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Technical complications with implant-supported dental prostheses

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Abstract: Studies are needed to determine the prognosis of different forms of dental prosthetic rehabilitation and the main complications involved. The purpose of the present study was to evaluate technical complications involving implant-supported prostheses. A retrospective one time snap-shot study was carried out with a total of 509 implants in 153 patients. Prosthetic conditions were determined by clinical and radiographic examination. The least frequent technical complication involved fracture (0.2%), loss (0.4%) and loosening (3.3%) of the screw. The most frequent complications were loss of resin covering the screw (23.8%), loss of overdenture retention (18.6%) and fractures of the resin (12.4%). A high frequency of misfit between the prosthesis and abutment (25.4%) was found, which was significantly associated ($P < 0.05$) with other variables, especially cemented prostheses ($P < 0.001$). To minimize the frequency of complications, protocols must be established from diagnosis to the completion of treatment and follow up of implant-supported prostheses, especially in terms of adequate technical steps and careful radiographic evaluation of the components.
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Keywords: dental prosthesis; implant-supported; survival analysis; dental implantation.

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Introduction

The most common complications that occur during treatments involving implants are mechanical. The combination of implant-bone anchoring, the attachment of prosthetic components with screws, and the dynamics involved result in a complex load with frequent loosening and fracture of the components of the implant supported prostheses. Design characteristics of the prostheses and implants, the materials employed and biomechanical issues all exert an important influence on the outcome of these prostheses (1). The main technical complications occurring with implant-supported prostheses, which can lead to failure or the need for repairs, are screw fracture, screw loss, loss of resin covering the screw, fracture of the metallic, resin or porcelain structure and loss of overdenture retention (2-6).

While the literature reports that implant-supported prostheses constitute a safe, predictable treatment method with high success rate, technical and biological complications can occur (2,5,7). However, there is no consensus in the dental literature on the different types of complications found in implant-supported prostheses. The purpose of the present study was to evaluate technical complications involving implant-supported prostheses.

Materials and Methods

The present observational retrospective study was approved by the Human Research Ethics Committee of the Universidade Federal do Rio Grande do Norte, Brazil as Process No. 024/211 (Protocol 186/10-P). Participants were recruited from the Department of Dentistry of the University. Patients treated with dental implants between

Table 1 Characteristics of the sample

Variable		*n*	%
Prosthesis	Temporary	28	5.5
	Definitive	481	94.5
Type of prosthesis	Single-crown	196	38.5
	Overdenture	87	17.1
	Bone anchored complete denture	70	13.8
	Fixed partial denture	156	30.6
Location of prosthesis	Anterior	102	20.0
	Posterior	253	49.7
	Not applicable	154	30.3
Type of material	Resin	186	36.5
	Metalloceramic	323	63.5
Type of occlusion	Physiological	334	65.7
	Malocclusion	175	34.3
Attachment	Cement	115	22.6
	Screws	307	60.3
	Bar clip	70	13.8
	O-ring	17	3.3
Loosening of screw	No	492	96.7
	Yes	17	3.3
Screw fracture	No	508	99.8
	Yes	1	0.2
Screw loss	No	507	99.6
	Yes	2	0.4
Structural fracture	No	467	98.5
	Yes	7	1.5
Resin fracture	No	163	87.6
	Yes	23	12.4
Porcelain fracture	No	306	94.7
	Yes	17	5.3
Loss of retention	No	70	81.4
	Yes	17	18.6
Loss of resin covering screw	No	138	76.2
	Yes	43	23.8
Abutment/implant misfit	No	474	93.1
	Yes	35	6.9
Abutment/prosthesis misfit	No	315	74.6
	Yes	107	25.4
Previous repair	No	399	78.4
	Yes	110	21.6

the years 2000 and 2011 at the Federal University of Rio Grande do Norte and those who had received prostheses in private dental surgeries were included. The individuals in whom prostheses were fitted less than six months before the time of examination were excluded.

The sample size was calculated based on a 5% level of statistical significance and an 80% power to detect an odds ratio of 2.0. Due to the variability in prevalence rates of failure reported in different studies, a rate of 26.0% was considered based on the study by Pjetursson et al. (7). With an increase of 10% to compensate for possible losses, the minimum sample was determined to be 250 cases. However; the sample was increased to include all implants in the population studied (n = 509).

An intraoral examination was performed using a clinical probe and mouth mirror without removing the fixed prostheses (nor the screw) and the following aspects were recorded: location of prosthesis (anterior/posterior), type of prosthesis (single crown, fixed partial denture, bone anchored complete denture, overdenture), type of bite (physiological occlusion/malocclusion), type of attachment (screws, cement, barclip or O-ring), screw (loosened, lost or fractured), presence of screw protection material, fracture of resin, porcelain or metal structure, loss of overdenture retention mechanism, and need for previous repair.

Table 2 Association between abutment/prosthesis misfit and independent and confounding variables

		Abutment/prosthesis misfit					
		No		Yes			
Variable		*n*	%	*n*	%	Unadjusted OR (95% CI)	*P*
Type of prosthesis	Single-crown	143	73.0	53	27	–	0.004
	Bone anchored complete denture	63	90.0	7	10		
	Fixed partial denture	109	69.9	47	30.1		
Attachment	Screw	107	93.0	8	7.0	6.36 (2.98-13.57)	0.000
	Cement	208	67.8	99	32.2		
Age group	Up to 50 years	87	73.1	32	26.9	–	0.108
	51 to 60 years	140	80.9	33	19.1		
	61 years or older	105	71.4	42	28.6		
Gender	Male	96	87.3	14	12.7	2.70 (1.46-4.97)	0.001
	Female	236	71.7	93	28.3		
Duration of use	Up to 2 years	120	76.9	36	23.1	1.11 (0.70-1.76)	0.638
	3 years or more	212	74.9	71	25.1		
Location of prosthesis	Anterior	73	70.9	30	29.1	0.93 (0.56-1.54)	0.781
	Posterior	183	72.3	70	27.7		
Previous repair	No	268	77.9	76	22.1	1.70 (1.03-2.81)	0.034
	Yes	64	67.4	31	32.6		

Standardized periapical radiographs were obtained using a film-positioning device to evaluate the fit between the implant platform and abutment and between the prosthesis and abutment. The misfit was recorded based on an image of discontinuity between these components. The standard misfit was 150 µm (8). When a misfit image was observed; the misfit was measured by means of a digital paquimeter.

Data were analyzed using the Statistical Package for Social Sciences; version 19.0 for Windows. Bivariate analysis was performed to determine possible associations between misfit and the independent variables using either the chi-square test and Yates' correction for continuity or Fisher's exact test (when appropriate) and respective unadjusted odd ratios (OR). Multivariate analysis was performed using binary logistic regression models to determine the predictor effect of the independent variables, associated with the misfit between the prosthesis and abutment. The "enter" method was used to incorporate the variables into the models, based on the established level of significance ($P < 0.10$). In all analyses, a standard *P*-value of 0.05 was considered significant.

Results

One hundred and fifty three patients (31 men and 122 women; mean age: 56.7 ± 10.8 years) were included in the present investigation. The total sample involved 509 implants (116 [22.8%] in men and 393 [77.2%] in women). The most frequent implant sites were 36 (8.4%); 46 (7.1%) 45 (5.9%) and 21 (5.5%) regions. Table 1 displays the characteristics of the sample.

The complications related to screws occurred in less than 3.4% of the cases. Low rates of structural fracture were also found, where the most frequently fractured material was the resin (12.4% of cases). The need for repair occurred in 21.6% of cases, most frequently due to loss of overdenture retention and release of screw-protection material. With regard to radiographic complications, misfits between prosthesis/abutment occurred in 25.4% of the cases and the prevalence of misfit between implant/abutment was 6.9%.

Table 2 displays the results of the bivariate analysis of the association between prosthesis/abutment misfit and both the independent and confounding variables. Significant associations were found between misfit and the type of prosthesis ($P = 0.004$); type of attachment ($P < 0.001$); patient gender ($P = 0.001$) and previous repair ($P = 0.03$). These results indicate that the misfit was more common in single crowns and fixed partial denture than in bone anchored complete denture, and in prostheses that had undergone previous repairs. Considering the attachment type, misfits were more frequent in cemented prostheses. Moreover, results indicated that the misfit was more prevalent in women.

Table 3 displays the results of the bivariate analysis of the association between implant/abutment misfit and both the independent and confounding variables. No statistically significant associations were detected ($P > 0.05$).

Table 4 displays the results of the bivariate analysis of the association between prosthesis/abutment misfits

Table 3 Association between abutment/implant misfit and independent and confounding variables

		Abutment/prosthesis misfit					
		No		Yes			
Variable		*n*	%	*n*	%	Unadjusted OR (95% CI)	*P*
Attachment	Screw	108	93.9	7	6.1	1.30 (0.54-3.12)	0.544
	Cement	283	92.2	24	7.8		
Age group	Up to 50 years	113	90.4	12	9.6	–	0.236
	51 to 60 years	182	95.3	9	4.7		
	61 years or older	179	92.7	14	7.3		
Gender	Male	110	94.8	6	5.2	1.46 (0.59-3.60)	0.409
	Female	364	92.6	29	7.4		
Duration of use	Up to 2 years	170	93.9	11	6.1	1.22 (0.583-2.55)	0.597
	3 years or more	304	92.7	24	7.3		
Location of prosthesis	Anterior	94	91.3	9	8.7	0.70 (0.30-1.65)	0.419
	Posterior	237	93.7	16	6.3		
Previous repair	No	367	92.0	32	8.0	0.32 (0.97-1.07)	0.52
	Yes	107	97.3	3	2.7		

Table 4 Association between abutment/prosthesis misfit and type of prosthesis

		Abutment/prosthesis misfit					
		No		Yes			
Variable		*n*	%	*n*	%	Unadjusted OR (95% CI)	*P*
Single/partial	Single-crown	143	73.0	53	27.0	1.16 (0.73-1.85)	0.523
	Fixed partial denture	109	69.9	47	30.1		
Fixed total/partial	Bone anchored complete denture	63	90.0	7	10.0	3.88 (1.65-9.10)	0.001
	Fixed partial denture	109	69.9	47	30.1		

Table 5 Final binary regression model for abutment/prosthesis misfit

Variable	OR	95% CI		*P*
Gender				
Male	1			
Female	2.9	1.47	5.01	0.001
Attachment				
Screw	1			
Cement	5.39	2.91	13.5	<0.001
Single-crown/Bone anchored complete denture				
1	1			
0	3.52	1.49	8.26	0.004

P = 0.44; Hosmer-Lemeshow test

and different types of prosthesis. Significant associations were found between misfit and both single crown/bone anchored complete denture ($P = 0.003$) and bone anchored complete denture/fixed partial dentures ($P = 0.001$), corroborating the belief that misfits were more common in single crowns and fixed partial dentures than in bone anchored complete denture.

Table 5 displays the results of the final binary logistic regression model for prosthesis/abutment misfit. A cemented prosthesis had a 5.39 greater chance of presenting misfit. The female gender was associated with a 2.9 greater chance of misfit. Furthermore, a single crown exhibited a 3.52 greater chance of misfit in comparison to bone anchored complete denture.

Discussion

Among the total of 509 implants, the least frequent technical failures were related to the attachment screw. These rates are lower than those reported in the literature (2-6), possibly due to the cross-sectional study design, which only demonstrates the status of the prostheses at the time of examination without considering the number of previous repairs (21.6%). Such repairs often involve tightening or replacing the attachment screw.

Systematic reviews and meta-analyses report structural fractures to be one of the major technical complications (5-7), with rates as high as 66%, which may be explained by the period of time in which the prostheses were evaluated (10 to 15 years). As the present study considered the period of prosthesis use from one to eleven years (mean: 4 years), the time factor may have exerted an influence on the prevalence rate of this type of complication (6).

The rate of loss of the resin covering the attachment screw was lower than the rate reported in a systematic review (45.8%) (6), perhaps due to the 10-year period considered in the study. This is one of the frequent types of complications and may account for a large portion of previous repairs. Thus, the rate of resin loss may be underestimated in a cross-sectional evaluation in which previous repairs are not taken into account. None of the studies addressed this aspect.

Regarding overdentures, the most common type of complication was the loss of retention, which is in agreement with findings reported in the literature stating that the need for maintenance is much greater in the first year with regard to post-placement adjustments and maintenance of the components (9). Problems such as loosening, loss or fracture of retention clips constitute the main reasons for overdenture repairs (2). Wear or fracture of the ball-type abutment seems to be less frequent, but the replacement of rubber O-rings is recommended every one or two years, depending on the number of implants. The need for maintenance is related to the duration of prosthesis use (9). Moreover, patients must be informed of this need during the planning of treatment.

The misfit between the abutment and implant and between the abutment and prosthesis has not been reported in previous studies. A misfit between the implant and abutment can lead to both biological and mechanical problems. Biological problems involve the presence of bacteria in the apical portion of the abutment screw, which could affect the health of the tissues surrounding the implant over the long term (8). Mechanical problems are related to micro-movements and the possible loss or fracture of the abutment attachment screws, as well as the rotation or fracture of the abutment (10-13). Thus, a misfit can trigger the occurrence of other complications.

In bone anchored complete denture, the cause of the misfit between the prosthesis and abutment is multifactorial. Distortions may occur in different dimensions and may be caused by one or more of the following factors: implant alignment, casting materials and techniques, manufacturing process of the metallic structure, design of the metallic structure and the clinical and technical experience of the dental professionals regarding the execution of the procedures and evaluation of passivity. Different casting techniques, verification jigs, low-fusion metals and metallic structures formed in sections have been suggested to minimize the occurrence of misfits due to the fabrication of the structures. Forming sections and soldering structures can minimize discrepancies, but may not assure passive adaptation (10). Although there is no consensus regarding the degree of clinically-acceptable misfit (13), a fit which is not capable of causing any complication in the long term is defined as passive. It has been suggested that misfits smaller than 150µm are acceptable (8).

A tactile and visual inspection does not seem to be sufficient for the evaluation of misfit, especially when the location is subgingival. Moreover, a misfit of up to 500 µm may not be seen in this type of examination. Therefore, radiographs are routinely used to examine the fit of implant components, particularly when the interfaces are not easily visible. For this examination, a periapical radiograph is recommended (10). The observation of the interfaces of prosthetic components in a periapical radiograph is considered to be reliable when the opposing surfaces are parallel to the x-ray beam, so that a vertical misfit can be detected (14,15). A misfit of 12 µm can be identified up to a five-degree angle and a misfit of 190 µm can be seen up to a 15-degree angle. A change in the angle can result in an incorrect diagnosis and lead to the belief that the fit is fine (16). The high misfit rate between the prosthesis and abutment in the present study may be the result of complications during the technical and laboratory steps of the prosthetic fabrication process, cementing process or due to the lack or improper use of the radiographic technique.

The binary logistic regression revealed that cemented prostheses had a greater risk of misfit in comparison to screw-attached prostheses. This is in disagreement with findings reported in the literature that state that discrepancies in the fit between a prosthesis and abutment can be overcome by the use of a bonding agent, thereby conferring greater stability to the set of components (17). It should be stressed that the abovementioned studies are laboratory studies (13,18) and bonding in such cases is performed under ideal, pre-established conditions. A number of factors can affect the bonding of prostheses on both teeth and implants, such as the preparation of the abutment, the taper of the abutment, surface area, surface roughness, type of cement and experience of the dentist (19). Thus, clinical conditions are believed to be different from laboratory conditions, which can affect the outcome.

A greater risk of misfit was found for single-crown

prostheses in comparison to bone anchored complete denture. This may be explained by the fact that most single crowns were cemented (87.8%) and cemented prostheses had a greater risk of misfit in the present study. In contrast, all bone anchored complete denture were attached with screws.

Even after controlling for gender, females had a greater risk of prosthesis/abutment misfit. There are no data reported in the literature that may explain this finding. The present results underscore the importance of adequate follow up of prostheses to determine technical flaws and for the execution of repairs, as these alterations may trigger biological complications or another type of technical complication that may render repair impossible, leading to the need to replace components of the implant/abutment/prosthesis. Considering the sample evaluated, we may conclude that to minimize the frequency of complications in implant-supported prostheses, protocols should be established from diagnosis to the completion of treatment, and regular follow up must be ensured.

References

1. Carr AB (1998) Successful long-term treatment outcomes in the field of osseointegrated implants: prosthodontic determinants. Int J Prosthodont 11, 502-512.
2. Walton JN, MacEntee MI (1994) Problems with prostheses on implants: a retrospective study. J Prosthet Dent 71, 283-288.
3. Kreissl ME, Gerds T, Muche R, Heydecke G, Strub JR (2007) Technical complications of implant-supported fixed partial dentures in partially edentulous cases after an average observation period of 5 years. Clin Oral Implants Res 18, 720-726.
4. Jung RE, Pjetrusson BE, Glauser R, Zembic A, Zwahlen M, Lang NP (2008) A systematic review of the 5-year survival and complication rates of implant-supported single crowns. Clin Oral Implants Res 19, 119-130.
5. Bozini T, Petridis H, Tzanas K, Garefis P (2011) A meta-analysis of prosthodontic complication rates of implant-supported fixed dental prostheses in edentulous patients after an observation period of at least 5 years. Int J Oral Maxillofac Implants 26, 304-318.
6. Papaspyridakos P, Chen CJ, Chuang SK, Weber HP, Gallucci GO (2012) A systematic review of biologic and technical complications with fixed implant rehabilitations for edentulous patients. Int J Oral Maxillofac Implants 27, 102-110.
7. Pjetursson BE, Thoma D, Jung R, Zwahlen M, Zembic A (2012) A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years. Clin Oral Implants Res 23, Suppl 6, 22-38.
8. Jemt T, Book K (1996) Prosthesis misfit and marginal bone loss in edentulous implant patients. Int J Oral Maxillofac Implants 11, 620-625.
9. Payne AGT, Solomons YF (2000) The prosthodontic maintenance requirements of mandibular mucosa- and implant-supported overdentures: a review of the literature. Int J Prosthodont 13, 238-245.
10. Kan JYK, Rungcharassaeng K, Bohsali K, Goodacre CJ, Lang BR (1999) Clinical methods for evaluating implant framework fit. J Prosthet Dent 81, 7-13.
11. Yokoyama K, Ichikawa T, Murakami H, Miyamoto Y, Asaoka K (2002) Fracture mechanisms of retrieved titanium screw thread in dental implant. Biomaterials 23, 2459-2465.
12. Kano SC, Binon PP, Curtis DA (2007) A classification system to measure the implant-abutment microgap. Int J Oral Maxillofac Implants 22, 879-885.
13. de Torres EM, Barbosa GAS, Bernardes SR, de Mattos Mda G, Ribeiro RF (2011) Correlation between vertical misfits and stresses transmitted to implants from metal frameworks. J Biomech 44, 1735-1739.
14. Cameron SM, Joyce A, Brousseau JS, Parker MH (1998) Radiographic verification of implant abutment seating. J Prosthet Dent 79, 298-303.
15. Begoña Ormaechea M, Millstein P, Hirayama H (1999) Tube angulation effect on radiographic analysis of the implant-abutment interface. Int J Oral Maxillofac Implants 14, 77-85.
16. Sharkey S, Kelly A, Houston F, O'Sullivan M, Quinn F, O'Connell B (2011) A radiographic analysis of implant component misfit. Int J Oral MaxIliofac Implants 26, 807-815.
17. Karl M, Taylor TD, Wichmann MG, Heckmann SM (2006) In vivo stress behavior in cemented and screw-retained five-unit implant FPDs. J Prosthodont 15, 20-24.
18. Barbosa GAS, das Neves FD, de Mattos Mda G, Rodrigues RCS, Ribeiro RF (2010) Implant/abutment vertical misfit of one-piece cast frameworks made with different materials. Braz Dent J 21, 515-519.
19. Hebel KS, Gajjar RC (1997) Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. J Prosthet Dent 77, 28-35.