*Eur. J. Prosthodont. Rest. Dent.*, Vol.13, No. 4, pp 147–149
Printed in Great Britain



# Retentive Force of O-ring Attachment to Use Immediate Provisional Implant (IPI)-Retained Overdenture

Mariko Kobayashi*, Chikahiro Ohkubo†, Yasunori Suzuki†, Takayuki Aoki†, Jun-ichi Sato† and Toshio Hosoi‡

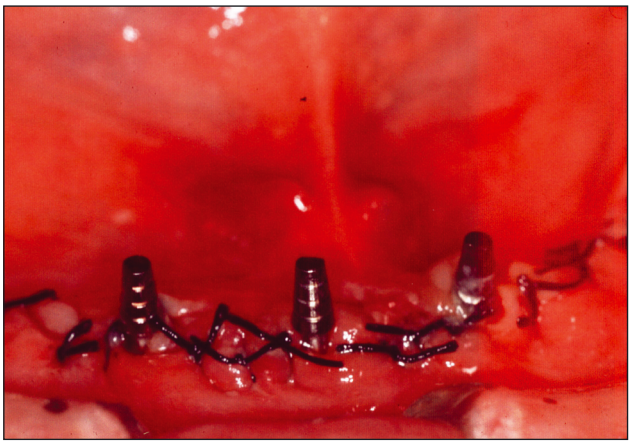
**Abstract** - *This study evaluated the retentive force of the O-ring attachment to an Immediate Provisional Implant (IPI)-retained overdenture. Two sizes of O-rings (#1, #2) were placed on the IPI abutment head. As the controls, soft relining material, silicone lining material, and the PMMA resin were used to connect the IPI abutment head. The retentive forces (n=5, N) obtained at a crosshead speed of 40 mm/min were analyzed by ANOVA/Tukey's HSD test ($\alpha$=0.05). O-ring #1 showed the significantly greatest force among all materials tested (p0.05). Appropriate retention was obtained using the smaller O-ring#1 for the IPI-retained overdenture.*

KEY WORDS: Transitional Implant, Immediate Provisional Implant (IPI), O-ring, Retentive force, Overdenture

## INTRODUCTION

Transitional Implants (TIs) have recently been introduced for patient comfort requirements during the healing period[1–3]. By the TIs placement, the pressure is absorbed during function and can protect the augmented implant site and the definitive implant from the stress of immediate loading[4–6]. The TIs are placed at the same time of sitting the definitive implant, and are removed once the definitive implants are ready to be loaded, they can support fixed provisional restorations with provisional cement[7].

One of the TIs is a Immediate Provisional Implant (IPI) which is composed of an abutment head (5 mm length), neck (3 mm length, 2.0 mm diam.), shoulder (1.5 mm), and IPI body (14 mm length, 2.8 mm–2.0 mm diam.)[7]. The abutment head has a five-degree taper, fitting to the prosthetic coping embedded in the fixed provisional restorations. In the full-arch mandible and maxilla, the manufacturer recommends the use of four or more IPIs and five IPIs for the fixed provisional prostheses, respectively[4–6]. For IPI and soft-tissue supported prostheses, two or three IPIs are placed to increase the stability and retention of existing complete denture both mandibular and maxillary jaws[12,13]. Generally, the abutment heads are connected to the prosthetic coping embedded in the denture base. Because the IPI coping does not fit the abutment head of IPI well, the IPI-retained overdenture cannot often obtain proper retention. In these cases, the abutment heads of each IPI are bent to be non-parallel using a system's bending tool. Alternatively, an O-ring can be fitted on the abutment head of the IPI to obtain appropriate retention for the IPI-retained overdenture[8,9] (*Figures 1a, b*).



*a*

*b*

***Figure 1a.*** *After three IPI (immediate provisional implant) fixtures are placed, O-rings are fitted on the suitable level of IPI head for immediate provisional overdenture. Utility wax was attached to the undercuts portion under the head of IPI to prevent the complete denture from interlocking.* ***b,*** *IPI-O-ring retention system was completed after trimming the excess acrylic resin and then polishing the surface of trimed resin*

*DMD
†DMD, PhD
‡DDS, PhD

The purpose of this study was to investigate the retention of the IPI-retained overdenture with new several retention systems. In vitro retentive forces of the IPI abutment head to O-rings, soft-lining material, silicone lining material, autopolymerized polymethy methacrylate (PMMA) resin, were measured.

## MATERIALS AND METHODS

### Specimens preparation

Upper and lower cylinder-shaped frameworks (10×10×25 mm) were milled with brass alloy so that both frameworks were properly fitted as male and female jointing (*Figure 2*). Since one lower framework was commonly used, 25 upper frameworks were prepared to fit it. The body of the IPI was embedded to its shoulder level into the lower framework with autopolymerized polymethyl methacrylate (PMMA) resin (Uni FastII). Similarly, the hollow was filled out in the upper framework with PMMA resin. Because the IPI neck was narrower than the abutment head portion, the IPI neck was blocked out with wax (utility wax). After the PMMA in the lower framework was completely polymerized, resin separator (petroleum jelly) was placed on the connecting surface of PMMA. Two sizes of O-ring [nitrile-butadiene rubber (NBR); No. 1 (O1); outer diameter: 3.5 mm; inner diameter, 1.0 mm; No. 2 (O2); outer diameter: 4.5 mm; inner diameter, 1.5 mm;] were seated on the bottom level of the IPI abutment head. Sufficient PMMA resin in the upper framework was removed to accommodate the O-ring on top of the IPI head. The upper framework was securely fitted to the lower framework with proper position with the male and female fitting, PMMA was placed into the hollow of the upper framework to overlay. As controls, soft relining material (SL), silicone lining material (SR), and the PMMA (RE) were used to connect the abutment head to the hollow of the PMMA in upper framework without the O-ring. After complete polymerization, the excess resin or soft relining materials were trimmed. Five female specimens were made for each retention type for a total of 25 specimens.

### Measurement of retentive force

Using a constant load-press machine, the upper and lower frameworks were joined under 5 kg pressure. Joined frameworks were mounted on a screw-driven mechanical testing machine. The retentive forces (N) were evaluated as tensile forces obtained when the upper and lower frameworks were separated at a crosshead speed of 40mm/min. This measurement was repeated 5 times for each test piece. The data were analyzed with the SPSS statistical package by ANOVA/Tukey's HSD test at a significance level of $\alpha$=0.05.

## RESULTS

As shown in *Figure 3*, the retentive forces for all materials ranged from 1.96 to 15.48 N. One-way ANOVA indicated that materials were significantly different ($p$<0.01). O1 showed the greatest force among all materials tested ($p$>0.05). There were no significant differences in retentive forces between O2 and RE, SL and SR ($p$>0.05). O2 and RE, SL and SR showed the almost equivalent value about 5.88, 1.96 N, respectively. Of the O-rings, the retentive forces of O1 (smaller O-ring) was approximately 2.8 times greater than for O2 (larger O-ring).

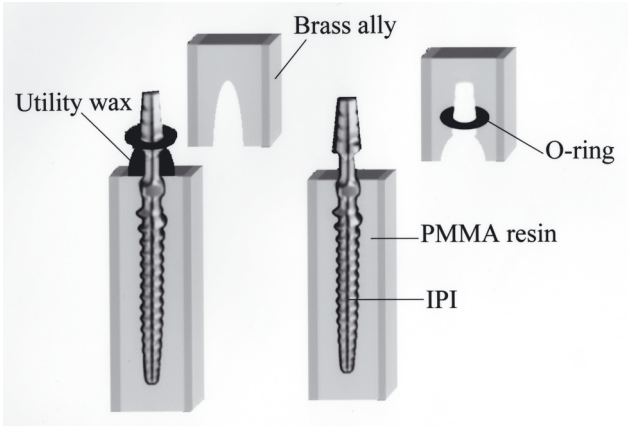



***Figure 2.*** *Schematic drawing of cylinder-shaped specimens for tensile test.*

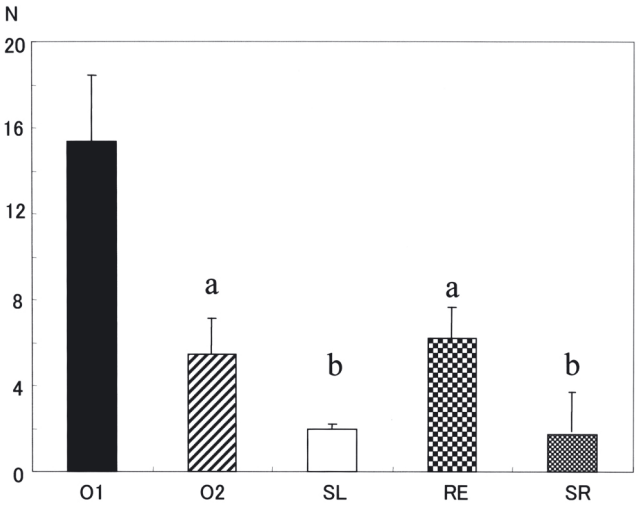



***Figure 3.*** *The retentive force of all materials tested. Identical letters indicate no statistical difference (p>0.05). (O1: 3.5 mm O-ring, O2: 4.4 mm O-ring, SL: Soft lining material, RE: autopolymerized polymethyl methacrylate resin, SR: Silicone lining material)*

## DISCUSSION

In an edentulous jaw, the manufacturer of IPI recommends that the fixed provisional restoration should be supported by 4 to 6 IPIs with temporary cement[7]. If a conventional implant stabilized overdenture will be delivered as a permanent prostheses, IPIs-retained overdenture may be selected as a provisional restoration instead of the fixed provisional restoration. An IPI-retained overdenture needs 2 to 4 IPIs because tissue support is simultaneously also required[8,9].

The advantages of the IPI-retained overdenture as compared with a conventional implant-retained overdenture are as follows: (1) immediate stabilization of an existing complete denture can be obtained; (2) easy surgical and prosthetic procedure with few steps; (3) low costs of implant and retention system. The disadvantages

of this technique are as follows: (1) TI is removed prior to placement of the final implant prosthesis; (2) a high retention force cannot be obtained.

The O-ring used as the female was from the O-ring Anchor attachment system[14]. Four sizes (#1 to #4) of O-ring were standardized in accordance with the four male sizes in the O-ring Plastic pattern Anchor (OPA) attachment system (Inoue attachment)[15]. The retentive force of an OPA attachment was reported as 360 N and 560 N for #1 and #2 respectively, under similar conditions[15]. The retentive forces of the O-ring-IPI system (O1 and 02) were larger than for the OPA system (#1 and #2).

The retentive forces of OPA system would be produced by the elasticity of O-ring, depending on the amount of undercut of the male. Because the head of IPI has very shallow grooves without undercut, the retention would be occurred by the friction between O-ring and the head[8,9].

In this study, O1 (smaller O-ring) showed the greater retentive force (1580 N). The abutment head of IPI has a 5 degree taper. There are differences of retentive force by the levels of O-ring position on the IPI abutment head.

When there are more than two retainers in the same jaw, the total retention of the removable prosthesis is affected by the parallel adjustment of the retainers. Similar to the placement of the definitive implant, the strict parallel of IPIs cannot be obtained in the many cases. Non-parallel IPIs can be bent using a system's bending tool so that IPIs can become parallel. However, in the case where IPIs are slightly non-parallel, the total retention of IPI-retained overdentures would be increased compared to parallel condition.

Using an IPI with the O-ring, stability and comfort of the existing mandibular complete dentures could be immediately improved. During the healing period until the denture was assisted by definitive implant, IPI-retained overdenture can avoid some patient discomfort.

## CONCLUSIONS

Although there was poor retention with the soft relining materials, appropriate retention was obtained using the smaller O-ring (O1) for the IPI-retained overdenture. Since the O-ring fit on the abutment head of IPI, and then O-ring is included in the worn or prefabricated CD using autopolymerized resin at the chair-side, the proper retention could be immediately obtained if this procedure were undertaken in the clinic.

## MANUFACTURERS' DETAILS

- O-ring attachment, Inoue Attachment, Tokyo, Japan.
- Immediate Provisional Implant, Nobel Biocare, Sweden.
- Uni fastII, GC Dental Corp., Tokyo, Japan.
- Utility wax, GC Dental Corp., Tokyo, Japan.
- Soft relining material, Soft-liner, GC Dental Corp., Tokyo, Japan.
- Silicone lining material, Sofreliner, Tokuyama, Japan.
- Constant load-press machine, Seiki, Japan.
- Screw-driven mechanical testing machine, Model UTMII, Tokyo Boldwin, Japan.
- SPSS, Version 10.0, SPSS Inc., Chicago, IL, USA.

## ADDRESS FOR CORRESPONDENCE

Dr. Mariko Kobayashi, Department of Removable Prosthodontics, Tsurumi University School of Dental Medicine, 2-1-3 Tsurumi, Tsurumi-ku, Yokohama, Kanagawa, Japan. E-mail: kobayashi-mariko@tsurumi-u.ac.jp

## REFERENCES

1. Petrungaro, P.S. Fixed temporization and bone-augmented ridge stabilization with transitional implants. *Pract. Periodontics Asthet. Dent.*, 1997; **9**:1071–1078.
2. Froum, S., Emitiaz, S., Bloom, M.J., Sclnick, J. and Tarnow, D.P. The use of transitional implants for immediate fixed temporary prostheses in case of implant restrations. *Pract. Periodontics Aesthet. Dent.*, 1998; **10**:737–746.
3. Bichacho, N., Landsberg, C.J., Rohrer, M. and Davidovich, Y. Immediate fixed transitional restoration in implant therapy. *Pract. Periodontics. Aesthet. Dent.*, 1999; **11**:45–51.
4. Bohsali, K., Simon, H., Kan, J.Y. and Redd, M. Modular transitional implants to support the interim maxillary overdenture. *Compend. Contin. Educ. Dent.*, 1999; **20**:975–978, 980, 982–983, quiz 984.
5. Harel Simon. Use of transitional implants to support a surgical guide: Enhancing the accuracy of implant placement. *J. Prosthet. Dent.*, 2002; 229–232.
6. Zubery, Y., Bichacho, N., Moses, O. and Tal, H. Immediate loading of modular transitional implants: a histologic and histomorphometric study in dogs. *Int. J. Periodontics Restorative Dent.,* 1999; **19**:343–353.
7. Babbush, C.A. Provisional Implants: Sugical and Prosthetics Aspects. *Implant Dentistry*, 2001; **10:**113.
8. Ohkubo, C., Sato, J., Hosoi, T. and Kurtz, K.S. O-ring attachments for transitional implant-retained overdentures. *J. Prosthet. Dent.*, 2004; **91**:195–197.
9. Ohkubo, C., Kobayashi, M., Sagae, T., Sato, J., Hosoi, T. and Kurtz, K.S. Evaluation of transitional implant (TI) stabilized overdentures: A case series report. *J. Oral Rehabil.,* in press.
10. Froum, S., Emtiaz, S., Bloom, M.J., Scolnick, J. and Tarnow, D.P. The use of transitional implants for immediate fixed temporary prostheses in cases of implant restorations. *Pract. Periodontics Aesthet. Dent.,* 1998; **10**:737–746.
11. Leshem, D., Mazor, Z., Leshem, R. and Rosen, D. A simple technique for fabrication of immediate interim removable prosthesis supported by transitional implants. *Implant Dent.,* 2003; **12**:227–231.
12. Bohsali, K., Simon, H., Kan, J.Y. and Redd, M. Modular transitional implants to support the interim maxillary overdenture. *Compend. Contin. Educ. Dent.,* 1999; **20**:975–978, 980.
13. el Attar, M.S., el Shazly, D., Osman, S., el Domiati, S. and Salloum, M.G. Study of the effect of using mini-transitional implants as temporary abutments in implant overdenture cases. *Implant Dent.,* 1999; **8**:152–158.
14. Ohyama, T. Clinical study on the new stud attachement with O'ring. *Tsurumi University Dental Journal,* 1976; **2**:91–110.
15. Suzuki, Y. Experimental Studies on the Retentive Force of OPA-Attachment. *Tsurumi University Dental Journal,* 1982; **8**: 13–33.