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Short Communication

Comparison of clinical fit of three-unit zirconia fixed prostheses fabricated using chairside and labside CAD/CAM systems

Jong-Ju Ahn [a], Eun-Bin Bae [a], Wan-Sun Lee [b], Won-Tak Cho [b], Jung-Bo Huh [a*]

[a] *Department of Prosthodontics, Dental Research Institute, Institute of Translational Dental Sciences, BK21 PLUS Project, School of Dentistry, Pusan National University, Yangsan, Republic of Korea*
[b] *Department of Prosthodontics, Dental Research Institute, Institute of Translational Dental Sciences, School of Dentistry, Pusan National University, Yangsan, Republic of Korea*

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Abstract The purpose of this study was to assess the clinical fit provided by EZIS system, the newly commercialized chairside CAD/CAM system. Prostheses were fabricated with the chairside CAD/CAM system (CS) and labside CAD/CAM system (LS) and marginal, axial, and occlusal fit of the prostheses were compared and analyzed by using replica technique. CS group presented significantly lower fit in all the three fits compared to LS group. Differences in marginal fit, axial fit, and occlusal fit were 12.57 μm ($P < 0.001$), 3.32 μm ($P < 0.05$), and 17.20 μm ($P < 0.05$), respectively. Newly commercialized EZIS system yielded clinically feasible fit; however, further researches covering its biomechanical, physiological, stability aspects are required to promote active clinical use.
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Introduction

Recently, in the dental field, digital technology is being used to produce prostheses that have been made by manual technique.[1] The use of such digital technology is based on the introduction of computer aided design and computer-aided manufacturing (CAD/CAM) systems.[2] The CAD/CAM system is a system for producing prostheses digitally using

* Corresponding author. Department of Prosthodontics, School of Dentistry, Pusan National University, 20, Geumo-ro, Mugleum-eup, Yangsan 50612, Republic of Korea. Fax: +82 55 360 5134.
E-mail address: neoplasia96@hanmail.net (J.-B. Huh).

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computers and machines and it consists of a scanner, design software, and a machine for processing materials.[3] The order of using them is to scan the digital impression with a scanner, design the prosthesis through CAD software, and finally produce the restoration using processing equipment.[3] Such CAD/CAM system is classified into labside CAD/CAM system and chairside CAD/CAM system according to the type and location of CAD/CAM system components.[4,5]

The labside CAD/CAM system means that in the laboratory there are scanners, software and prosthesis processing equipment.[5] Impressions are obtained by conventional impression method using hydrocolloid and stone model is produced, then in the laboratory the stone model is scanned by model scanner and the prosthesis is designed by CAD software and manufactured.[5] Chairside CAD/CAM system means that all of the components are in the dental office and all the manufacturing process is done in the dental office.[6] After taking the impression with the intraoral scanner, the prosthesis is designed by CAD software using the digital file obtained from intraoral scanner and manufactured in the dental office.[5] The chairside CAD/CAM system saves time compared to traditional methods because the dentist can do everything in the office from preparation to prosthetic production.[7] And the dentist who performs preparation can make a prosthesis directly, so it has the advantage of making more accurate prosthesis.[8]

With recent extension of the CAD/CAM system market in dentistry, new CAD/CAM systems are being introduced in dental market.[9] Prostheses fabricated with the newly introduced CAD/CAM systems may have issues of fit and performance; hence, systematic and objective assessment on the systems are essential.[9] Therefore, this study aimed to compare the fit of zirconia bridge prostheses that were fabricated by EZIS system, which is a newly developed domestic chairside CAD/CAM system and fabricated by the labside CAD/CAM system, which comprises the products from different manufacturers.

Material and method

Process of manufacturing prosthesis and fitness measurement

This study was approved by the Institutional Review Board of Pusan National University Dental Hospital (IRB No: PNUDH-2018-015-MD). Twenty patients need prosthesis treatment were recruited.

After taking impression by using rubber impression material (Imprint II GarantTM regular/light body, 3M ESPE, MN, USA), stone models (DK MUNGYO, Gimhae, Korea) were fabricated. The stone models were then scanned by using Identica Blue (Medit, Seoul, Korea). The scanned abutment tooth file was transferred to EZIS VR (DDS, Seoul, Korea) and EXO CAD (ExocadGmbH, Darmstadt, Germany) software to design. Internal and marginal values of prostheses were set as each manufacturer recommending. For the fabrication of prostheses in labside (LS) group, EXOCAD software was used for design process, the cement space of 70 μm was set 1 mm above to the margin, and the cement space of 135 μm and 0 mm were set for incisal (occlusal) side and lateral side, respectively. In chairside (CS) group, EZIS VR software was used, the cement space of 110 μm was set 0.5 mm above to the margin, and the cement space of 40 μm was set for marginal region. Each of the prostheses designed with two different types of CAD software was fabricated of zirconia blocks (Luxen, Dentalmax, Seoul, Korea) by using EZIS. HM (DDS, Seoul, Korea) and Trione Z (DIO, Busan, Korea). After fabrication, any other post-treatment was not performed such as internal adjustment and polishing. In-vivo experiments process is shown in Fig. 1A.

The fit of the fabricated prostheses was evaluated using Replica technique. When a fit checker (GC Corp., Tokyo, Japan) was filled in prostheses, restoration was mounted on the abutment. After the fit checker was completely cured, it was removed from teeth abutment. Then regular body type impression was put into the prosthesis. Two replicates were made per prosthesis to incise the bucco-lingual and mesio-distal direction. The images of the incised silicon replicas were captured by microscope (Olympus BX 51; Olympus, Tokyo, Japan) at × 100 magnifications and the captured images were measured at 19 reference points in anterior prosthesis and 21 points for posterior by using measuring program (I-solution, Nagoo Trading Co., Seoul, Korea). A mean value of 3 times measurement at each spot was recorded. All the 19 points were assigned to measure the gap in the anterior case. In the posterior case of 21 points were assigned to measure the gap in the posterior case (Fig. 1B).

Statistical analysis

To compare the fits between the two groups, the fits were divided into marginal, axial, and occlusal aspects; and independent t-test was performed for each aspect and the significance was tested. SPSS software ver. 25.0 (SPSS Inc., Chicago, USA) was used for the statistical analysis and all measured values were evaluated with the 5% of the level of significance.

Results

Marginal fit was 36.03 ± 23.59 μm in CS group and 48.60 ± 33.41 μm in LS group; and CS group presented narrower marginal gap with statistical significance ($P < 0.001$) (Fig. 2A). Axial fit was 20.67 ± 9.40 μm in CS group and 23.99 ± 15.23 μm in LS group (Fig. 2B). Occlusal fit was 46.65 ± 29.89 mm CS group and 63.85 ± 30.52 μm in LS group (Fig. 2C). CS group showed narrow gap compared to LS group in axial and occlusal gap in statistically ($P < 0.05$) (Fig. 2B and C).

Discussion

The fitness of the prosthesis is an important impact on the clinical success and longevity of the prosthesis.[8] Poor fitness can induce cement dissolution, microleakage and plaque accumulation, which reason of gingival inflammation, caries.[8] Recently, various CAD/CAM systems have been introduced through the activation of the CAD/CAM market.[9] However, the newly introduced systems need to

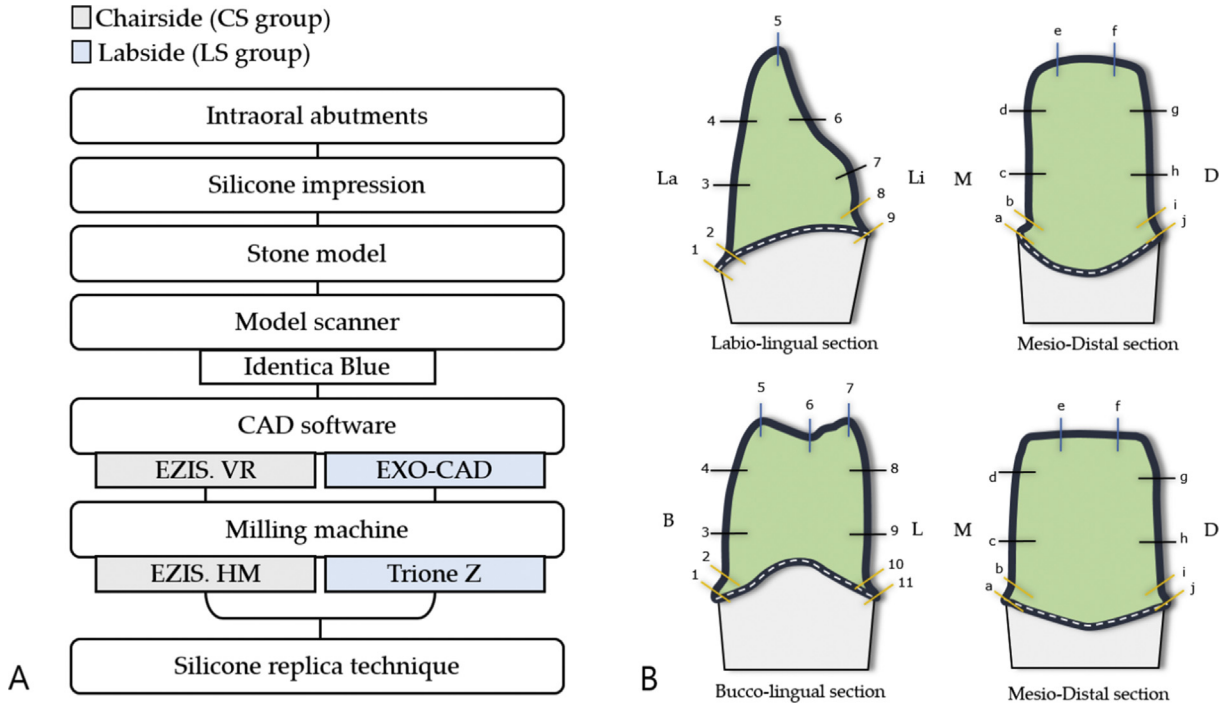

Figure 1 Procedure of Experiment Method. (A) Flow chart of fabrication of prosthesis, (B) Definition of reference points.

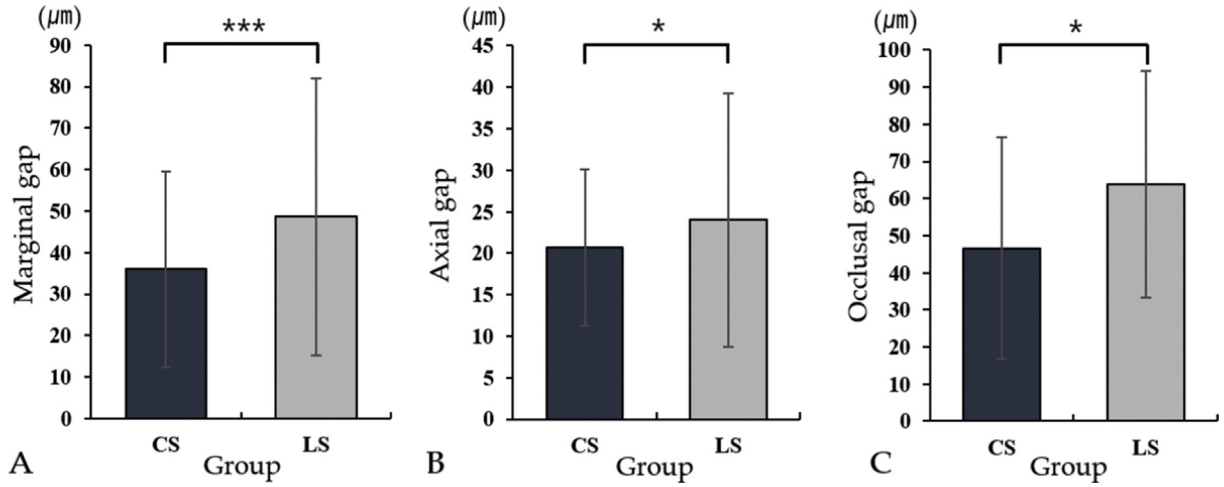

Figure 2 Clinical fit of (A) marginal gap, (B) axial gap, (C) occlusal gap (***$P < 0.001$, *$P < 0.05$).

be validated for clinical use. So the purpose of this study is to evaluate the fitness of the newly introduced chairside CAD/CAM system, EZIS system, compared with the existing labside CAD/CAM system.

In this study, we evaluated the fitness of the prosthesis using the replica technique method. This method is the non-destructive and measures the fitness of prosthesis at the same reference point.[10] For this reason, replica technique method is selected in this study. However, this method has a disadvantage in that the number of sections is limited and only two-dimensional measurements can be done. Thus, we made two replicates per prosthesis for more accurate fitness evaluation. One for mesio-distal direction section and the other for bucco-lingual. In addition, prostheses were made for a total of 20 patients to obtain more accurate results based on various cases.

In general, the chairside CAD/CAM system uses the intraoral scanner to directly scan the impression in the oral cavity and designs the prosthesis without the stone model. On the other hand, the labside CAD/CAM system takes an impression using alginate to create the stone model then scan the stone model with a model scanner to obtain a scan file to design the prosthesis.[3] In this study, however, for comparing the accuracy of the CAD software, both CAD/CAM systems taked an impression with alginate and scanned the stone model using model scanner to designed and manufactured the prostheses without the scan-related parameters.

The marginal fit value of CAD/CAM prostheses can be accepted in clinically is until 120μm.8 Within the limitation of this study, the marginal gap results were both CS group and LS group showed lower gap values than 120 μm. According to results of this study, both CAD/CAM systems which is used to this research were able to make a suitable restoration in aspect of fitness.

Within the limitation of this study, both CAD/CAM systems showed a proper fit that could be used in clinically, and the newly EZIS system showed better fit than the conventional system.

Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article.

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