Effects of Abutment and Screw Access Channel Modification on Dislodgement of Cement-Retained Implant-Supported Restorations

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This study investigated the influence of implant abutment and screw access channel modification on the retention of copings. Titanium abutment access openings were either left open or modified by placing two vent holes 3 mm from the occlusal edge and 180 degrees apart. Access openings sealed with a resin material were used as controls. Metal copings were cemented and subjected to tensile testing until failure. Access openings with two vent holes resulted in significantly higher mean retention values compared to the opened or sealed screw access groups ($P < .05$). Cement flow was affected by the internal vent, which increased the area of cement-abutment contact. *Int J Prosthodont 2013;26:54–56. doi: 10.11607/ijp.3069*

A survey of dental schools in the United States reported that 86% of program directors in advanced prosthodontics suggest sealing the screw access opening, and none recommended leaving this channel open prior to cementation of the restoration.[1] Abutment wall height and filling modality of the screw access channel influence the retention of the coping to the abutment.[2] Vent holes have been used to allow cement extrusion external to the restoration.[3] The internal venting of implant abutments has also been proposed as a means of retaining cement within the implant abutment.[4] The objective of this preliminary study was to evaluate the effect of implant abutment and screw access channel modification on the retention of metal copings cemented onto implant abutments.

Materials and Methods

Twenty-seven anatomical abutments (CrossFit regular, Straumann) and analogs were used. A custom silicone jig allowed for the fabrication of standardized wax copings directly onto the metal abutment, as recommended by the manufacturer. Wax copings were invested (Microstar HS, Jensen Dental) and cast (JP1 Alloy, Jensen Dental). Copings fit to the abutments were examined at 20× magnification and randomly assigned to one of three groups (n = 9):

1. Closed abutment (CA) group, in which the screw access hole was completely filled with a resin material (Triad, Dentsply) to serve as the control.
2. Open abutment (OA) group, in which the screw access remained open with a pellet of polytetrafluoroethylene tape placed over the screw head to simulate clinical practice.[5]
3. Internal vent abutment (IVA) group, which was similar to the OA group but with the addition of two 0.75-mm-radius holes placed 3 mm below the occlusal edge, 180 degrees apart, at the proximal surfaces (Fig 1).

Dental cement (TempBond NE, Kerr) was mixed according to the manufacturer's instructions, loaded into a 1.2-mL syringe with a fine tip (Ultradent), and applied to the intaglio surface until the coping was approximately 75% filled. Each coping was seated onto the appropriate abutment, first with finger pressure and then with a 5-kg compression force.[4] After setting for 10 minutes, the excess cement was cleaned from the coping margins.

After incubation in a 37°C water bath for 24 hours, the cemented copings were placed in a universal testing machine (Model 8511, Instron) and subjected to a tensile test at a crosshead speed of 5 mm/min. The specimens were examined for the cement flow pattern into the screw access channel. One-way analysis of variance and the Tukey honestly significant difference test were used to analyze the retention values at $\alpha = .05$.

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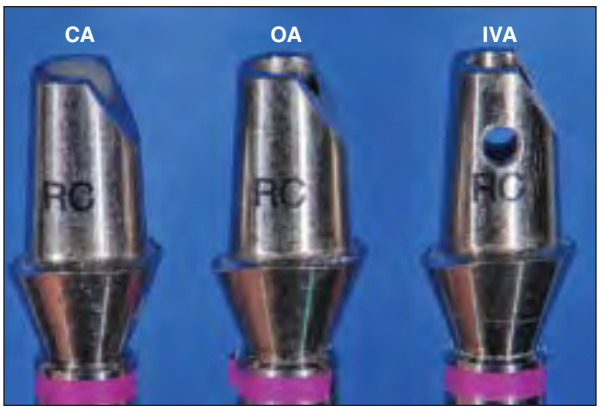


Fig 1 Implant abutment designs tested in this study: closed abutment (CA), open abutment (OA), and implant vent abutment (IVA).

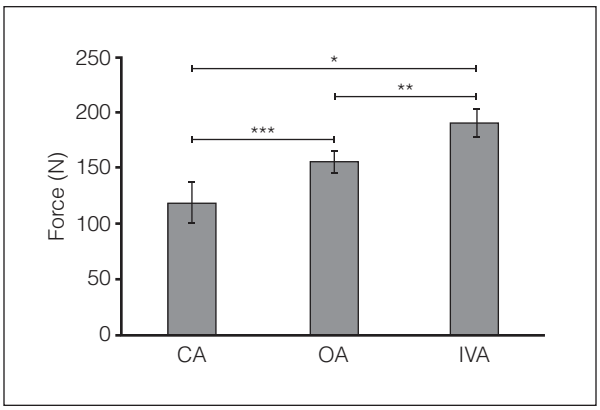
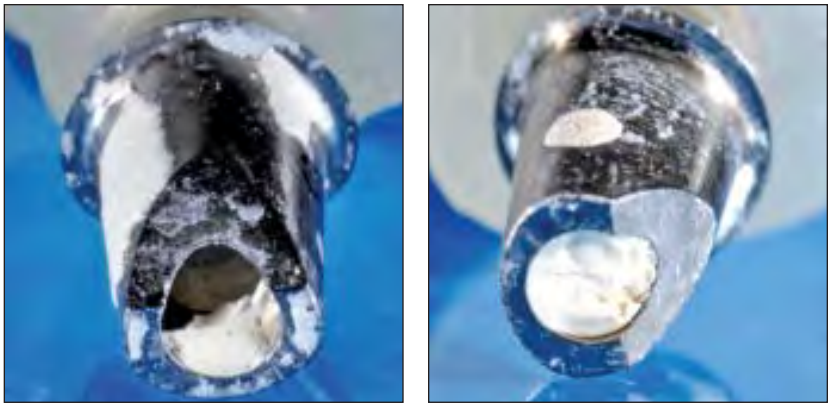


Fig 2 Results of the retention test and statistical analyses. Significant differences between groups are linked by horizontal lines. CA = closed abutment; OA = open abutment; IVA = implant vent abutment. *$P < .001$, **$P < .01$, ***$P < .05$.

Fig 3 Representative open abutment *(left)* and internal vent abutment *(right)* showing the cement flow inside the screw access channel.



Results

The mean (± standard deviation) retentive force values ranged from 119.6 ± 18.0 N to 191.5 ± 11.7 N and were significantly different between groups ($P < .05$) (Fig 2). Separation of the copings and observation of the cement remnants revealed that the IVA specimens were consistently filled, whereas voids within the cement were noted in the OA group (Fig 3).

Discussion

Differences between CA, OA, and IVA approaches have been studied with respect to the weight of cement extruded at the abutment-crown margin.[4] The internal volume available for IVA abutments was calculated to be approximately 3 mm^3 greater than for OA abutments, which would be unlikely to account for the significant increase in retention between the two groups as long as the cement totally filled the available space. However, the cement flow patterns indicated a better infill of the screw access channel with the IVA abutments, suggesting that the vents allow air to escape more readily. Additionally, these vents act as an internal reservoir for cement that may otherwise be extruded through the abutment-crown margin. Fabrication of implant abutments with some form of internal venting should be considered whenever a screw access channel exists.

This study has several limitations. The cement studied was eugenol-free zinc oxide; other cements may behave differently. Titanium was used as the abutment material; it is unknown if other materials would be suitable for this technique. Finally, the number, size, and location of venting channels require further investigation.

Conclusions

Leaving the screw access channel open with or without abutment venting improved the retention of a cemented coping. Placement of two vent holes significantly improved retention by altering cement flow within the screw access channel.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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Literature Abstract

For which clinical indications in dental implantology is the use of bone substitute materials scientifically substantiated?

This systematic review evaluated the effect of different bone substitute materials on the survival of implants placed in augmented maxillary sinus floors, as well as on lateral and/or vertical alveolar ridge augmentation. Histomorphometric data were also evaluated. The inclusion criteria for this review were: *(1)* simultaneous or delayed dental implant placement in healthy patients without local infections and systemic illness affecting bone metabolism; *(2)* external or internal maxillary sinus floor elevation and vertical and/or lateral alveolar ridge augmentation with bone substitute materials; *(3)* retro- and prospective studies written in English or German with at least 20 patients, randomized controlled studies, or split-mouth trials with at least 5 patients. Outcome parameters studied were: *(1)* survival of implant and peri-implant bone levels under functional loading; *(2)* postoperative changes in ridge dimensions and rate of total augmentation failure, as well as histomorphometric data of augmented areas. Seventy-two articles (52 studies on maxillary sinus floor elevation procedures, 20 studies on vertical and/or lateral alveolar ridge augmentation) fulfilled the inclusion criteria. This study found that survival rates of dental implants inserted into augmented bone and pristine bone were similar. For external maxillary sinus floor elevation, implants had a cumulative survival rate of 96.55%. Histomorphometric data showed formation of at least 20% to 30% new vital bone after 6 to 8 months. For internal maxillary sinus floor elevation, implant survival was 94.8% to 100%, no histomorphometric data were available. For alveolar ridge augmentation, the cumulative survival rate of implants was 95.91%, and mean peri-implant bone loss was 0.59 to 1.87 mm after 6 to 12 months. Postoperative changes in ridge dimensions after 6 months were 2.0 to 5.6 mm for vertical augmentation, and 3.6 to 5.6 mm for lateral augmentation. Total augmentation failure was 3.9% for vertical augmentation and 3.1% for lateral augmentation. Histomorphometric data of alveolar ridge augmentation showed 20.6% to 42% new vital bone after 4 to 7 months. The shortlisted studies did not allow identification of a superior grafting technique for alveolar ridge augmentation.

Klein MO, Al-Nawas B. *Eur J Oral Implantol* 2011;4:11–29. **References:** 91. **Reprints:** PD DR Dr Marcus Oliver Klien. Email: klein@mkg.klink.uni-mainz.de—*Simon Ng, Singapore*