# A basic study on the accuracy of a zirconia coping fabricated by CAD/CAM system-Effect of abutment modification-

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**Abstract**

The purpose of this study was to evaluate the influence of 2 different abutment tooth forms (for metal coping and CAD/CAM coping) on the fitting accuracy of zirconia coping. Zirconia copings were made of a semi-sintered zirconia block (Cercon® base, DeguDent) using the dental CAD/CAM system (Cercon® brain, DeguDent). Fitting accuracy was evaluated by a cement-replica technique with white and blue silicone materials. After the cement-replica specimens were sectioned, the thickness of the cross-sectioned white silicone layer was measured at 5 points. For zirconia coping specimens, the mean discrepancy of fitting gaps was over 120 ㎛ between the die and the zirconia coping at all points in each group. This study suggested that the zirconia coping fabricated by this system requires more precise fitting accuracy.

## Introduction

The dental CAM system and CAD/CAM system has been used generally to fabricate various prostheses in clinical dentistry. The progress of dental CAD/CAM technology has made it possible to use high-strength ceramic materials such as zirconia, and zirconia ceramics have become popular materials in clinical dentistry. Zirconia ceramics have excellent mechanical strength for prosthetic appliances and are biocompatible with a significant reduction in plaque.[1)] These facts suggest that zirconia ceramics are clinically useful for keeper copings of magnetic attachments.

Nevertheless, the keeper copings of magnetic attachments were still cast by the lost wax method used in dental casting. Our present study[2)] introduced the method of zirconia keeper copings fabricated by the dental CAM system. However, the adaption had poorer clinical acceptability than did other prostheses. Thus, we prepared 2 different abutment tooth forms for zirconia keeper copings and investigated the fitting accuracy.

The purpose of this study was to evaluate the influence on fitting accuracy of 2 different abutment tooth forms of zirconia copings fabricated by the same CAD/CAM system.

## Materials and Methods

*Materials:* The prepared epoxy resin lower canine tooth (338: NISSIN) was selected as the abutment tooth. The abutment tooth forms for the metal coping (MC) and the abutment tooth form for the CAD/CAM coping (CC) are shown in Figs. 1 and 2. As compared to the abutment tooth form for MC, the rotational resistance groove was removed for the CC, giving additional reduction to gain more clearance and rounding all orifice line angles.

The keeper copings were fabricated using the dental CAD/CAM system (Cercon® brain, DeguDent), and a semi-sintered zirconia block (Cercon® base, DeguDent) was employed for the keeper coping material (Table 1).

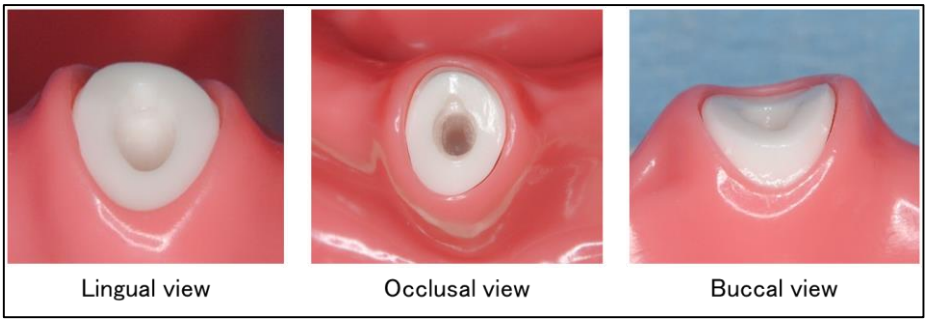


Fig.1 Abutment tooth form for the MC

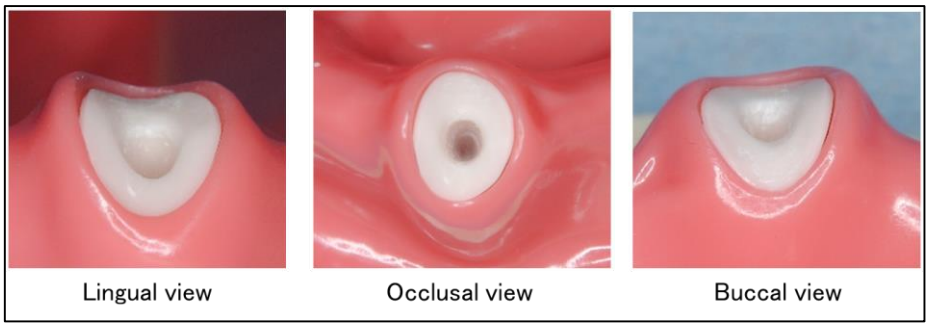


Fig.2 Abutment tooth form for the CC

| Puroduct | Composition |
|---|---|
| Cercon® base | $ZrO_2$ 89.2% |
| | $Y_2O_3$ 5.0% |
| | $HfO_2$ 5.0% |
| | other oxides |

Table 1 Material composition

*Methods* (*Cement-replica technique*): Fitting accuracy was evaluated using a cement-replica technique. Each keeper coping was placed in the master die with a white silicone material (FIT CHECKER ADVANCED, GC). After curing the white silicone material, the keeper coping with the white silicone material was removed from the master die. Then, the keeper coping with it was embedded in a blue silicone material (EXAMIXFINE Regular Type, GC). The keeper coping was demounted from the cured silicone material, and a blue silicone material filled in the space (Fig.3).

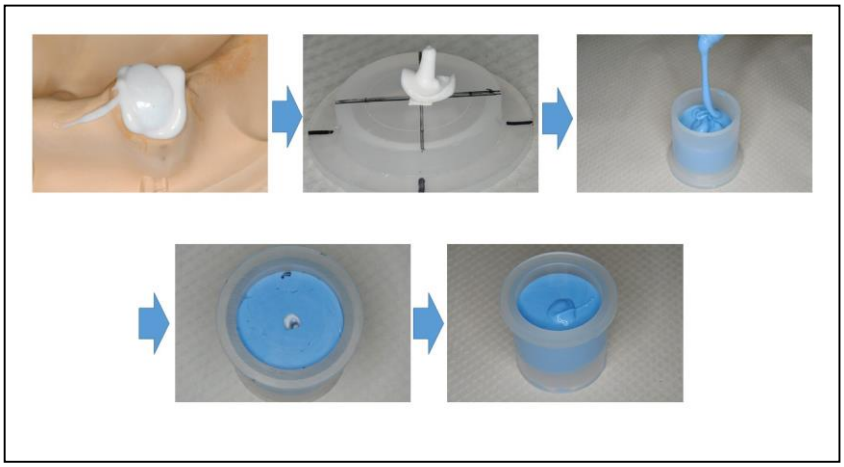

Fig.3 Procedure for fabricating specimens (cement-replica technique)

*Determination of fitting accuracy*: Each silicone-replica specimen was sectioned in the buccolingual direction through the center of the coronal root. The measuring points of the white silicone layer are shown in Fig.4. The thickness of the white silicone layer was measured at each point (a: canal orifice of the lingual wall; b: center of the lingual wall; c: apical part of the post; d: center of the buccal wall; e: canal orifice of the buccal wall).

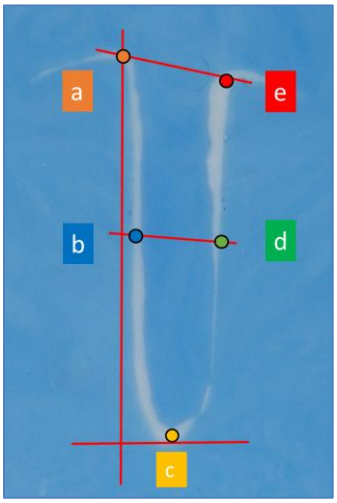


Fig.4 Locations of the measuring points

## Results

The mean thicknesses of the white silicone layer, namely the mean fitting gaps, were 781±79 ㎛ at point a, 167±69㎛ at point b, 193±31㎛ at point c, 168±58㎛ at point d, and 156±46㎛ at point e in the MC group (Fig.5). There were statistically significant differences between point a and other measuring points by one-way ANOVA and the Tukey–Kramer method ($p<0.05$).

In the CC group, the mean fitting gaps were 300±147 ㎛ at point a, 171±19 ㎛ at point b, 250±67 ㎛ at point c, 127±43 ㎛ at point d, and 192±129 ㎛ at point e (Fig.6). There were no significant differences in the mean thicknesses of the white silicone layers between the 5 measuring points by one-way ANOVA and the Tukey–Kramer method ($p<0.05$).

Application of the Student *t*-test indicated that there was a statistically significant difference between the MC and the CC groups at point a (Fig.7).

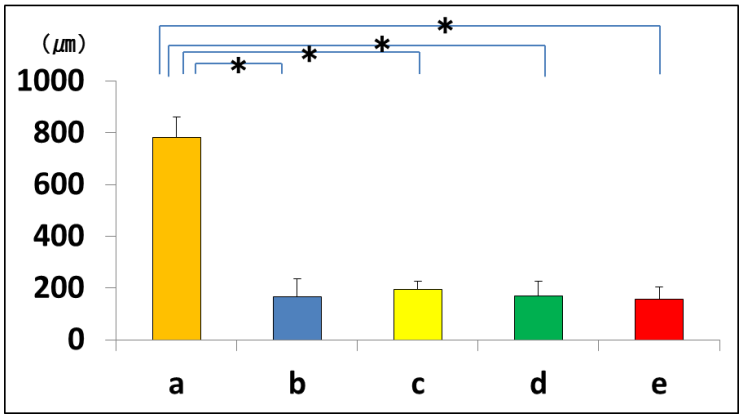


Fig.5 Mean thicknesses of the white silicone layers at 5 measuring points (MC)

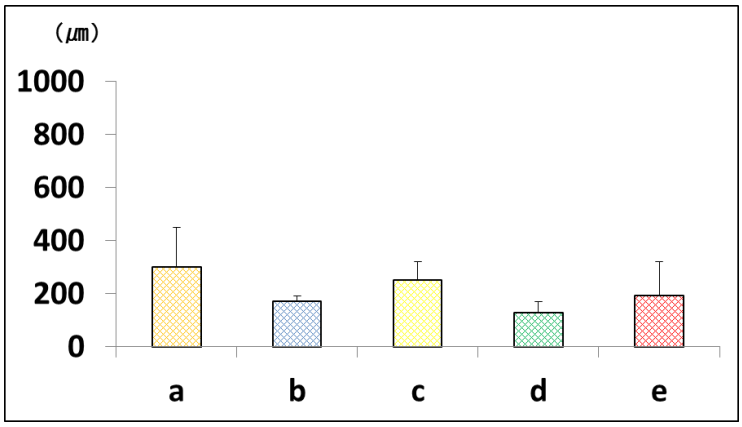


Fig.6 Mean thicknesses of the white silicone layers at 5 measuring points (CC)

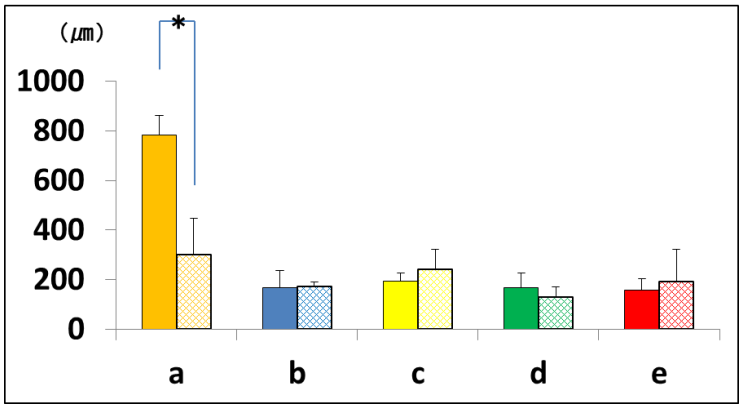


Fig.7 Mean thicknesses of the white silicone layers at 5 measuring points in both groups

## Discussion

Within the limitations of this study, it was concluded that modification of the abutment tooth form improved fitting accuracy at point a in this system. This result indicates that removing rotational resistance grooves and rounding all orifice line angles could have influenced the fitting accuracy of point a. However, the fitting accuracy of a zirconia keeper coping fabricated by this system, ether MC or CC, had unacceptable marginal gaps of 100 μm.[3)] This result suggests that the adaptation of a zirconia keeper coping fabricated by this system is not clinically recommended. Further investigation is needed to fabricate CAD/CAM keeper copings.

## References

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