

Showa Univ J Med Sci 27(2), 137~142, June 2015

## Technical Note

# Novel Removable Keeper System for Magnetic Attachments on Overdenture Abutments

Sawako TAKEUCHI<sup>\*1)</sup>, Yuji SATO<sup>1)</sup>, Dan NATHANSON<sup>2)</sup>  
Noboru KITAGAWA<sup>1)</sup>, Yoshiki KINOSHITA<sup>3)</sup> and Tadahiko KAJITA<sup>3)</sup>

**Abstract:** Magnetic attachments are being increasingly used for removable dental prostheses, mainly because they are relatively simpler to use than other attachments, and they show good retention and stability. However, this approach poses some problems. In patients undergoing magnetic resonance imaging (MRI) procedures, the presence of magnetic structures and keepers may cause artifacts that hinder the diagnosis. We therefore aimed to develop a technique that could reduce the damage caused to dental roots and root caps during removal of the magnetic keepers. A modified keeper tray and custom-made metallic guide bar were used for root cap fabrication. The retrieval hole of the root caps was made from the bottom of the keeper tray to the labial side of the root. A special crown remover was then inserted into the retrieval hole and rotated to facilitate removal of the magnetic keepers through the hole without causing damage to the root caps. **Conclusion:** This study describes a new technique that uses a keeper tray along with magnetic attachments for overdentures to enable simple removal of the keeper without causing damage.

**Key words:** magnetic attachment, MRI, root cap, overdenture

## Introduction

Magnetic attachments have been used in Japan as overdenture keepers since the 1990s<sup>1, 2)</sup>. These attachments are relatively simpler than other attachments, and they show good retention and stability, making them increasingly popular for removable dental prostheses. Magnetic attachments for dentures offer the following advantages: 1) a simple attachment system, 2) excellent retention, 3) no loss of retentive strength during use, 4) easy placement and denture removal, 5) easy cleaning, and 6) retention strength adjustment according to the size of the magnet<sup>3)</sup>. The magnetic attachment system is composed of root caps, which are cemented to the abutments and contain ferromagnetic stainless steel keepers, and corresponding magnets embedded in the overdenture.

<sup>1)</sup> Department of Geriatric Dentistry, Showa University School of Dentistry, 2-1-1, Kitasenzoku, Ohta-ku, Tokyo 145-8515, Japan.

<sup>2)</sup> Department of Restorative Sciences and Biomaterials, Boston University, Henry M. Goldman School of Dental Medicine.

<sup>3)</sup> Dental Laboratory of Showa University Dental Hospital.

\* To whom corresponding should be addressed.

Elderly individuals may require periodic systemic examinations that involve magnetic resonance imaging (MRI) due to various medical conditions. However, the presence of magnetic structures and keepers during MRI analysis could create artifacts that hinder diagnosis (Fig. 1)<sup>4-8)</sup>. Conventional magnetic keepers (GIGAUSS<sup>®</sup>; GC Corporation, Tokyo, Japan) can be cast with the root caps; however, this technique poses the following problems: 1) decreased retention strength over time due to oxidation and transformation of the magnetic keepers during casting, and 2) the root caps need to be sectioned (i.e., with a carbide bur) and destroyed in order to remove the magnetic keepers before MRI examinations, potentially causing root damage. Therefore, a new system has been developed that uses cement to attach the magnetic keepers to the root caps (GIGAUSS<sup>®</sup> KB; GC Corporation, Tokyo, Japan) (Fig. 2)<sup>9)</sup>, and although this technique should eliminate the problems mentioned above, it still has a limitation. In order to remove the magnetic keepers, the keepers need to be sectioned in a process that can easily damage the interior of the root caps (Fig. 3) and eliminate the possibility of installing new keepers into the root caps after MRI examination. Therefore, a new technique is needed to prevent root cap damage during removal of the magnetic keepers.

This study describes a new procedure for easier and damage-free removal of magnetic keepers using a narrow-neck crown remover (WAMkey<sup>®</sup>; CrossField France, EU, size1) with an oral tip (1.8 mm × 2.0 mm) (Fig. 4).

## Materials and methods

This procedure was performed at the Department of Geriatric Dentistry, Showa University School of Dentistry, Tokyo, Japan. The root cap was fabricated using a modified keeper tray and a custom-made metallic guide bar, as follows.

First, a 2.1 mm × 2.6 mm slot was made in the resin pattern of the keeper tray (GIGAUSS C 600<sup>®</sup>; GC Corporation, Tokyo, Japan) (Fig. 5), as part of the root cap wax pattern. The resin keeper tray was burned out using Inlay wax (INLAY WAX S<sup>®</sup>; GC Corporation, Tokyo, Japan) at the time of casting. The complete root cap was then prepared with the Inlay wax, including the keeper pattern as shown on the dental cast. A retrieval hole was made from the bottom of the keeper tray to the labial side of the root cap using a custom-made metallic guide bar (2.1 mm × 20 mm) (Fig. 5). The complete wax-up of the root cap, including the keeper tray pattern, is shown in Figs. 6, 7A. The root cap was cast in an Au-Ag-Pd alloy (CASTWELL M.C. < 12 % GOLD ><sup>®</sup>; GC Corporation, Tokyo, Japan), followed by finishing and polishing. The cast root cap with the opening on the labial side is shown in Figs. 7B, 8.

Next, the custom-made metallic guide bar with petrolatum paste applied to the surface was inserted into the retrieval hole of the root cap. The keeper was cemented with a resin cement (LINKMAX<sup>®</sup>; GC Corporation, Tokyo, Japan) over the custom-made metallic guide bar (Fig. 9), which was removed after the cement was set, and the retrieval hole was sealed with a composite resin (SOLARE P<sup>®</sup>; GC Corporation Tokyo, Japan) (Figs. 10, 11A). After the fitting, the root cap was fixed onto the root with the resin cement.

The composite resin within the retrieval hole was then removed with a carbide bur to remove



Fig. 1. Artifact created by the magnetic keeper

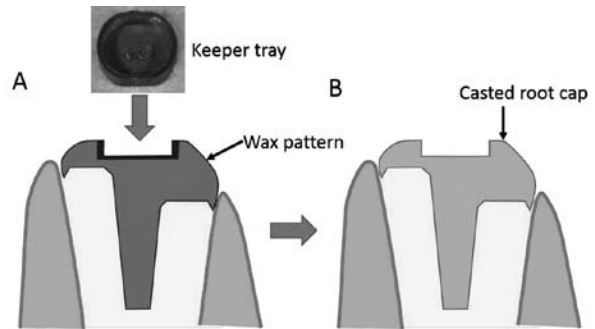


Fig. 2. A new technique developed by the GC Corporation: A) Completed wax-up of the root cap; B) Completed root cap.



Fig. 3. Conventional method for removal of magnetic keepers using a high-speed carbide bur

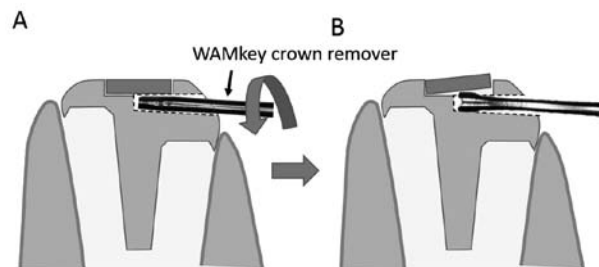


Fig. 4. A) A crown remover is inserted into the slot and rotated; B) The keeper is removed.

the magnetic keeper. A special narrow-neck crown remover was then inserted and rotated (Fig 11B) to lift and remove the magnetic keeper (Fig. 12). As with the conventional procedures, residual cement was removed by a sonic or hand scaler, or by using a dental explorer through a loupe.

#### **Difference from conventional methods**

This technique is a new procedure for intraoral removal of magnetic keepers using a narrow-neck crown remover; it has been developed to overcome the various problems posed by

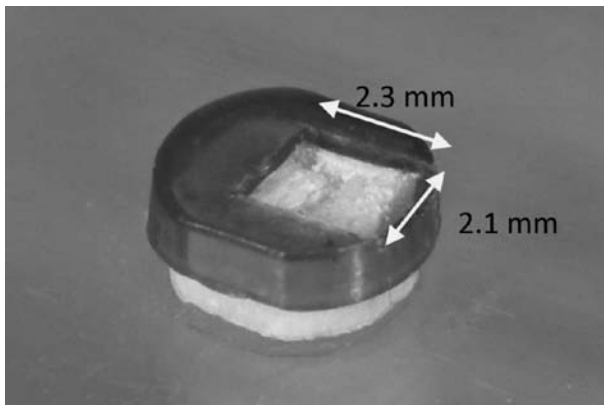


Fig. 5. Formation of a slot (2.1 mm × 2.6 mm) in the keeper tray for magnetic attachment

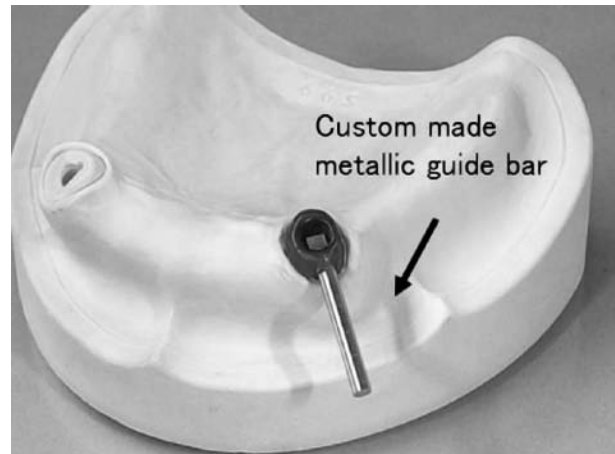


Fig. 6. Crown wax-up with custom-made metallic guide bar below the keeper tray

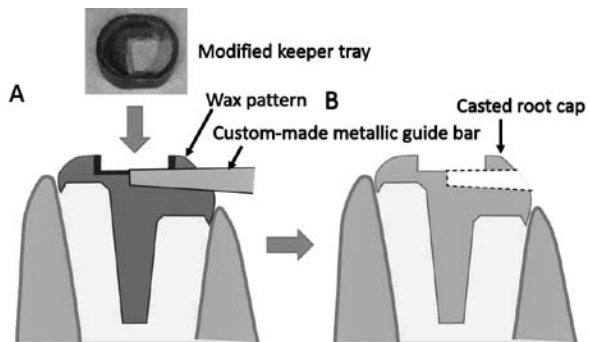


Fig. 7. A removable keeper system: A) Completed wax-up of the root cap; B) Completed root cap.



Fig. 8. Completed wax-up of the root cap



Fig. 9. Completed root cap



Fig. 10. Resin cement applied to the keeper

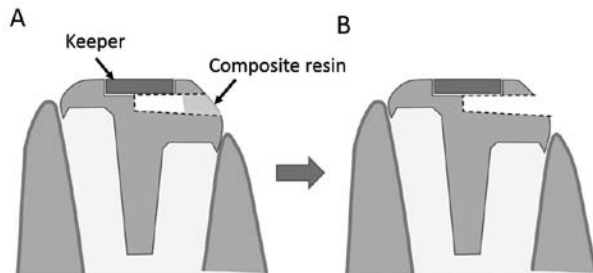


Fig. 11. A removable keeper system: A) Hole sealed with a composite resin; B) Removal of the resin cement.



Fig. 12. The retrieval hole sealed with a composite resin



Fig. 13. Removal of the keeper with a crown remover

conventional methods (Fig. 13). Similar to the technique proposed by Schweitzer et al<sup>10)</sup> for the retrieval of cement-retained implant-supported prostheses, the slot mechanism described here enables removal of the magnetic keepers using the slot design.

Our new technique also includes several unique procedures to overcome the severe root damage generally caused by having to section and destroy magnetic keepers for root caps prior to MRI. Specifically, a special crown remover is essential for this procedure to ensure smooth removal of the magnetic keepers from the hole of the root caps. Accordingly, the height of root caps in the side of the hole should be raised by 0.85 mm. In addition, the modified keeper used in the present study had a slot with an internal width of 2.1 mm and depth of 2.6 mm, and the custom-made metallic guide bar should be made to fit that slot. In most cases, the retrieval hole is made on the labial side because it is lower than other sides. However, if an arrangement of artificial teeth is difficult due to limited space, we have no other choice than to use the existing technique developed by the GC corporation.

## Effect or performance

After receiving approval from the Ethics Committee, Showa University (2011–2017) , this new procedure was already applied without any negative incidents in 10 patients.

Of note, the root cap design should be sufficiently high to allow room for the retrieval hole, while a microscope might be needed when fabricating the root caps with the modified keeper tray. To this end, the usefulness of the keeper tray now should be tested in more cases to adequately assess the clinical outcomes. The improved GC keeper trays and metallic bars are available at present. Two patent applications have been submitted. (JP #2013-52218 A, March, 2013, US 2013/0216977 A1, Aug, )

In summary, the removable keeper system for magnetic attachments on overdenture abutments seems to be clinically advantageous, with the design feature presented in this report allowing removal of the magnetic keepers without causing root cap damage.

## Acknowledgement

The authors would like to thank Mr. Takayama (GC Corporation, Tokyo, Japan) for development of the modified keeper tray and the custom-made metallic guide bar.

## Conflict of interest disclosure

The authors declare no conflict of interest for this study other than the patent application.

## References

- 1) Ishigami T. The magnetic attachment improved from a merit demerit. *Quintessence Dent Technol.* 2012;**37**:738–745. (in Japanese).
- 2) Hideshima M, Mizutani H, Ando T, *et al.* Effects of dental alloys and a magnetic keeper on MRI. Part 2: relationship between cast crowns and artifacts of axial plane images. *J Jpn Soc Magh Appl Dent.* 2009;**18**:25–28.
- 3) Yoshikawa H, Okuda H, Uchida S, *et al.* Clinical survey of dentures with magnetic attachments. *J Osaka Odontol Soc.* 1998;**61**:105–111. (in Japanese).
- 4) Laurell KA, Gegauff AG, Rosenstiel SF. Magnetic resonance image degradation from prosthetic magnet keepers. *J Prosthet Dent.* 1989;**62**:344–348.
- 5) Tanaka Y, Mihara M, Kishimoto Y, *et al.* Magnetic attachment retainers of removable partial denture interfere with MR-CT examination. *Maxillofac Prosthet.* 1988;**11**:55–62. (in Japanese).
- 6) Imuro FT. Magnetic resonance imaging artifacts and the magnetic attachment system. *Dent Mater J.* 1994;**13**:76–88.
- 7) Ishigami T, Naitoh M, Tanaka Y, *et al.* Experimental observations of effect of dental magnetic attachments on MRI. *Maxillofac Prosthet.* 1994;**17**:124–136. (in Japanese).
- 8) Masumi S, Nagatomi K, Miyake S, *et al.* Removable magnetic dental attachment that permits magnetic resonance imaging. *J Prosthet Dent.* 1992;**68**:698–701.
- 9) Tsuchida F, Suminaga Y, Takishin N, *et al.* Cast-bonding technique and direct-bonding technique on magnetic attachments. *J Jpn Soc Magn Appl Dent.* 2005;**14**:53–60 (in Japanese).
- 10) Schweitzer D, Berg R, Mancia GO. A technique for retrieval of cement-retained implant-supported prostheses. *J Prosthet Dent.* 2011;**106**:134–138.

[Received January 16, 2015 : Accepted March 23, 2015]