	Premolar	68.56 ± 8.42	79.14 ± 5.55	0.10
	Molar	60.20 ± 11.94	78.56 ± 3.42	0.06
	p-value	0.24	0.69	

Significant difference at P<0.05

Discussion

CAD/CAM technology in zirconia fixed partial prostheses

Although, many studies reported the complications of the zirconia restorations such as chipping of the veneering material, poor retention and presence of secondary caries,[18-21] the use of zirconia for FPDs still has been increasingly interested due to improvements in the esthetics and mechanical properties of these materials such as color stability, high wear resistance, and low thermal conductivity.[22] Since marginal and internal adaptation is an essential factor for the success of fixed prosthesis, this study aimed to compared the marginal and internal gap of posterior zirconia FPDs fabricated by two different impression techniques.

Marginal adaptation Previous studies reported that restorations fabricated from digital and conventional impression techniques resulted in clinically acceptable adaptation but restorations fabricated from a digital impression technique showed better adaptation than those fabricated from a conventional impression technique.[4,23] However, Kapos and Evans [24] investigated the effect of conventional and digital fabrication techniques and found no statistically significant differences in both marginal and internal discrepancy. In this study, the marginal adaptation of posterior zirconia FPDs fabricated from two impression techniques were also not significantly different. Also, the marginal adaptation between two abutments was not significantly different. In addition, the marginal gap width lower than 120 µm is clinically acceptable.[25,26] Poor marginal adaptation in fixed prostheses leads to increased plaque retention and subsequent changes in the subgingival microflora, leading to periodontal disease and eventually crown failure.[27-29]

Internal adaptation Although the uniform 50 µm cement space was managed for FPDs fabrication, the CAD/CAM technique cannot create a uniform internal adaptation along all the tooth preparation. Similar to other studies,[30-32] the different measuring points presented different levels of adaptation which may be related to the quality of digital data, the key factor for the accuracy of the CAD/CAM restorations.[33] The large internal gap width could relate to the diameter and shape of the milling instruments that are incapable of reproducing fine details, especially in regions with sharp angles.[34-35] In this study, the highest value of internal gap width was found at point 6 which could be due to the limitation of the milling technique to create the grooves and inclined planes of occlusal surfaces.[36] Poorly fitting restorations are supported mainly by the luting cement and their longevity might be jeopardized.[37] Despite different shape and morphology of the premolar and molar, no significant differences between gaps at all measuring points has been found. This may be because of the capability to acquire tooth surface details and produce the shape of these two teeth by both digital technique and conventional technique. One of the limitations of the study that should be taken into account is small sample size. Even though the size of experimental group was not large, the number was sufficient to demonstrate the effectiveness of the test method and highlight significant statistical evidences.

Micro-computer tomography (Micro-CT) Different techniques and tools are available to evaluate the restoration adaptation.[25,38,39] The micro-CT nondestructive analysis method was considered to be a useful tool to measure the adaptation of three-unit FDPs. This measurement method allows high resolution investigation of the internal and marginal gap between tooth preparation and the restoration. The scanning procedure was performed without cementation to improve the contrast between the metal die and the FPD.[36] Limitations of the micro-CT are due to, for example, limited X-ray flux, use of polychromatic radiation (in laboratory systems), finite resolution, discrete sampling and X-ray scatter causing artefacts such as ring artefacts, streak artifacts and noise in the reconstructed image.[40] However, zirconia FPDs produces small artifacts that preclude 3D analysis of the cement space.[34] Thus, the micro-CT technology which has been recommended in many studies[41,42] can be a reliable tool to evaluate the adaptation of FPDs.

Conclusions

Within the limitations, it could be concluded that marginal adaptations of FPDs fabricated from the digital impression technique and the conventional impression technique were not significantly different. However, in terms of internal gap widths, significant difference between both groups was found. The internal gap width at occlusal surface of premolar showed the highest value. All measured gap widths fall within clinically acceptable ranges.

References

1. Rekow ED. High-technology innovations--and limitations--for restorative dentistry. Dent Clin N Am 1993;37(3):513-24.
2. Wassell RW, Barker D, Walls AW. Crowns and other extra-coronal restorations: impression materials and technique. Br Dent J 2002;192(12):679-84, 87-90.
3. Andersson M, Razzoog ME, Odén A, Hegenbarth EA, Lang BR. Procera: a new way to achieve an all-ceramic crown. Quintessence Int 1998;29(5):285-96.
4. Syrek A, Reich G, Ranftl D, Klein C, Cerny B, Brodesser J. Clinical evaluation of all-ceramic crowns fabricated from intraoral digital impressions based on the principle of active wavefront sampling. J Dent 2010;38(7):553-9.
5. Wassell R, Barker D, Walls A. Crowns and other extra-coronal restorations: impression materials and technique. Br Dent J 2002;192(12):679.
6. Rajan BN, Jayaraman S, Kandhasamy B, Rajakumaran I. Evaluation of marginal fit and internal adaptation of zirconia copings fabricated by two CAD-CAM systems: An *in vitro* study. J Indian Prosthodont Soc 2015;15(2):173.
7. Gonzalo E, Suárez MJ, Serrano B, Lozano JF. A comparison of the marginal vertical discrepancies of zirconium and metal ceramic posterior fixed dental prostheses before and after cementation. J Prosthet Dent 2009;102(6):378-84.
8. Björn AL, Björn H, Grkovic B. Marginal fit of restorations and its relation to periodontal bone level. II. Crowns. Odontol Revy 1969;21(3):337-46.
9. Saltzberg D, Ceravolo F, Holstein F, Groom G, Gottsegen R. Scanning electron microscope study of the junction between restorations and gingival cavosurface margins. J Prosthet Dent 1976;36(5): 517-22.
10. Schwartz NL, Whitsett L, Berry TG, Stewart JL. Unserviceable crowns and fixed partial dentures: life-span and causes for loss of serviceability. J Am Dent Assoc 1970;81(6):1395-401.
11. Karlsson S. A clinical evaluation of fixed bridges, 10 years following insertion. J Oral Rehabil 1986;13(5): 423-32.
12. Bergenholtz G, Cox C, Loesche W, Syed S. Bacterial leakage around dental restorations: its effect on the dental pulp. J Oral Pathol Med 1982;11(6):439-50.
13. Janenko C, Smales R. Anterior crowns and gingival health. Aust Dent J 1979;24(4):225-30.
14. Sorensen S, Larsen I, Jörgensen KD. Gingival and alveolar bone reaction to marginal fit of subgingival crown margins. Euro J Oral Sciences 1986;94(2): 109-14.
15. Felton D, Kanoy B, Bayne Sa, Wirthman G. Effect of *in vivo* crown margin discrepancies on periodontal health. J Prosthet Dent 1991;65(3): 357-64.

16. Jahangiri L, Wahlers C, Hittelman E, Matheson P. Assessment of sensitivity and specificity of clinical evaluation of cast restoration marginal accuracy compared to stereomicroscopy. J Prosthet Dent 2005;93(2):138-42.
17. Beuer F, Naumann M, Gernet W, Sorensen JA. Precision of fit: zirconia three-unit fixed dental prostheses. Clin Oral Investig 2009;13(3):343-9.
18. Molin MK, Karlsson SL. Five-Year Clinical Prospective Evaluation of Zirconia-BasedDenzir 3-Unit FPDs. Int J Prosthodont 2008;21(3):223-7.
19. Sailer I, Feher A, Filser F, Gauckler LJ, Lüthy H, Hämmerle CHF. Five-year clinical results of zirconia frameworks for posterior fixed partial dentures. Int J Prosthodont 2007;20(4):383-8.
20. Tinschert J, Schulze KA, Natt G, Latzke P, Heussen N, Spiekermann H. Clinical behavior of zirconia-based fixed partial dentures made of DC-Zirkon: 3-year results. Int J Prosthodont 2008;21(3):217-22.
21. Von Steyern PV, Carlson P, Nilner K. All-ceramic fixed partial dentures designed according to the DC-Zirkon® technique. A 2-year clinical study. J Oral Rehabil 2005;32(3):180-7.
22. Conrad HJ, Seong W-J, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent 2007;98(5):389-404.
23. Chochlidakis KM, Papaspyridakos P, Geminiani A, Chen C-J, Feng IJ, Ercoli C. Digital versus conventional impressions for fixed prosthodontics: a systematic review and meta-analysis. J Prosthet Dent 2016; 116(2):184-90. e12.
24. Kapos T, Evans C. CAD/CAM technology for implant abutments, crowns, and superstructures. Int J Oral Maxillofac Implants 2014;29:117-36.
25. Reich S, Kappe K, Teschner H, Schmitt J. Clinical fit of four-unit zirconia posterior fixed dental prostheses. Euro J Oral Sciences 2008;116(6): 579-84.
26. Komine F, Gerds T, Witkowski S, Strub JR. Influence of framework configuration on the marginal adaptation of zirconium dioxide ceramic anterior four-unit frameworks. Acta Odontol Scand 2005;63(6):361-6.
27. Valderhaugw J, Birkeland J. Periodontal conditions in patients 5 years following insertion of fixed prostheses: pocket depth and loss of attachment. J Oral Rehabil 1976;3(3):237-43.
28. Bader JD, Rozier RG, McFall Jr WT, Ramsey DL. Effect of crown margins on periodontal conditions in regularly attending patients. J Prosthet Dent 1991;65(1):75-9.
29. Kokubo Y, Tsumita M, Kano T, Sakurai S, Fukushima S. Clinical marginal and internal gaps of zirconia all-ceramic crowns. J Prosthodont Res 2011;55(1):40-3.
30. Ucar Y, Akova T, Akyil MS, Brantley WA. Internal fit evaluation of crowns prepared using a new dental crown fabrication technique: laser-sintered Co-Cr crowns. J Prosthet Dent 2009;102(4):253-9.
31. Tan PL, Gratton DG, Diaz-Arnold AM, Holmes DC. An *in vitro* comparison of vertical marginal gaps of CAD/CAM titanium and conventional cast restorations. J Prosthodont 2008;17(5):378-83.
32. Tuntiprawon M, Wilson PR. The effect of cement thickness on the fracture strength of all-ceramic crowns. Aust Dent J 1995;40(1):17-21.
33. Tinschert J, Natt G, Hassenpflug S, Spiekermann H. Status of current CAD/CAM technology in dental medicine. Int J Comput Dent 2004;7(1):25-45.
34. Borba M, Miranda Jr WG, Cesar PF, Griggs JA, Bona AD. Evaluation of the adaptation of zirconia-based fixed partial dentures using micro-CT technology. Braz Oral Res 2013;27(5):396-402.
35. Kim KB, Kim JH, Kim WC, Kim JH. Three-dimensional evaluation of gaps associated with fixed dental prostheses fabricated with new technologies. J Prosthet Dent 2014;112(6):1432-6.

36. Daou EE, Ounsi H, Özcan M, Husain NA-H, Salameh Z. Marginal and internal fit of pre-sintered Co-Cr and zirconia 3-unit fixed dental prostheses as measured using microcomputed tomography. J Prosthet Dent 2018;120(3):409-14.
37. Sjögren G. Marginal and internal fit of four different types of ceramic inlays after luting An in vitro study. Acta Odontol Scand 1995;53(1):24-8.
38. Colpani JT, Borba M, Della Bona Á. Evaluation of marginal and internal fit of ceramic crown copings. Dent Mater 2013;29(2):174-80.
39. Molin M, Karlsson S. The fit of gold inlays and three ceramic inlay systems: A clinical and in vitro study. Acta Odontol Scand 1993;51(4):201-6.
40. Davis G, Elliott J. Artefacts in X-ray microtomography of materials. Mater Sci Technol 2006;22(9):1011-8.
41. Zinelis S. Micro-CT evaluation of the marginal fit of different In-Ceram alumina copings. Eur J Esthet Dent 2009;4(3):278-92.
42. Seo D, Yi Y, Roh B. The effect of preparation designs on the marginal and internal gaps in Cerec3 partial ceramic crowns. J Dent 2009;37(5):374-82.

Corresponding Author

Noppavan Nagaviroj
Department of Prosthodontics,
Faculty of Dentistry, Mahidol University,
Ratchathewi, Bangkok, 10400.
Tel. : +66 2 200 7555
E-mail : n.nagaviroj@gmail.com

การเปรียบเทียบความแนบสนิทภายในและบริเวณขอบของสะพานฟันหลังเซอร์โคเนียที่ใช้วิธีพิมพ์ปากแบบดั้งเดิมและแบบดิจิทัล

นพวรรณท์ นาควิโรจน์ เปรมวรา ตรีวัฒนา* ภัทรมน โพธิ์วิเชียร***

บทคัดย่อ

วัตถุประสงค์ของการทดลองนี้เพื่อเปรียบเทียบความแนบสนิทภายในและความแนบสนิทบริเวณขอบของสะพานฟันหลังเซอร์โคเนียเมื่อใช้การพิมพ์ปากด้วยวิธีดั้งเดิมและวิธีดิจิทัล โดยสร้างแบบจำลองโคบอลต์-โครเมียมอัลลอย ซึ่งมีฟันกรามน้อยบนขวาซี่ที่หนึ่ง และ ฟันกรามกรามบนขวาซี่ที่หนึ่ง เป็นฟันหลัก และบริเวณฟันกรามน้อยบนขวาซี่ที่สองเป็นช่องว่างไร้ฟัน สร้างชิ้นงานสะพานฟันหลังเซอร์โคเนีย 3 ยูนิต จำนวน 5 ชิ้นงานต่อกลุ่ม โดยใช้วิธีการพิมพ์ปากที่แตกต่างกัน กลุ่มที่ 1 (วิธีพิมพ์ปากดั้งเดิม) พิมพ์แบบจำลองโคบอลต์-โครเมียมด้วยเทคนิคการพิมพ์วัสดุพิมพ์ซิลิโคนชนิดพัตตี้และชนิดหนืดน้อย เทแบบจำลองยิปซัม และสแกนแบบจำลองด้วยเครื่องสแกนนอกช่องปาก กลุ่มที่ 2 (วิธีพิมพ์ปากดิจิทัล) สแกนแบบจำลองโคบอลต์-โครเมียมด้วยเครื่องสแกนในช่องปาก จากนั้นสร้างชิ้นงานสะพานฟันจากแบบจำลองดิจิทัล และทำการวัดช่องว่างบริเวณขอบและช่องว่างภายในสะพานฟันด้วยเครื่องเอกซเรย์คอมพิวเตอร์ระดับไมโครเมตร ผลการศึกษาพบว่าค่าเฉลี่ยช่องว่างบริเวณขอบของทั้งสองกลุ่มไม่มีความแตกต่างกันอย่างมีนัยสำคัญ อย่างไรก็ตาม พบความแตกต่างของช่องว่างภายในอย่างมีนัยสำคัญ โดยพบความไม่แนบสนิทมากที่สุดบริเวณด้านบดเคี้ยวระหว่างผิวด้านในของครอบฟันและฟันกรามน้อยซี่ที่หนึ่งบนขวาในกลุ่มที่ 2 (154.54±9.39 ไมโครเมตร)

คำไขรหัส: *ความแนบบริเวณขอบ/ ความแนบภายใน/ เครื่องเอ็กซเรย์คอมพิวเตอร์ระดับไมโครเมตร/ สะพานฟันเซอร์โคเนีย*

ผู้รับผิดชอบบทความ

นพวรรณท์ นาควิโรจน์
ภาควิชาทันตกรรมประดิษฐ์
คณะทันตแพทยศาสตร์ มหาวิทยาลัยมหิดล
เขตราชเทวี กรุงเทพฯ 10400
โทรศัพท์ : 02 200 7555
จดหมายอิเล็กทรอนิกส์ : n.nagaviroj@gmail.com

** ภาควิชาทันตกรรมประดิษฐ์ คณะทันตแพทยศาสตร์ มหาวิทยาลัยมหิดล กรุงเทพฯ*
*** หลักสูตรการฝึกอบรมทันตแพทย์ประจำบ้านสาขาทันตกรรมประดิษฐ์ คณะทันตแพทยศาสตร์ มหาวิทยาลัยมหิดล กรุงเทพฯ*