

Mechanical complications of implant-supported complete-arch restorations and impact on patient quality of life: A retrospective cohort study

Alba Sánchez-Torres, MS,^a Iñaki Cercadillo-Ibarguren, PhD,^b Rui Figueiredo, PhD,^c Cosme Gay-Escoda, PhD,^d and Eduard Valmaseda-Castellón, PhD^e

^aAssociate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^bAssociate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^c Associate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^dChairman and Professor of Oral and Maxillofacial Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; Director of the Master's Degree Program in Oral Surgery and Implantology (EFHRE International University/FUCSO), Belize City, Belize; Coordinator/Researcher, IDIBELL Institute, Barcelona, Spain; and Head of the Department of Oral Surgery, Implantology and Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.

^eProfessor of Oral Surgery, Professor of the Master's Degree Program in Oral Surgery and Implantology, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

Corresponding author:

Dr Rui Figueiredo

School of Medicine and Health Sciences

Campus de Bellvitge, University of Barcelona

Acknowledgments

This study was carried out by the Odontological and Maxillofacial Pathology and Therapeutics research group at the IDIBELL Institute. Mary Georgina Hardinge provided English language editing services.

JPD-19-159

CLINICAL RESEARCH

Mechanical complications of implant-supported complete-arch restorations and impact on patient quality of life: A retrospective cohort study

Alba Sánchez-Torres, MS,^a Iñaki Cercadillo-Ibarguren, PhD,^b Rui Figueiredo, PhD,^c Cosme Gay-Escoda, PhD,^d and Eduard Valmaseda-Castellón, PhD^e

^aAssociate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^bAssociate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^c Associate Professor of Oral Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

^dChairman and Professor of Oral and Maxillofacial Surgery, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; Director of the Master's Degree Program in Oral Surgery and Implantology (EFHRE International University/FUCSO), Belize City, Belize; Coordinator/Researcher, IDIBELL Institute, Barcelona, Spain; and Head of the Department of Oral Surgery, Implantology and Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.

^eProfessor of Oral Surgery, Professor of the Master's Degree Program in Oral Surgery and Implantology, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain; and Researcher, IDIBELL Institute, Barcelona, Spain.

ABSTRACT

Statement of problem. Mechanical complications (for example, fractures) in implant-supported complete-arch restorations may affect the social and professional activities of the patient.

However, most studies seem to overlook patient perceptions and generally do not assess the changes in the quality of life (QoL) of patients who experience these complications.

Purpose. The purpose of this retrospective cohort study was to assess the influence of technical or mechanical complications of complete-arch implant-supported prostheses on patient perception and QoL using the Oral Health Impact Profile (OHIP)-14.

Material and methods. A retrospective cohort study was formed of patients treated consecutively at a private clinic with immediately loaded complete-arch prostheses supported by a minimum of 4 implants (Replace Tapered; Nobel Biocare AB) and Multi-Unit conical abutments (Multi-Unit abutments; Nobel Biocare AB). OHIP-14 and questions regarding self-reported satisfaction were used to evaluate the influence of mechanical complications on QoL.

Results. Fifty-six participants (26 men and 30 women) with a mean age of 64 ± 11.1 years and 72 restored arches were included. The mean \pm standard deviation follow-up time was 52 ± 26 months. The prosthetic success rate was 38.8% and the survival rate was 100% (no failure was registered). The most common complications were abutment screw loosening (43%), chipping or fracture of the veneering material (25%), and screw loosening (21%). The OHIP-14 scores were close to zero, without differences between participants with or without mechanical complications. Overall, the participants reported that the prostheses allowed good oral hygiene (94.6%) and met their expectations (89%) and that they would repeat the treatment (87.5%) and would recommend it to others (93%).

Conclusions. Minor mechanical complications like screw loosening and chipping or fracture of the veneering material were frequent events but had no impact on the satisfaction and QoL of patients with immediately loaded complete-arch implant-supported prostheses.

CLINICAL IMPLICATIONS

Prosthetic mechanical complications are frequent and increase over time. The patients' quality of life and perception of the treatment outcome do not seem to be influenced by these issues. Thus, mechanical complications seem to have little influence on satisfaction levels.

INTRODUCTION

Historically, implant dentistry studies have used clinical and radiographic parameters as the main outcome variables, and asking for the perceptions of patients has been overlooked.¹⁻³ However, in recent years, these perceptions have started to be used to assess treatment outcomes.⁴

Some assessment tools such as Patient Reported Outcome Measures (PROMs) can play an important role in the evaluation of treatment results by reflecting the patients' subjective perceptions of their oral health status and its impact on everyday life and, hence, on their quality of life (QoL).^{5,6} Another such tool is the Oral Health Impact Profile (OHIP) questionnaire. This indicator of oral health-related QoL (OHRQoL) was designed to measure self-reported functional limitation, discomfort, and disability attributed to oral conditions⁶ and has been validated for completely edentulous patients.⁴ The value of this psychometric test relies on its validity and reliability, as these assessments are subjective in nature. These measurements are helpful in assessing treatment outcomes and also for analyzing how patients perceive the need for implant treatment.⁵

Currently, the data on the influence of mechanical complications on the QoL of patients are limited.⁷ In addition, mechanical or technical complications related to implant-supported restorations have often been incompletely reported.⁸⁻¹⁰ Most studies have classed the prosthetic outcomes as survival (the prostheses continue to function until the last follow-up) or failure.¹¹⁻¹⁵ However, information on minor complications such as veneering material fracture or screw loosening is scarce. According to a recent systematic review,¹⁶ technical complications appear progressively over the years. Although they do not compromise the survival of the implants or prostheses in most situations, many of these complications require unscheduled visits, which are obviously considered drawbacks by both patients and clinicians.

The purpose of this retrospective clinical study was to assess the effect of technical or mechanical complications of immediately loaded complete-arch implant-supported prostheses on patient perception and QoL. An additional intention was to determine the risk factors associated with mechanical complications. The null hypothesis was that the occurrence of mechanical complications would not influence the QoL of the majority of patients.

MATERIAL AND METHODS

A retrospective cohort study of participants treated consecutively with immediately loaded complete-arch rehabilitations supported by a minimum of 4 implants (Replace Tapered; Nobel Biocare AB) and Multi-Unit straight or angled conical abutments (Multi-Unit abutments; Nobel Biocare AB) was conducted at a private clinic (Clínica Odontológica Ahoa; Barcelona, Spain). Informed consent was signed by all the participants, and the study protocol was approved by the ethical review board of the Dental Hospital of the University of Barcelona (Protocol number 2014-28). The Declaration of Helsinki guidelines were followed throughout the research.¹⁷ The

manuscript was written in accordance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.¹⁸

Radiological diagnosis was first performed by means of panoramic radiographs (PaX-Flex 2D Digital Panoramic X-ray; Vatech) and cone beam computed tomography (CBCT) scans (5G XL; NewTom) to determine the available bone in order to plan the surgical procedure. Implant placement was performed under conscious sedation and local anesthesia. Four to six implants were placed per arch and conical abutments were connected. The main criterion for immediate loading of the implants was an insertion torque equal to or greater than 35 Ncm. When necessary, soft tissue augmentation techniques such as connective tissue grafting were used. In the case of peri-implant gaps in immediately placed implants, insufficient width of bone, or the presence of bone defects such as dehiscence or fenestration, guided bone regeneration was performed by using autologous bone chips and/or xenografts (BioOss; Geistlich Biomaterials) along with a resorbable bovine collagen membrane (BioGide; Geistlich Biomaterials).

After placing open-tray impression copings, the wound was closed with 4/0 (Supramid; SMI AG) or 5/0 polyglycolic resorbable sutures (Resotex; Resorba, Wundversorgung GmbH & Co.), and an open-tray impression was made with polyether material (Impregum-Penta; 3M ESPE). A dental laboratory technician fabricated a screw-retained acrylic resin complete-arch interim prosthesis, with ovoid pontics and without cantilevers, reinforced by a 1.2-mm-wide metal ligature. The interim prostheses were placed within 6 to 48 hours after surgery, and the occlusion was adjusted to leave only posterior balanced contacts. After 12 to 16 weeks of osseointegration, a definitive conventional cast-metal framework with acrylic resin or ceramic teeth was fabricated. Occlusal contacts were adjusted in centric relation to achieve light and balanced contact in all teeth, assuring group function in lateral movements. Occlusal devices

were fabricated for patients with bruxism (diagnosed by the presence of tooth wear or through patient history). All the participants were enrolled in a peri-implant maintenance program that consisted of follow-up visits every 6 months. This protocol has been described in greater detail in a previous report,¹⁹ and the peri-implant status of this cohort has also been published.²⁰

Between January 2016 and January 2017, all the participants with at least 1 year since loading were recalled for a follow-up maintenance appointment. They were asked to fill in the Spanish version of the OHIP-14 questionnaire⁴ and to report on their satisfaction, which was assessed by means of 4 questions addressing whether the prosthesis allowed good oral hygiene, whether it had met the patient's expectations, whether the patient would repeat the treatment, and whether he or she would recommend it to others. If the participants had doubts when filling in the self-reporting questionnaire, they were allowed to ask the clinician questions. At the same appointment, a panoramic radiograph was made, and 1 examiner (A.S.T.) performed clinical assessments after disconnecting the prosthesis. The following data were registered: patient characteristics (age, sex, arch, and bruxism), treatment variables (type of prosthetic material, opposing dentition, and time of follow-up since the placement of the definitive prosthesis), and outcome data (mechanical complications: framework fracture, chipping or fracture of the veneering material, screw loosening, screw fracture, abutment screw loosening, abutment screw fracture, replacement of acrylic resin teeth due to excessive wear, loss of access-hole filling, and conversion to complete denture or overdenture). Screw and abutment screw loosening were defined as loss of the torque recommended by the manufacturer.

The success, survival, and failure rates were recorded taking into consideration the criteria published by Papaspyridakos et al¹⁶ and Tartaglia et al.¹³ Specifically, prosthetic success was defined as a functioning prosthesis without any mechanical complications over the follow-

up period; prosthetic survival was defined as a prosthesis having one or more complications but still functioning; and prosthetic failure was defined as a prosthesis that had to be replaced.

The data were processed with statistical software (IBM SPSS Statistics, v22.0; IBM Corp). Chi-square tests were used for dichotomous variables, and the Student *t* test was used to assess the relationship between mechanical complications and follow-up time ($\alpha=.05$). A Kaplan-Meier survival analysis was performed for the occurrence of mechanical events in the sample over the follow-up time and, specifically, for the most common mechanical complications. The effects of bruxism on mechanical complications were estimated by means of a Mantel-Cox comparison.

RESULTS

All the eligible patients agreed to participate in this study. Fifty-six participants (26 men and 30 women; 72 restored arches) with a mean age of 64 ± 11.1 years (range: 41 to 87 years) were enrolled. The mean follow-up time was 52 ± 26 months. Table 1 shows the mechanical complications by sex, arch, restoration material, bruxism, opposing dentition, and follow-up time. Abutment screw loosening was the most frequent mechanical complication (43% of participants, with a mean follow-up time of 59 months). Chipping or fracture of the veneering material affected 21 areas in 14 participants (25% of participants). Twelve participants had fractures of maxillary anterior teeth, 1 of a maxillary posterior tooth, 3 of mandibular anterior teeth, and 5 of mandibular posterior teeth. Other complications, including screw loosening (21%), loss of access-hole filling (11%), prosthetic screw fracture (9%), and replacement of acrylic resin teeth due to excessive wear (2%) were also observed. No participants had a framework fracture, abutment screw fracture, or replacement of the prosthesis with a complete

denture or overdenture. Longer follow-up times were significantly associated with abutment screw loosening ($P=.033$), the most frequent mechanical complication, and with screw fracture ($P=.019$). No significant relationships were found between other variables (arch, opposing dentition, restoration material, and bruxism) and the occurrence of mechanical complications.

Twenty-five prostheses in 21 participants had no complications. The prosthetic success rate was 38.8% with a mean follow-up time of 40 months. The survival rate was 100%, although 47 prostheses in 38 participants presented minor mechanical complications. Of 16 participants with a bimaxillary complete-arch restoration, 3 had complications in 1 arch.

Table 2 displays the OHIP-14 results by presence or absence of mechanical complications. The overall score was 0.15, and there were no differences between participants with and without mechanical complications. Figure 1 shows the self-reported satisfaction responses, which indicate that the participants were generally very satisfied with the treatment. The complete-arch prostheses were reported to allow good oral hygiene by 94.6% of the participants, 89% of them stated that the prostheses had met their expectations, 87.5% of them would repeat the treatment, and 93% of them would recommend it to others.

Figure 2 shows the cumulative survival graph for the most frequent complications: abutment screw loosening, chipping, and prosthetic screw loosening. The appearance of mechanical events appeared to be related to increasing follow-up time. Kaplan-Meier survival analysis through Mantel-Cox comparison revealed that bruxism was significantly related to chipping ($P=.014$) but not to abutment screw loosening ($P=.133$) or prosthetic screw loosening ($P=.400$), as seen in Figure 3. Overall, Figure 4 shows the progressive occurrence of mechanical events over the follow-up time.

DISCUSSION

The results support the acceptance of the null hypothesis of the study as the QoL of participants was not diminished by prosthetic complications. Despite the high prevalence of abutment screw loosening and chipping, these complications did not seem to affect patient satisfaction. The OHIP-14 results showed similar scores for participants with and without mechanical complications. This could be explained by the fact that these mechanical complications do not have a negative effect on QoL and thus should be considered minor complications. Another possible explanation is that these events might have remained unnoticed by the participants. Limitations of the study include the retrospective nature of the data recovery and the lack of a baseline questionnaire before the treatment. A baseline questionnaire would have allowed comparisons when assessing changes in the patients' quality of life.

Mechanical complications of definitive prostheses increase the cost and the time spent by the patient and the clinician.¹⁶ A strict maintenance protocol focused on periodically checking the occlusion and the prosthetic components is therefore recommended to reduce the incidence of these complications. In our opinion, evaluation visits are especially important to ensure that the abutments are properly screwed into the implants, as otherwise this could lead to biological complications. Unfortunately, the literature about mechanical problems in complete-arch restorations is scarce. Indeed, most authors only report the survival (presence of the prosthesis) or failure (absence) rates, without specifying the nature of these complications. A systematic review¹⁶ reported that only 29.3% of prostheses were free of complications after 5 years. This figure is similar to the data from the present sample, where 37.5% of the participants and 38.8% of the prostheses had no mechanical complications after a mean follow-up of 5 years.

These complications have a multifactorial etiology¹¹ in which patient-related factors (parafunctional habits) and treatment-related factors such as the characteristics of the materials, the lack of restorative space, an unfavorable intermaxillary relationship, and misfit could influence the outcome.^{8,21} Few studies are available regarding treatment decisions concerning prosthetic material selection. Furthermore, it would appear that no material for complete-arch implant-supported restorations is exempt from mechanical complications. In addition, patients with implant-supported complete-arch prostheses have less masticatory proprioception than dentate patients and worse control of maximal masticatory forces.¹² In the present study, only follow-up time was associated with a significant increase in complications. Variables like opposing dentition, arch, bruxism, and restorative material were not related to the different mechanical events.

The participants in this research received prostheses made with a conventional cast metal framework, which could be one of the reasons for the high rate of abutment screw loosening. Computer-aided design and computer-aided manufacturing (CAD-CAM) technology might reduce mechanical events because of a better passive fit.¹³

Tartaglia et al¹³ assessed mechanical complications after 5 years of follow-up in edentulous arches with CAD-CAM metal-resin or metal-zirconia restorations and showed that maxillary metal-resin complete-arch prostheses in men had a significantly higher risk of developing mechanical complications. Fracture or wear of acrylic teeth seems to be more frequent in anterior areas,¹³ probably because of shear forces. However, occlusal access holes have been cited as a critical point providing less resistance for porcelain, thus promoting more chipping in these areas.⁹ Fracture of the veneer material is one of the most frequent mechanical complications.²² This event may even appear in the opposing dentition.¹⁰

Patients with bruxism are more prone to mechanical complications.^{11,16} The present study only found significant associations between this parafunctional habit and chipping. No relationship was found with the other mechanical events. The fact that occlusal devices were fabricated for all patients with bruxism in the present study and that the occlusion was carefully evaluated in the follow-up appointments might explain this lack of association.²² Another important variable to consider is the opposing arch. While some studies have not found significant associations between mechanical complications and opposing dentition,^{10,13} Malo et al¹⁴ concluded that antagonist implant-supported complete-arch restorations tended to induce more mechanical complications, although this factor did not seem to affect long-term survival.

The eighth European Workshop on Periodontology⁵ emphasized the importance of introducing patient-reported measures to improve the assessment of treatment outcomes based on the patient's perception rather than on clinical parameters alone. From the overall results of the present study, it can be assumed that most participants' expectations were fulfilled and that their QoL probably improved. Specifically, in this study the self-assessment of the oral hygiene condition could lead to an overestimation of this variable. The plaque index measured over the prosthetic and abutment surfaces is expected to be more reliable.

The OHIP-14 questionnaire has been used to study patient satisfaction with implant-supported prostheses by measuring 7 basic domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. A similar study by Testori et al²³ observed a low rate of mechanical complications associated with a high degree of satisfaction in complete-arch maxillary implant-supported restorations after 10 years of follow-up. Interestingly, Erkapers et al³ found an overall improvement in OHIP-49 scores for patients with maxillary immediately loaded prostheses,

comparing the presurgical visit with a follow-up visit after 1 year. However, the social disability and handicap scores changed less than those for the remaining parameters. These authors hypothesized that these domains could have low specificity for assessing the outcome of a dental implant treatment or that they could be difficult to improve. The prosthesis they used in their cohort study was made of acrylic resin with a welded titanium framework. Toljanic et al¹⁵ reported complications appearing after a 5-year follow-up period. Fracture of the prosthetic teeth was the most prevalent mechanical complication, and the prosthesis survival rate was 97.5% (1 prosthesis had to be replaced).

CONCLUSIONS

Based on the findings of this retrospective clinical study, the following conclusions were drawn:

1. The occurrence of minor mechanical complications has no impact on the satisfaction and QoL of patients with immediately-loaded complete-arch implant-supported prostheses.
2. Although the frequency of mechanical complications increases significantly over time, the prosthetic survival rate is high.
3. Follow-up visits for implant prosthetics are mandatory in order to evaluate the status of all the components and to control risk factors for mechanical events such as bruxism.

REFERENCES

1. Dolz J, Silvestre FJ, Montero J. Changes in general and oral health-related quality of life in immediate or conventionally loaded dental implants: a nonrandomized clinical trial. *Int J Oral Maxillofac Implants* 2014;29:391-401.
2. Brennan M, Houston F, O'Sullivan M, O'Connell B. Patient satisfaction and oral health-related quality of life outcomes of implant overdentures and fixed complete dentures. *Int J Oral Maxillofac Implants* 2010;25:791-800.
3. Erkapers M, Ekstrand K, Baer RA, Toljanic JA, Thor A. Patient satisfaction following dental implant treatment with immediate loading in the edentulous atrophic maxilla. *Int J Oral Maxillofac Implants* 2011;26:356-64.
4. De Bruyn H, Raes S, Matthys C, Cosyn J. The current use of patient-centered/reported outcomes in implant dentistry: a systematic review. *Clin Oral Impl Res* 2015;26:45-56.
5. Lang NP, Zitzmann NU, on behalf of Working Group 3 of the VIII European Workshop on Periodontology. Clinical research in implant dentistry: evaluation of implant-supported restorations, aesthetic and patient-reported outcomes. *J Clin Periodontol* 2012;39:133-8.
6. Montero-Martín J, Bravo-Pérez M, Albaladejo-Martínez A, HernándezMartín LA, Rosel-Gallardo EM. Validation the Oral Health Impact Profile (OHIP-14sp) for adults in Spain. *Med Oral Patol Oral Cir Bucal* 2009;14:44-50.
7. Kwon T, Bain PA, Levin L. Systematic review of short- (5-10 years) and long-term (10 years or more) survival and success of full-arch fixed dental hybrid prostheses and supporting implants. *J Dent* 2014;42:1228-41.

8. Francetti L, Corbella S, Taschieri S, Cavalli N, Del Fabbro M. Medium- and long-term complications in full-arch rehabilitations supported by upright and tilted implants. *Clin Implant Dent Relat Res* 2015;17:758-64.
9. Noda K, Arakawa H, Maekawa K, Hara ES, Yamazaki S, Kimura-Ono A, et al. Identification of risk factors for fracture of veneering materials and screw loosening of implant-supported fixed partial dentures in partially edentulous cases. *J Oral Rehabil* 2013;40:214-20.
10. Limmer B, Sanders AE, Reside G, Cooper LF. Complications and patient-centered outcomes with an implant-supported monolithic zirconia fixed dental prosthesis: 1 year results. *J Prosthodont* 2014;23:267-75.
11. Lopes A, Maló P, de Araújo Nobre M, Sánchez-Fernández E, Gravito I. The NobelGuide(®) All-on-4(®) treatment concept for rehabilitation of edentulous jaws: a retrospective report on the 7-years clinical and 5-years radiographic outcomes. *Clin Implant Dent Relat Res* 2017;19:233-44.
12. Rojas Vizcaya F. Retrospective 2- to 7-year follow-up study of 20 double full-arch implant-supported monolithic zirconia fixed prostheses: measurements and recommendations for optimal design. *J Prosthodont* 2018;27:501-8.
13. Tartaglia GM, Maiorana C, Gallo M, Codari M, Sforza C. Implant-supported immediately loaded full-arch rehabilitations: comparison of resin and zirconia clinical outcomes in a 5-year retrospective follow-up study. *Implant Dent* 2016;25:74-82.
14. Maló P, Araújo Nobre MD, Lopes A, Rodrigues R. Double full-arch versus single full-arch, four implant-supported rehabilitations: a retrospective, 5-year cohort study. *J Prosthodont* 2015;24:263-70.

15. Toljanic JA, Ekstrand K, Baer RA, Thor A. Immediate loading of implants in the edentulous maxilla with a fixed provisional restoration without bone augmentation: a report on 5-year outcomes data obtained from a prospective clinical trial. *Int J Oral Maxillofac Implants* 2016;31:1164-70.
16. Papaspyridakos P, Chen CJ, Chuang SK, Weber HP, Gallucci GO. A systematic review of biologic and technical complications with fixed implant rehabilitations for edentulous patients. *Int J Oral Maxillofac Implants* 2012; 27:102-10.
17. World Medical Association. World medical association declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA* 2013;310:2191-4.
18. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008;61:344-9.
19. Cercadillo-Ibarguren I, Sánchez-Torres A, Figueiredo R, Valmaseda-Castellón E. Early complications of immediate loading in edentulous full-arch restorations: a retrospective analysis of 88 cases. *Int J Oral Maxillofac Implants* 2017;32:1116-22.
20. Cercadillo-Ibarguren I, Sánchez-Torres A, Figueiredo R, Schwarz F, Gay-Escoda C, Valmaseda-Castellón E. Immediately loaded implant-supported full-arches: peri-implant status after 1-9 years in a private practice. *J Dent* 2017;67:72-6.
21. Drago C. Cantilever lengths and anterior-posterior spreads of interim, acrylic resin, full-arch screw-retained prostheses and their relationship to prosthetic complications. *J Prosthodont* 2017;26:502-7.

22. Hsu YT, Fu JH, Al-Hezaimi K, Wang HL. Biomechanical implant treatment complications: a systematic review of clinical studies of implants with at least 1 year of functional loading. *Int J Oral Maxillofac Implants* 2012;27:894-904.
23. Testori T, Galli F, Fumagalli L, Capelli M, Zuffetti F, Deflorian M, et al. Assessment of long-term survival of immediately loaded tilted implants supporting a maxillary full-arch fixed prosthesis. *Int J Oral Maxillofac Implants* 2017;32:904-11.

Corresponding author:

Dr Rui Figueiredo

School of Medicine and Health Sciences

Campus de Bellvitge, University of Barcelona

C/ Feixa Llarga, s/n; Pavelló Govern, 2^a planta, Despatx 2.9

08907 L'Hospitalet de Llobregat

Barcelona

SPAIN

Email: rui@ruibf.com

Acknowledgments

This study was carried out by the Odontological and Maxillofacial Pathology and Therapeutics research group at the IDIBELL Institute. Mary Georgina Hardinge provided English language editing services.

TABLES

Table 1. Mechanical complications and participant characteristics

	PARTICIPANTS							ARCHES								
	TOTAL PARTICIPANTS	Sex		Restorative material		Bruxism	Follow-up (months)	TOTAL ARCHES	Restorative material		Arch		Opposing dentition			Estimated event rate (95%CI)
		M	F	Resin	Ceramic				Resin	Ceramic	Mx	Md	Natural	CD	Complete arch	
Chipping/veneering material fracture	14	6	8	7	7	7	58.9 (12-107)	21	7	14	14	7	6	0	9	0.25 (0.155-0.377)
Screw loosening	12	7	5	3	9	5	60.6 (22-108)	14	4	10	7	7	5	1	7	0.21 (0.127-0.338)
Screw fracture	5	1	4	2	3	2	77 (61-108)	7	2	5	2	5	2	1	2	0.09 (0.039-0.193)
Abutment screw loosening	24	11	13	-	-	10	59 (14-108)	52	-	-	26	26	11	3	10	0.43 (0.308-0.559)
Replacement of acrylic resin teeth	1	1	0	1	-	1	89	1	1	-	1	0	1	-	-	0.02 (0.003-0.094)
Loss of access hole filling	6	3	3	2	4	2	66.5 (12-107)	7	2	5	4	3	4	0	2	0.11 (0.050-0.215)

M, male; F, female; Mx, maxillary; Md, mandibular; CD, complete denture; CI, confidence interval.

Table 2. OHIP-14 questionnaire. Results related to participants with and without mechanical complications (mean)

OHIP-14	Chipping		Screw loosening		Screw fracture		Abutment screw loosening		Tooth wear	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Results by mechanical complication	0.10	0.17	0.14	0.16	0.01	0.17	0.06	0.23	0	0.16

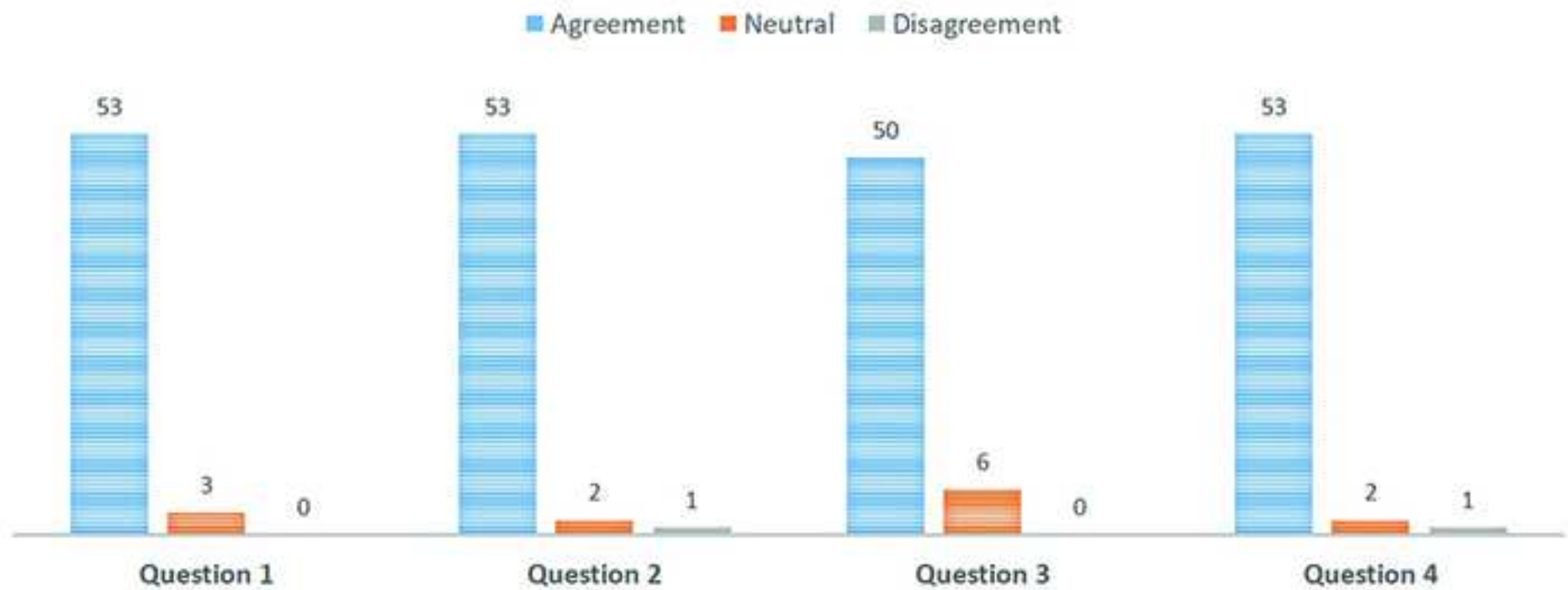
FIGURES

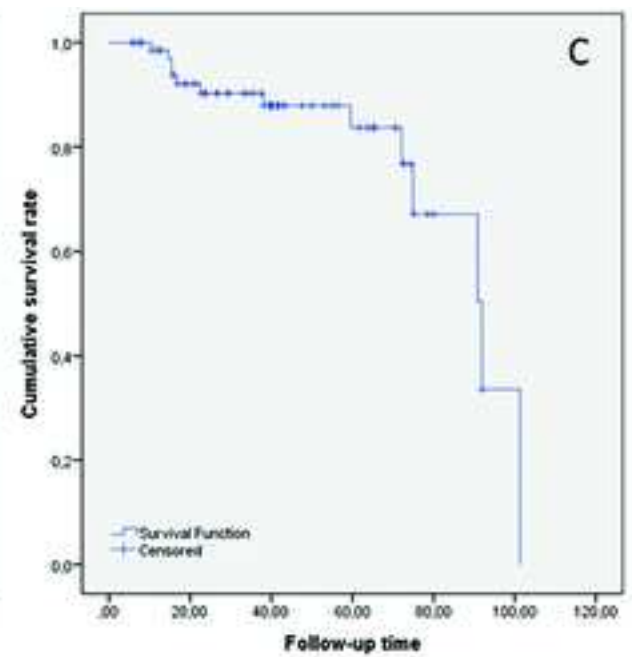
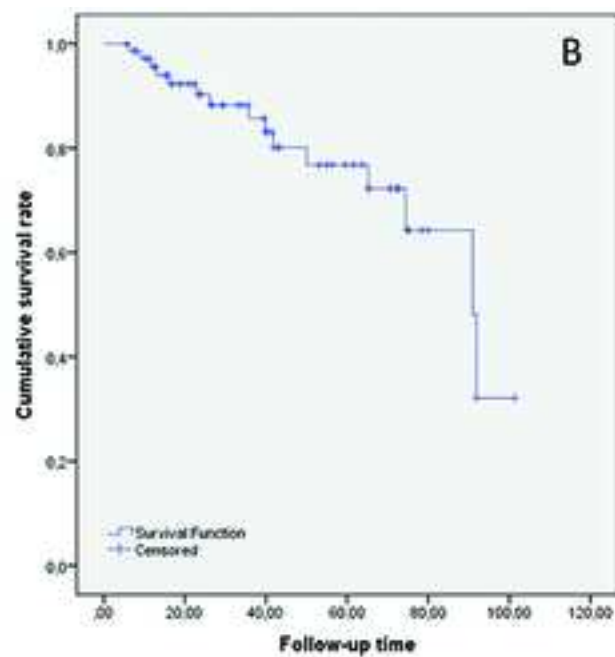
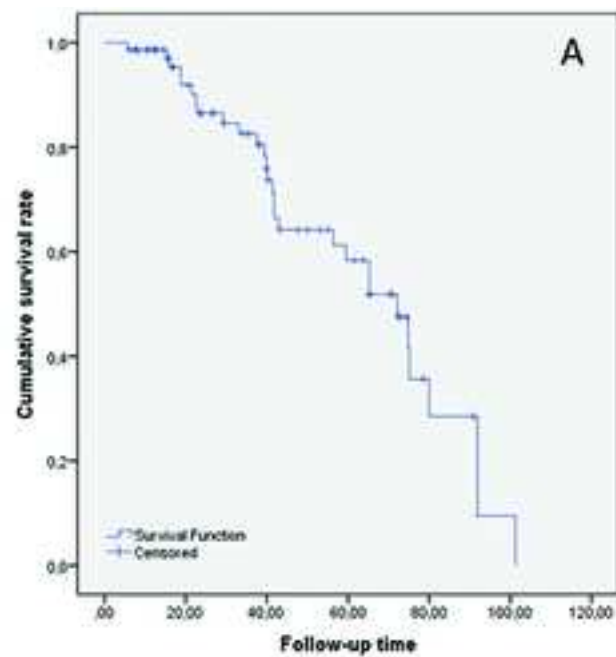
Figure 1. Self-reported satisfaction. Question 1: Does the prosthesis allow correct daily dental hygiene? Question 2: Have your expectations been met? Question 3: Would you have the treatment again? Question 4: Would you recommend this treatment to others?

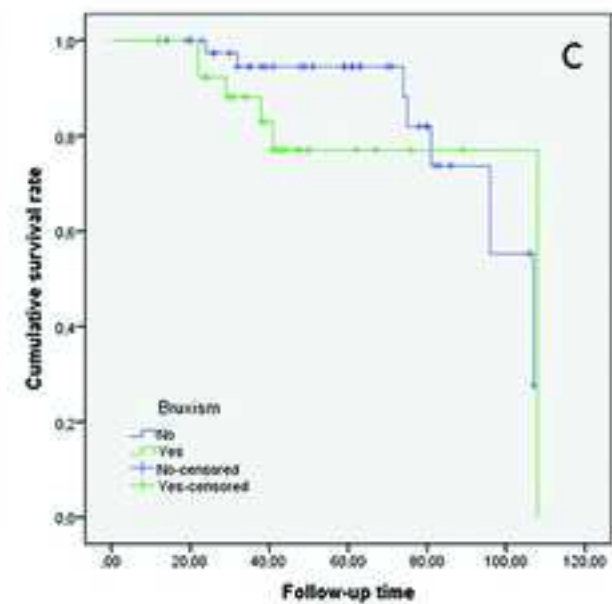
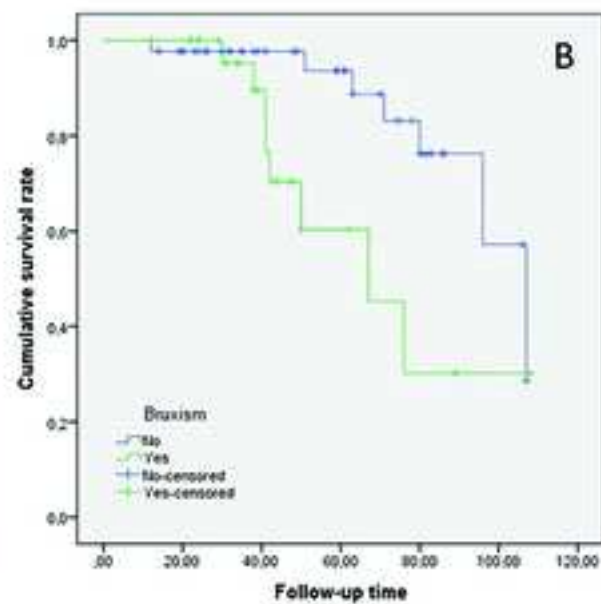
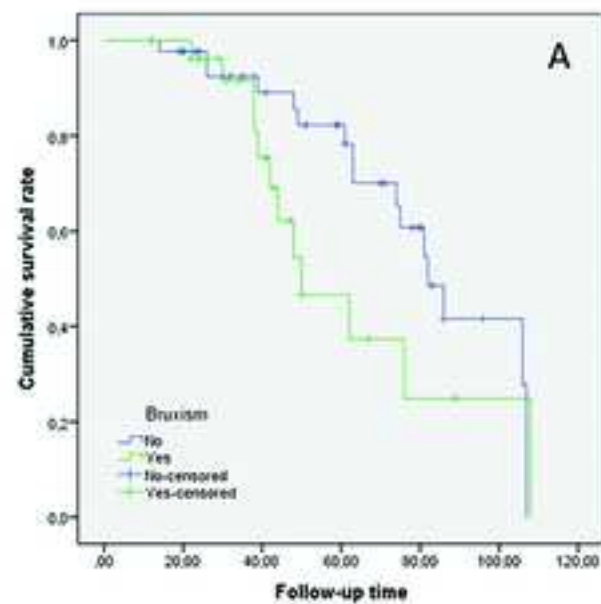
Figure 2. Cumulative survival rate for most common mechanical complications. A, Abutment screw loosening. B, Chipping. C. Prosthetic screw loosening.

Figure 3. Cumulative survival rate for most common mechanical complications in relation to bruxism. A, Abutment screw loosening. B, Chipping. C, Prosthetic screw loosening. Vertical axis: cumulative proportion of prostheses without complications

Figure 4. Cumulative rate for mechanical complications.







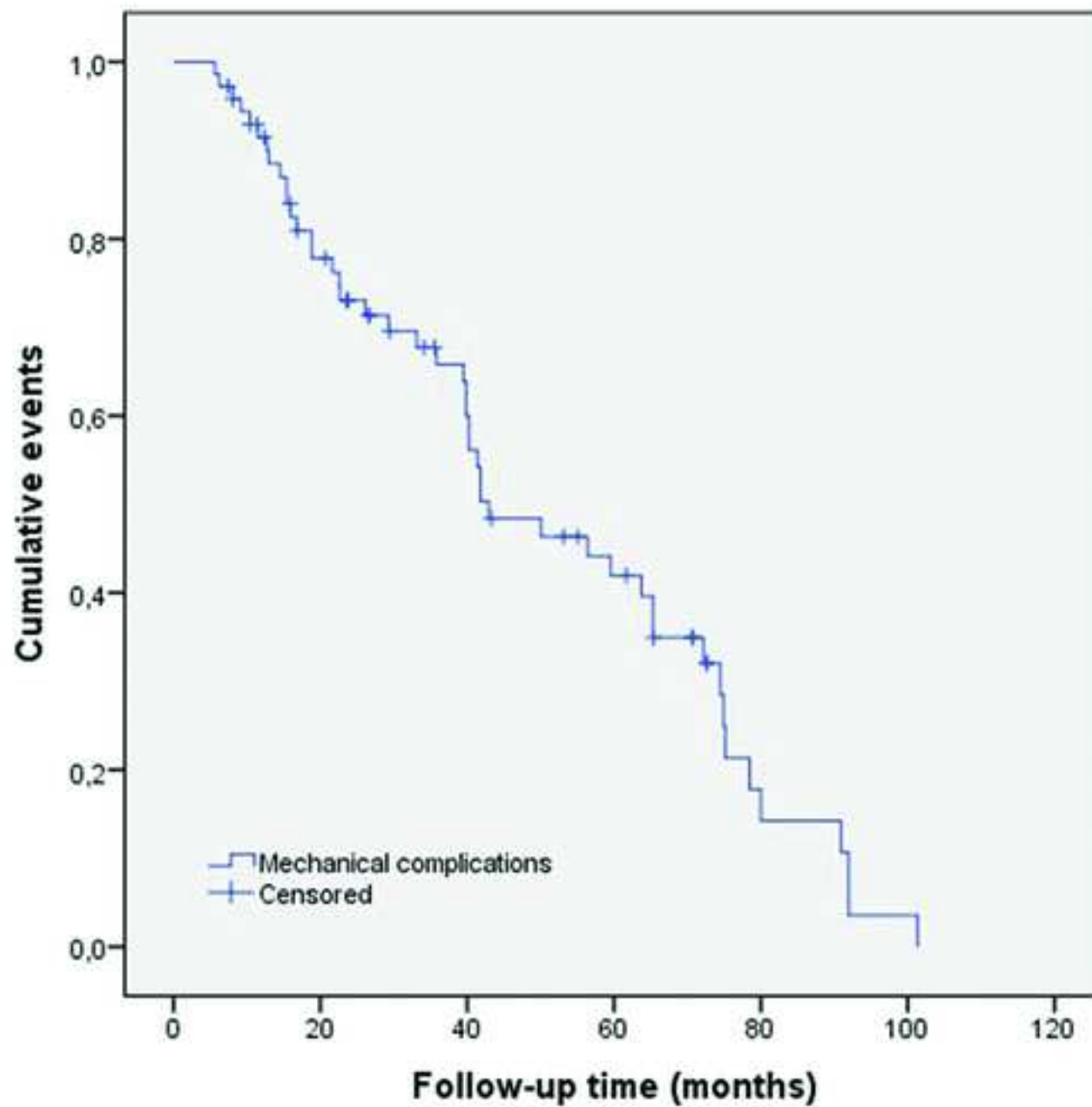


Table 1. Mechanical complications and participants’ characteristics

	PARTICIPANTS							ARCHES								
	TOTAL PARTICIP-ANTS	Gender		Restorative material		Bruxism	Follow-up (months)	TOTAL ARCHES	Restorative material		Arch		Opposing dentition			Estimated event rate (95%CI)
		M	F	Resin	Ceramic				Resin	Ceramic	Mx	Md	Natural	CD	Complete arch	
Chipping/veneering material fracture	14	6	8	7	7	7	58.9 (12-107)	21	7	14	14	7	6	0	9	0.25 (0.155-0.377)
Screw loosening	12	7	5	3	9	5	60.6 (22-108)	14	4	10	7	7	5	1	7	0.21 (0.127-0.338)
Screw fracture	5	1	4	2	3	2	77 (61-108)	7	2	5	2	5	2	1	2	0.09 (0.039-0.193)
Abutment screw loosening	24	11	13	-	-	10	59 (14-108)	52	-	-	26	26	11	3	10	0.43 (0.308-0.559)
Replacement of acrylic resin teeth	1	1	0	1	-	1	89	1	1	-	1	0	1	-	-	0.02 (0.003-0.094)
Loss of access hole filling	6	3	3	2	4	2	66.5 (12-107)	7	2	5	4	3	4	0	2	0.11 (0.050-0.215)

M: male; F: female; Mx: maxillary; Md: mandibular; CD: complete denture; CI: confidence interval.

Table 2. OHIP-14 questionnaire. Results related to participants with **and without** mechanical complications (mean)

OHIP-14	Chipping		Screw loosening		Screw fracture		Abutment screw loosening		Tooth wear	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Results by mechanical complication	0.10	0.17	0.14	0.16	0.01	0.17	0.06	0.23	0	0.16