THE JOURNAL OF PROSTHETIC DENTISTRY

CLINICAL RESEARCH

Reliability of retrievable cemented implant-supported prostheses

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ABSTRACT

Statement of problem. One of the disadvantages of a cemented implant restoration is the potential difficulty of retrieving it. The restoration may be destroyed during removal.

Purpose. The purpose of this retrospective clinical study was to assess the long-term survival rates of cemented posterior metal ceramic implant-supported prostheses (ISPs) with a metal screw access hole.

Material and methods. During a 12-year period, 274 cemented ISPs with an abutment screw access hole in the metal framework were assessed and served as the study group, and 119 conventional cemented ISPs (without access hole) served as the control group. Participants were followed every 6 months in the first year and once a year subsequently. Ceramic fracture, screw loosening, and refabrication were the prosthetic outcome parameters evaluated at the recall. The Pearson Chi square and Fisher exact test were used to compare the outcome parameters between the control and study groups.

Results. A total of 1005 implants and 393 ISPs were evaluated. Ceramic fracture occurred in 6.6% of the ISPs (6.2% test and 7.6% control). Screw loosening occurred in 3.28% of the test group and 3.36% of the control group. Refabrication of ISPs was done in 2.79% of all restorations, (1.45% test and 6.72% control [P=.012]).

Conclusions. Within the limits of this study, preparing cemented ISPs with a screw access hole in the metal framework improves ISP survival rates over time and lowers the cost of maintenance without increasing the risk for porcelain fracture or screw loosening. (J Prosthet Dent 2016;115:587-591)

Implant dentistry is considered a predictable procedure with high success rates.[1-3] Screw-retained implant-supported prostheses (ISP) have the advantage of retrievability. However, obtaining passivity of screw-retained frameworks is challenging, the access screw hole compromises esthetics, and the prosthetic components are more costly.[4,5]

The use of cemented ISPs is an acceptable alternative.[6] Such restorations have proved reliable in providing long-term success.[7] Cementing ISPs may compensate for minor dimensional discrepancies of restoration fitting, eliminate unesthetic screw access holes, and reduce expense.[4,5]

The ability to cement ISPs by using techniques similar to those for conventional fixed prostheses simplifies treatment planning and implant restoration. One of the disadvantages is the potential difficulty in retrieving the restoration; another is the possibility of residual subgingival cement. Should an abutment loosen or any repair of the restoration become necessary, the restoration may be destroyed during the removal procedure. Furthermore, the force applied to a restoration on a loosened abutment could damage the internal threads of the implant.[8]

Several authors have described techniques for retrieving cemented ISPs with minimal damage.[8-16] Those techniques need to be validated by long-cohort studies to ensure that mechanical complications are not

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Clinical Implications

Use of a screw access hole in the metal framework of cemented implant-supported prostheses (ISP) is recommended to improve ISP survival rates and reduce the cost of maintenance.

increased.[17-30] The purpose of the present study was to assess the long-term survival rates of cemented posterior metal ceramic ISPs with a metal screw access hole.

MATERIAL AND METHODS

Consecutive individuals diagnosed as partially edentulous and treatment planned for posterior ISPs during the years 1998 to 2009 at the Oral Rehabilitation Department, Tel Aviv Medical School of Dentistry were included in the present study. A single laboratory (Shenhav Ltd) and skilled clinicians specialized in prosthodontics performed the restorations in this retrospective study.

During a 12-year period, 274 cemented ISPs with an abutment screw access hole in the metal frame served as the study group, and 119 conventional cemented ISPs (without access hole) as the control group. The definitive impression was made 4 to 6 weeks after second stage surgery, an implant replica was connected to the impression coping, and the impression was poured in Type IV artificial stone (New Fujirock; GC Corp) following the manufacturer's instructions. Once the definitive abutment was complete, conventional metal ceramic definitive crowns were fabricated. The metal framework was made from a palladium-silver alloy (59.9% Pd, 26.3% Ag main composition; Argelite 60+; Argen Corp). For the study group, the metal framework was fabricated with a 0.6-mm diameter hole to provide access to the abutment screw (Figs. 1, 2) and to allow easier retrievability of the cemented ISP. For the control group, the metal framework was fabricated without access holes. After clinical verification of the metal framework fit, the veneering porcelain (Super Porcelain EX-3; Kuraray Noritake Dental Inc) was applied in layers to the metal framework to achieve the desired contours while obtaining adequate proximal and occlusal contacts (Fig. 3). In the study group, ceramic stain was used to mark the occlusal surface of the crown where the screw access opening was located. The occlusal surfaces of the restorations were designed to avoid premature contacts during lateral and protrusive movements. All the abutments were screwed onto the implants with a torque wrench calibrated at 30 Ncm. All definitive restorations were cemented with an interim cement (Temp Bond NE; Kerr Corp). After restoration delivery, all participants were followed every 6 months in the first year and once a year in the following years.

Figure 1. Metal framework with 0.6-mm diameter hole that provided access to abutment screw.

The following prosthetic outcome parameters were evaluated at the recall: ceramic fracture and restoration stability (screw loosening, refabrication of ISPs). When abutment loosening was diagnosed clinically, a periapical radiograph was made to evaluate pathology. The porcelain was removed with a super coarse diamond rotary cutting instrument (5805-023; Brasseler) under copious water, (Fig. 4). The abutment was resecured at the torque recommended by the manufacturer, followed by clinical and radiographic verification of the restoration fit, and the restoration screw access opening was sealed with a light-polymerized composite resin (Fermit; 3M ESPE Dental-Medizin). The occlusion was adjusted as needed (Fig. 5). Refabrication of the ISP was defined as the need to remake the entire veneering porcelain, or the entire restoration, including the metal framework where sectioning the ISP was needed to remove it. The recorded data for the present retrospective study were collected from the participants' files. The Pearson Chi square and Fisher exact test were used to compare the outcome parameters between the control and study groups.

RESULTS

The study population included 245 individuals (144 women and 101 men) ranging from 20 to 77 years of age, with a mean age of 53 ±10 years. A total of 393 ISPs were inserted (245 mandibular ISPs and 148 maxillary ISPs). A total of 1005 implants were used as follows: 270 Nobel Biocare implants (101 ISPs); 252 Zimmer Dental implants (95 ISPs); 218 3i implants (92 ISPs); and 265 MIS implants (105 ISPs).

Ceramic fracture occurred in 6.6% (26 of 393) of ISPs, 6.2% (17 of 274) of the test group, and 7.6% (9 of 119), of the control group (P=.660). Thus it can be concluded that adding a screw hole in the metal framework did not increase the ceramic fracture ratio. Screw loosening occurred in 3.3% (13/393) of all ISPs (3.28% of the test and 3.36% of the control group) (P=.859). Thus it can be concluded

Figure 2. Metal framework verification using screwdriver.

Figure 3. Definitive implant-supported prostheses.

Figure 4. Removal of porcelain to locate screw access opening before resecuring abutment.

Figure 5. Abutment screw hole filled with light-polymerized composite resin restoration.

that adding a screw hole in the metal framework did not increase the screw loosening ratio. Refabrication of ISPs was done in 2.79% (11/393) of all restorations (1.45% of the test group and 6.72% of the control group). The difference between the test and control groups was statistically significant (P=.012). Thus it can be concluded that adding a screw hole in the metal framework significantly decreased the need for ISP refabrication. In the study group, most instances of refabrication consisted of remaking the veneering porcelain alone, as opposed to the control group, in which refabrication included remaking the metal framework (Table 1).

DISCUSSION

Cemented ISPs have become a predictable treatment alternative in patients with partial edentulism.[6,7] Over the years, mechanical complications may occur.[17] Porcelain fractures occur in 5.7% to 8.8% of the restorations,[18,19] and abutment screw loosening occurred in about 6% of the restorations.[20] Complications in cemented ISPs due to lack of retrievability may lead to refabrication.

Several authors have described techniques for retrieving cemented ISPs with minimal damage.[8-14] Doerr[9] described a technique that requires a clear, vacuum-formed screw location guide similar to a surgical guide. This guide marks the point of entry but not the exact path of drilling. The technique requires that the original implant and abutment level casts be retained.[9] Okamoto and Minagi[10] suggested preparing a cylindrical guide hole on the lingual surface of the abutment and an access hole on the lingual side of the superstructure. The removal of the superstructure from the abutment is achieved by inserting a removing driver into the guide hole through the access hole and turning the removing driver to generate a shear force to raise the superstructure. The shear force will cause the interim cement layer to fracture and enable removal of the superstructure from the abutment.[10] This technique is not applicable when interocclusal distance is limited. Chee et al[8] described a technique that uses threaded tubes that are incorporated into the restoration to direct retrieval screws parallel to the long axis of the abutment. When the restorations are cemented, activating the displacing screw against the abutment will break the cement seal and allow easy removal of the restoration.[8]

Table 1. Outcome parameters

Parameter	Porcelain Fracture		Screw Loosening		Refabrication		Total
	–	+	–	+	–	+	
Test							
N	257	17	265	9	271	3	274
%	93.8	6.2	96.72	3.28	98.55	1.45	100
Control							
N	110	9	115	4	111	8	119
%	92.4	7.6	96.64	3.36	93.28	6.72	100
Total							
N	367	26	380	13	382	11	393
%	93.4	6.6	96.7	3.3	97.21	2.79	100
P	.660		.859		.012		

This technique increases laboratory costs and might diminish esthetics if the access hole is visible. Valbao et al[12] described a technique of increasing the retention of a provisionally cemented restoration by creating a palatal light-polymerized resin lock that is easily removed if needed, avoiding spontaneous decementation,[12] similar to the technique described by Okamoto and Minagi,[10] adequate interocclusal distance is required. Schwedhelm and Raigrodski[14] suggested a technique that may facilitate the clinician's ability to locate the abutment screw access in the event of abutment screw loosening by marking it on the veneering porcelain. Here, similar to the technique of Doerr,[9] only the point of entry is marked; only after perforating the metal structure can one be sure that the drilling is accurate.

The present study evaluated a method that facilitates retrievability when complications occur. The presence of the metal screw hole in the ISP allows the clinician to ensure accurate drilling through the veneering porcelain to locate the screw access hole, thus minimizing the access hole within the porcelain and improving its strength and esthetics.

Takeshita et al[21] found that screw-retained ISPs were less fracture resistant than cemented ones. Based on these findings, an in vitro study was conducted comparing the occurrence of chipping fractures on the occlusal surface of screw- and cement-retained ceramic veneered ISPs under dynamic loading. Significantly more chipping fractures occurred in screw-retained than in cemented ISPs.[16,22] From the aspect of porcelain fracture, the present study shows no statistically significant difference between the 2 groups (P=.619). The number of porcelain fractures, 6.2% in the test group and 7.6% in the control group, resulting in an overall of 6.6%, coincides with reports in the published research of 5.7% to 8.8% of porcelain fractures in ISPs during a follow-up period of 5 years.[18,19]

Screw loosening is a challenging prosthetic complication of cement-retained implant-supported restorations, ranging from 3% to 25%.[22-28] Screw loosening is rare in single implant restorations, regardless of the implant abutment connection geometry, provided that proper antirotational features and torque are used. Screw loosening occurs in less than 3% of single implant restorations.[23] Goodacre et al,[20] in a review article, reported 6% abutment screw loosening and 2% abutment screw fractures. The average loosening with implant single crowns that used early screw designs was 25%. When the data from 6 recent studies were combined, the mean incidence was 8%, indicating substantial improvement with new screw designs; 4% was recorded with implant fixed partial dentures. According to Jung et al,[24] after 5 years, the cumulative incidence of screw or abutment loosening was 12.7%. From this aspect, 1 study[27] reporting on single crowns on Nobel Biocare implants tightened with gold screws was a clear outlier. If this study is excluded from the analysis, the cumulative incidence is reduced to 5.8%, similar to the incidence of another 5-year study[25] of ISP complications.

Screw loosening can cause the development of granulation tissue between the loose abutment and the implant, leading to fistulae formation and infection of the soft tissue. In addition, loose screws are more apt to fracture under load, leading to long-term prosthesis complications.[26] When a screw is tightened, a tensile force (preload) is built up in the stem of the screw. This preload creates a clamping force between the abutment and implant. The closer the tightening force approaches the recommended force for any particular screw, the more stable the connection will be. Thus, the design of the head and body of the screw is significant and should allow a maximum of torque to be introduced in the stem of the screw. The design of the screw head, screw material, and tightening force are important parameters for screw joint stability. The clamping load must be greater than the separating forces to keep screws tight.[28]

Screw loosening occurred in the present study in 3.3% of the restorations (3.28% in the test group versus 3.36% in the control group (P>.05). These results are similar to published values (3% to 6% of screw loosening).[23-28] Consequently, it can be concluded that the presence of an occlusal hole of 0.6 mm in diameter in the metal framework does not increase the risk for porcelain fracture or abutment screw loosening.

The purpose of the occlusal hole of 0.6 mm in diameter in the metal framework was to improve the survival of cemented ISPs by improving retrievability. In the test group, 1.45% of ISPs needed refabrication versus 6.72% in the control group. This difference was found to be statistically significant (Table 1). Published reports suggest a survival rate of 95.4% for ISPs after 5 years and 92.8% after 10 years,[25] suggesting a need for refabrication in 4.6% to 7.2% of prostheses, a similar refabrication rate to that of the control group. In the study group, most instances of refabrication consisted of remaking the veneering porcelain alone due to the retrievability of the

restoration, as opposed to the control group, in which the refabrication included remaking the metal framework due to the lack of retrievability, which required more appointments and additional treatment cost.

In the present study, the access hole was made only if it was located on the occlusal table. It would be interesting to see if this technique offers a viable solution in situations where the access hole is located off center, on one of the cusps or on the lingual or buccal aspect of a restoration (on posterior teeth where esthetic considerations do not contraindicate it). In such prostheses, locating and accessing the abutment screw is more complicated, and with conventional cemented restorations, screw loosening often means refabrication. Further research is needed to fully appreciate the advantage of the screw access hole in the metal framework technique.

CONCLUSIONS

Within the limits of this retrospective clinical study, preparing cemented ISPs with a screw access hole in the metal framework improved ISP survival rates and lowered the cost of maintenance without increasing the risk for porcelain fracture or screw loosening.

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