

Prosthodontic Complications in a Prospective Clinical Trial of Single-stage Implants at 36 Months

Jacqueline P. Duncan, DMD, MDSc¹/Elena Nazarova, DMD, PhD²/Theodora Vogiatzi, DDS¹/
Thomas D. Taylor, DDS, MSD³

Purpose: The present material reports on prosthodontic complications in a trial of 51 patients with prostheses supported by single-stage implants over a period of 36 months. **Materials and Methods:** One hundred eighty-six single-stage implants were placed in 51 patients over a 3-year period in 2 carefully controlled prospective clinical trials. Nineteen of the patients (103 implants) were completely edentulous and restored with a maxillary complete denture and a mandibular fixed-detachable complete prosthesis. Single metal-ceramic crowns or fixed partial dentures were fabricated for the remaining 32 patients (83 implants). The fixed restorations were either screw-retained or cemented. **Results:** All patients/implants were followed for a minimum of 3 years. Complications in the edentulous patients included fracture of denture teeth, fracture of the maxillary denture, and occlusal screw loosening. Occlusal screw loosening and loss of the resin composite access plug were the only complications observed in the patients treated with screw-retained restorations. No complications were found in the patients restored with cemented restorations on solid abutments. **Discussion:** Problems with prostheses were very common in the completely edentulous patients (13 of 19 patients encountered complications), possibly a result of increased bite force or inadequate laboratory technique. Tooth fractures were seen more frequently in men than in women. Complications occurred in only 5 of the 32 partially edentulous patients. **Conclusion:** Complications were associated with laboratory-related procedures rather than the implant system itself. (INT J ORAL MAXILLOFAC IMPLANTS 2003;18:561–565)

Key words: dental implants, dental prosthesis repair, denture design, endosseous dental implantation, implant-supported dental prosthesis

Implant osseointegration and successful restoration with a prosthesis are accepted as positive outcomes for implant therapy. Prosthodontic complications of a technical or mechanical nature may compromise these outcomes to varying degrees. Several authors have documented prosthodontic complications with different implant systems. The types of complications are the same throughout, but the frequency differs with each study.^{1–4}

The most common complication reported in the literature is loosening or fracture of abutment and occlusal screws. Some authors found that the rate of abutment screw loosening or fracture exceeds that of the occlusal screw, but the frequency of problems with occlusal screws was also high.^{1,5–11} The prosthesis-retaining (occlusal) screw is intended to be the weak point of the implant/abutment/prosthesis assembly. Some believe that this “weak link” is a design feature that allows failure of the less critical occlusal screw before the abutment or implant is stressed to the point of failure.^{2,4,12}

Various types of prosthesis fractures have been reported throughout the literature. Acrylic resin fractures of either single denture teeth or entire denture bases have been documented.^{1,4,13} Porcelain veneers have fractured on metal frameworks. Metal framework fractures have been attributed to inadequate metal thickness, excessive cantilever length, alloys with inadequate strength, or improper framework design.¹²

Complications during maintenance of implant-supported prostheses have considerable clinical and

¹Assistant Professor, Department of Prosthodontics and Operative Dentistry, University of Connecticut School of Dental Medicine, Farmington, Connecticut.

²Assistant Clinical Professor, Department of Prosthodontics and Operative Dentistry, University of Connecticut School of Dental Medicine, Farmington, Connecticut.

³Professor and Head, Department of Prosthodontics and Operative Dentistry, University of Connecticut School of Dental Medicine, Farmington, Connecticut.

Reprint requests: Dr Jacqueline P. Duncan, Department of Prosthodontics and Operative Dentistry, University of Connecticut School of Dental Medicine, Farmington, CT 06030-1615. Fax: 860-679-1370. E-mail: jduncan@nso2.uchc.edu

Table 1 Prosthetic Complications Observed in the 19 Patients Treated with a Maxillary Complete Denture and a Mandibular Fixed-Detachable Full-Arch Implant-Supported Prosthesis

Sex	Age	Time of complication (mo)					
		3	6	12	18	24	36
F	69				24 (31) fx CD crack OS loose		25, 31 (41, 47) fx
F	59						
M	50			10 (22) fx			CD fx
F	67					23,24,27 (32, 31, 43) fx	
M	60			19 (36) fx CD fx			25 (41) fx 8 (11) chip
M	61	18, 22 (37, 33) fx		25 (41) fx		21 (34) chip	30 (46) fx
M	60		24 (31) fx	24 (31) fx	24 (31) fx		24 (31) fx
F	67						
M	46				11 (23) chip		CD fx
M	51						26 (42) fx
F	65						
M	79						
M	69						CD fx
M	60					CD fx 10 (22) fx	
F	62					6 (13) fx	
M	64				27 (43) fx	24 (31) fx OS loose	26 (42) fx
M	61					19 (36) fx	
F	52						
F	68						

Tooth numbers refer to the relative tooth position on either the maxillary or mandibular prosthesis. Number systems are Universal (FDI).
fx = fracture; OS = occlusal screw; CD = complete denture.

laboratory implications. It is important for the practitioner who uses implants to have an understanding of the type and frequency of complications that may arise. This article describes the prosthodontic complications found in a group of 51 patients restored with either single crowns, fixed partial dentures, or mandibular fixed-detachable complete cantilever prostheses on single-stage, non-submerged ITI implants (Straumann USA, Waltham, MA). These patients were part of larger multicenter prospective clinical trials evaluating the efficacy of this implant system.

MATERIALS AND METHODS

One hundred eighty-six single-stage implants were placed in 51 patients over a 3-year period. Nineteen of the patients (103 implants) were completely edentulous and were restored with a maxillary complete denture and a mandibular fixed-detachable prosthe-

sis. Single metal-ceramic crowns or fixed partial dentures were fabricated for the remaining 32 patients (83 implants). The fixed restorations were either screw-retained (42 implants) or cemented (41 implants) with zinc phosphate. The study population is detailed in Tables 1 and 2 (raw data).

Clinical examinations were performed at 3, 6, 12, 18, 24, and 36 months from the initial loading of the implants. Periapical radiographs of the implants and adjacent teeth were taken at all visits. In addition, the following information was collected: bleeding on probing, plaque score, probing depths of adjacent teeth, width of attached gingiva relative to the implant shoulder, and location of the gingival margin relative to the implant shoulder.

The occlusal and functional aspects of the prostheses were also recorded, including: Angle classification of occlusion; canine guidance, group function, or bilateral balance; presence of bruxism; anterior vertical and horizontal overlap (where appropriate); and cantilever length (where appropriate).

Table 2 Prosthetic Complications Observed in the 32 Patients Treated with a Fixed Prosthesis That Were Either Screw-retained (Octa Abutment) or Cemented (Solid Abutment)

Sex	Age	Implant location	Abutment type	Prosthesis type	Time of complication (mo)					
					3	6	12	18	24	36
M	21	8, 9 (11, 21)	Octa	Single PFMs						
M	59	7, 8, 9, 10 (12, 11, 21, 22)	Octa	Single PFMs		7 (12) OS loose				
M	34	9 (21)	Octa	PFM					OS loose	
F	45	8, 9 (11, 21)	Octa	PFM						
F	30	6, 11 (13, 23)	Octa	2 FPDs mesial cantilevers						
F	41	8 (11)	Octa	PFM						
M	76	18, 19, 30, 31 (37, 36, 46, 47)	Octa	2 PFM FPDs						
F	49	18, 19, 30, 31 (37, 36, 46, 47)	Octa	2 PFM FPDs						
F	40	2, 5, 13, 15 (17, 14, 25, 27)	Octa	2 PFM FPDs		13, 15 (25, 27) OS loose				
F	39	18, 20, 28, 29 (37, 35, 44, 45)	Octa	2 PFM FPDs						
F	40	3, 4 (16, 15)	Octa	PFM FPD						No show
F	76	18, 19, 20 (37, 36, 35)	Octa	PFM FPD mesial cantilever						Composite out of access hole
F	49	18, 20, 30, 31 (37, 35, 46, 47)	Octa	2 PFM FPDs						
M	70	18, 20, 28, 30, 31 (37, 35, 44, 46, 47)	Octa	2 Gold FPDs		18, 20 (37, 35) OS loose		28, 30, 31 (44, 46, 47) OS loose		
F	39	8, 9 (11, 21)	Solid	Single PFMs						
F	23	7 (12)	Solid	PFM						
F	37	11 (23)	Solid	PFM						
M	40	7, 9 (12, 21)	Solid	PFM FPD						
F	40	8, 9 (11, 21)	Solid	Single PFMs						
M	41	8 (11)	Solid	PFM						
M	28	8, 10 (11, 22)	Solid	PFM FPD						
F	46	11 (23)	Solid	PFM						
M	30	10 (22)	Solid	PFM						
F	50	8, 9 (11, 21)	Solid	Single PFMs						
F	28	10 (22)	Solid	PFM						
M	68	7, 8, 9, 10 (12, 11, 21, 22)	Solid	Single PFMs						
F	33	8, 9 (11, 21)	Solid	Single PFMs						
F	21	7, 8, 9 (12, 11, 21)	Solid	Single PFMs						
F	39	11 (23)	Solid	PFM						
M	59	19, 20, 21, 28, 30 (36, 35, 34, 44, 46)	Solid	2 PFM FPDs						
M	40	2, 3, 19, 20, 29, 30 (17, 16, 36, 35, 45, 46)	Solid	3 PFM FPDs						
F	50	18, 19, 30, 31 (37, 36, 46, 47)	Solid	2 PFM FPDs 1 with mesial cantilever						

Tooth numbers are Universal (FDI).

PFM = porcelain-fused-to-metal prosthesis; FPD = fixed partial denture; OS = occlusal screw.

RESULTS

All patients were available for all follow-up appointments, with 1 exception. One patient, accounting for 2 implants and 1 screw-retained prosthesis, did not present for the 36-month follow-up. Data were collected for the remaining 184 implants. No implant failures resulting from loss of osseointegration or “peri-implantitis” were observed at 36 months post-loading. Additionally, no soft tissue complications were noted regardless of whether the prosthesis was cement-retained or screw-retained (this includes both metal-ceramic restorations and fixed-detachable mandibular restorations).

Completely Edentulous Patients

Nineteen patients (11 men and 8 women) were treated with a maxillary complete denture and mandibular fixed-detachable prosthesis. The mean age was 61.6 years (range, 46 to 79). All 103 implants were restored with screw-retained prostheses. Prosthodontic complications were recorded for 13 of these patients (10 men and 3 women). The complications included 5 fractured maxillary complete dentures, 22 fractured denture teeth on either the maxillary or mandibular prosthesis, and 2 loose occlusal screws (Table 1).

Partially Edentulous Patients

Twelve men and 20 women were treated with either single metal-ceramic crowns or fixed partial dentures. The mean age was 43.2 years (range, 21 to 76). Screw retention was used in 14 patients (5 men and 9 women). These implants were restored with 12 single metal-ceramic crowns and 16 fixed partial dentures (2 of which were cantilevers). Cemented restorations were placed in the remaining 18 patients (7 men and 11 women). Twenty-two single metal-ceramic crowns and 9 fixed partial dentures (including 1 cantilever) were used to restore the implants in these patients.

Occlusal screw loosening and loss of the resin composite screw access plug were the only complications noted in 5 of the 14 patients restored with screw-retained prostheses. No complications were recorded for any of the patients in whom restorations had been cemented on solid abutments (Table 2).

DISCUSSION

Fixed-Detachable Prostheses

Sixty-eight percent of the patients treated with a fixed-detachable prosthesis encountered complications. Denture tooth fracture accounted for the majority of complications, with most occurring on the mandibular prosthesis (17 mandibular, 5 maxil-

lary). Additionally, anterior teeth fractured more frequently than posterior teeth (5 posterior, 17 anterior). Repeated fractures of the same tooth were seen in 1 patient. All repairs except 1 were done in the laboratory with acrylic resin to reattach the existing tooth (if intact) or replace the tooth if completely missing. Five complete maxillary dentures cracked or completely fractured.

The high incidence of denture tooth fracture may be the result of the patient's ability to exert greater force during function. Maximum biting forces for patients with maxillary and mandibular complete dentures have been reported in the range of 8 to 12 N,¹⁴ while a maxillary complete denture opposing a mandibular implant-supported fixed-detachable prosthesis can exert between 140 and 330 N.^{15,16} The maximum biting force increases substantially in patients provided with an implant-supported mandibular prosthesis.¹⁷

A combination of factors may account for the higher number of anterior tooth fractures compared to posterior teeth. First, the fixed mandibular prosthesis allows the patient to incise food more easily than with a complete mandibular denture. Incising places unfavorable shearing forces on anterior denture teeth, unlike the more vertical compressive occlusal forces on posterior teeth. Additionally, there is a greater surface area on the posterior denture tooth for bonding to the denture base.

Inadequate laboratory technique may also have been responsible for the high occurrence of tooth fractures observed. The tendency for tooth fracture became apparent approximately 1 year after the delivery of the initial prostheses. At this point, treatment had been completed on 75% of the patients in this group. For the remaining 25%, the laboratory technique was modified by creating mechanical retention in the denture teeth prior to final packing of the acrylic resin. This modification did not result in a reduction in complications. Four of the 5 patients who received this modified laboratory approach had complications consistent with the other patients in the group.

It is also interesting to note that of the 11 male patients with fixed-detachable full-arch prostheses, 10 presented with complications, while only 3 of the 8 female patients experienced prosthetic difficulties. Four of the 5 fractured dentures were seen in male patients. Greater biting forces have been documented for men when compared to women.¹⁸ This may account for the higher number of fractures seen with the male patients.

Screw tightness was not checked at all recall visits, since the screw access holes were sealed with resin after delivery of the prosthesis. Two screws

were found loose coincident with denture tooth fracture. This could lead one to consider how frequently occlusal screws might be found loose if checked routinely.⁷ One should also consider whether a relationship might exist between the fracture of denture teeth and looseness of the screws.

Cemented and Screw-retained Restorations

Four of the 14 patients restored with screw-retained restorations presented with loose occlusal screws. Two of these patients presented more than once. Either the patient or the clinician noted mobility of the restoration, which led to removal of the resin composite plug and tightening of the occlusal screw. Only 1 patient had lost the resin composite plug completely and needed replacement.

No complications were encountered in the patients treated with cemented restorations on solid abutments. This group, like the screw-retained group, included single crowns and fixed partial dentures.

Retrievability is considered one of the significant benefits of screw-retained restorations; however, the clinical and laboratory procedures are more complicated and expensive than cemented restorations on solid abutments. This study and at least one other⁹ have shown a higher incidence of complications with screw-retained restorations. One must weigh the advantages and disadvantages of the 2 treatment modalities and decide what best fits his or her practice.

Loss of osseointegration has been described as both a surgical and prosthodontic complication, with the rationale that if an implant is lost, it has direct bearing on the prosthesis it is supporting (ie, it must be modified or remade). A survival rate of 100% was recorded in this group of 184 implants through 3 years post-loading. In fact, other than occlusal screw loosening, all complications in this study were related to the prosthesis rather than to any implant components.

CONCLUSION

As with most aspects of clinical dentistry, complications are likely to arise as the time in service of a prosthesis lengthens. This article provides a preliminary review of the complications found in the study groups presented. The number and type of complications could be different at the 5- or 10-year mark. The data at those landmarks will be presented when available.

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