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Complications in implant-supported full-arch immediate prostheses: a Brazilian retrospective, observational, longitudinal study

Chane Wittcinski[1], Fabíola MM Kubo[1], Marcelo L Teixeira[1], André A Pelegrine[1]

1. Faculdade São Leopoldo Mandic, Division of Implant Dentistry, Campinas, Brazil

ABSTRACT

Edentulism causes aesthetic, functional, nutritional, phonetic and psychological damage. One of the best treatments for it is implant-supported full-arch prostheses. However, like all techniques, it involves challenges. ***Aim:*** *To evaluate the main complications in implant-supported complete dentures.* ***Materials and Method:*** *This study analyzed the medical records of 140 patients rehabilitated with implant-supported full-arch prostheses with immediate loading using the passive fit technique. The analysis considered the antagonist, and complication location (upper and/or lower jaw). All cases had 1 to 8 years under load.* ***Results:*** *No complication was reported in 115 (82.1%) patients, while 25 presented complications: 14 (56%) prosthetic tooth fractures, 3 (12%) prosthesis retention screw fractures, 3 (12%) loss of cementation of the cylinder, and 5 (20%) implant losses. There were more complications in implant-supported complete dentures in the upper arch or cases of both jaws ($p<0.05$). The success rate (patients without complications during follow-up) was 82.1%.* ***Conclusion:*** *Implant-supported complete dentures made by the passive fit technique were predictable in the long term for rehabilitation of completely edentulous patients.*

Keywords: *implant supported prostheses - passive fit technique - implant loss*

Complicações em próteses totais imediatas implanto-suportadas: um estudo brasileiro retrospectivo, observacional e longitudinal

RESUMO

O edentulismo causa danos estéticos, funcionais, nutricionais, fonéticos e psicológicos. As próteses totais implanto-suportadas são consideradas um dos tratamentos mais adequados para essa situação clínica. No entanto, como todas as técnicas, esta tem seus desafios. ***Objetivo:*** *Avaliar as principais complicações em próteses totais implanto-suportadas.* ***Materiais e Método:*** *Foram analisados os prontuários de 140 pacientes reabilitados com próteses totais implanto-suportadas com carga imediata, utilizando a técnica de assentamento passivo, levando em consideração a característica do antagonista e a localização (maxila e/ou mandíbula). Os casos tinham pelo menos um ano e até 8 anos em função.* ***Resultados:*** *Nenhuma complicação foi relatada em 115 (82,1%) indivíduos. Do total de pacientes, foram observadas 25 ocorrências, nas quais 14 (56%) apresentaram fratura dentária da peça protética, 3 (12%) apresentaram fratura do parafuso de retenção da prótese, 3 (12%) apresentaram perda da cimentação do cilindro e 5 pacientes (20%) tiveram perda do implante. Próteses totais implanto-suportadas na maxila ou em ambas as arcadas apresentaram mais complicações ($p<0,05$). A taxa de sucesso correspondeu a 82,1% dos pacientes, que não apresentaram nenhum infortúnio durante os períodos de retorno.* ***Conclusão:*** *Próteses totais implanto-suportadas confeccionadas pela técnica de assentamento passivo mostraram-se previsíveis em longo prazo para reabilitação de pacientes totalmente desdentados.*

Palavras-chave: *próteses totais implanto suportadas - técnica de assentamento passivo - perda do implante*

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Corresponding Author:
Fabíola Mayumi Miyauchi Kubo
fabiolakubo1@gmail.com

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INTRODUCTION

The prosthetic options for completely edentulous patients are conventional dentures, implant overdentures and implant-supported fixed dental prostheses. The advantage of the latter is that it is fully supported by implants, and does not transfer load to adjacent tissues. The masticatory forces are thus transferred to the implants, thereby preventing any further bone resorption of the residual alveolar ridge, as occurs with conventional complete dentures supported by gingival and bone tissue[1,2].

Fabrication and retention methods influence the fit of the prosthetic superstructure. Initially proposed by Sellers in 1989, the passive fit technique consists of three cylinders (castable, brass and titanium). The brass cylinder is larger than the titanium one, but the bases are equal. The calcinable cylinder was designed to adapt to the base of these two cylinders. So, the space between the castable and the brass cylinders is smaller than the space between the castable and the titanium cylinders. The brass cylinder is used as a base for waxing the casting pattern, and after the cast bar, it is cemented on the titanium cylinders. Because there is a size difference between the cylinders, the internal space for cementation will be preserved, and the inherent distortions to the casting procedure will be eliminated[3]. Full-arch implant-supported rehabilitations performed with this passive fitting technique precisely adapt the metallic framework on the abutments, and the immobilization of multiple implants can limit micromotion at the bone-implant interface[4]. The stabilization of implants at initial placement and the limitation of micromotion to 100 µm contribute to successful osseointegration[5,6].

Dental implant loading may be early (1 week to 2 months after implant placement), conventional (more than two months after implant placement), or immediate (less than one week after implant placement)[7]. Several advantages have been related to immediate loading, including primary function and aesthetics, avoidance of a conventional denture during the healing phase, avoidance of second surgeries, and preservation of hard and soft tissue anatomy[8]. According to recent studies, implants loaded immediately with full-arch fixed prostheses achieve high success rates after several years of follow-up in post-extraction bone and healed bone in the maxilla and the mandible[9]. The aim of this research was to evaluate the clinical information reported in the medical records of 140 patients rehabilitated with implant-supported full-arch prostheses with immediate loading, made by the passive fit technique, with 1 to 8 years under load. The study analyzed the main complications, identified their possible association with the antagonist, and compared upper and lower arches.

MATERIALS AND METHOD

This retrospective, observational, longitudinal study was based on a survey of data filed at the Institute of Graduate Studies and Research in Dentistry in Balneario Camboriu, Brazil. Informed consent was obtained from the people involved. The research was approved by the Research Ethics Committee of the São Leopoldo Mandic Institute and Research Center under number 5,501,597.

The sample consisted of 140 patients selected according to the following inclusion criteria; treatments of implant-supported fixed dental prostheses performed between 2013 and 2021, surgeries with implants that received fixed prostheses with immediate loading in at least one arch, produced by the same laboratory (Buche, Curitiba, Brazil), same laboratory technique of passive fitting, and implants and abutments of the same brand (Neodent, Curitiba, Brazil). Exclusion criteria were the following: smokers, prostheses with less than one year under load, ceramic protocols, prostheses without prosthetic components, patients whose surgery and prosthesis were not performed at the same venue (Institute of Graduate Studies and Research in Dentistry in Balneario Camboriu, Brazil), deceased patients, medical records without information or with incomplete data, patients with removable partial denture as antagonist type, and patients who did not sign the free and informed consent form. All complications were recorded and analyzed for correlation with antagonist type and location (upper and/or lower jaw).

Descriptive analysis of variables and hypothesis tests were performed using Fisher's Exact Test and Pearson's test. All tests were performed with a 95% confidence level. Statistical analyses were performed with the software r: Ris, a language and environment for statistical computing and graphics developed at Bell Laboratories (Lucent Technologies).

RESULTS

A total 140 patients were included in the study, 49

male and 91 female, mean age 65. One hundred and forty implant-supported full arch prostheses were analyzed: 100 lower prostheses (71.4%) and 40 upper prostheses (28.6%), with average loading time 60.2 months. This distribution occurred because of the 170 prostheses; 30 patients had bimaxillary prostheses. There were no complications in 20 of them, so they were randomly distributed among ten uppers and ten lowers to achieve one of our objectives: to compare upper to lower.

Over the time analyzed, no complication was reported in 115 (82.1%) individuals, while 25 (17.9%) patients had problems: 14 (56%) with veneer fracture, 5 (20%) with implant loss, 3 (12%) with cylinder cementation loss, and 3 (12%) with fracture of the prosthesis fixation screw. Relative to the total number of patients, the distribution was 10% veneer fracture, 3.57% implant loss, 2.14% cementation loosening and 2.14% screw fracture.

Considering the 40 (28.6%) upper prostheses and 100 (71.4%) lower prostheses, there were complications in 30% (12) of the upper prostheses (10 veneer fractures and 2 implant losses), and in only 13% (13) of the lower prostheses (4 veneer fractures, 3 implant losses, 3 fractures of the prosthesis fixation screw and 3 cementation losses).

Regarding antagonists, 75 (53.6%) patients had conventional full arch dentures, with no complications in 66 (88%) and complications in 9 (12%); 30 (21.4%) had implant-supported full arch prostheses, with no complications in 20 (66.7%) and complications in 10 (33.3%); 18 (12.9%) had natural teeth and implants, with no complications in 16 (88.9%) and complications in 2 (11.1%); and 17 (12.1%) had natural teeth, with no complications in 13 (76.5%) and complications in 4 (23.5%).

Table 1 shows the distribution of complication type in implant-supported full-arch immediate prostheses. Tables 2 and 3 show the results of comparative statistics and the association test. Full arch implant-supported prostheses antagonist resulted in higher complications.

DISCUSSION

This study found an 81.2% success rate (no complication reported in patients' records) for implant-supported full-arch immediate prostheses made by the passive fit technique. Notwithstanding the high survival rate of implants and prostheses, dentists should be aware of the biological and mechanical complications that may occur in implant-supported prosthesis rehabilitation.

Biological complications after installation of the definitive prosthesis include soft tissue inflammation and hyperplasia, peri-implant soft tissue recession, mucositis, peri-implantitis, and implant failure.

Table 1. Complication type in implant-supported full-arch immediate prostheses

Complication	Number of cases	% of complications (n=25)	% of total patients (n=140)
Veneer fracture	14	56%	10%
Implant loss	5	20%	3.57%
Cylinder cementation loss	3	12%	2.14%
Prosthesis fixation screw fracture	3	12%	2.14%
Total with complications	25	100%	17.9%
Without complications	115	—	82.1%

Table 2. Ratio test between antagonists

Comparison	Test	Test P-Value	Conclusion
Natural teeth vs. Natural teeth + Implants	0.2763	0.5992	H 0 not rejected [p-value>α]
Natural teeth vs. Implant-supported full arch prosthese	0.1401	0.7082	H0 not rejected [p-value>α]
Natural teeth vs. Conventional denture	0.7167	0.3972	H0 not rejected [p-value>α]
Natural teeth + Implants vs. conventional denture	0.0000	1.0000	H0 not rejected [p-value>α]
Implant-supported full arch prosthesis vs. Conventional denture	5.2195	0.0223	H0 rejected [p-value≤α]

H_0: There is no difference between the antagonists.

Table 3. Hypothesis testing between all antagonists and the full arch implant-supported prostheses antagonist

	P-Value	Conclusion	Statistic Test
Antagonist	0.0598	H0 not rejected [p-value>α]	Fisher's Exact Test

H_0: There is no association between "Antagonist" and "Complication/No Complication."

	P-Value	Conclusion	Statistic Test
Implant-supported full arch prostheses	0.0267	H0 rejected [p-value≤α]	Pearson's Test

H_0: There is no association between "full arch implant-supported prostheses" and "Complication/No Complication."

Technical/mechanical complications involve wear of the prosthetic material (localized or generalized), fractures of the prosthetic material, loss of material covering the access to the prosthetic screw, loss of cementation, loosening or fracture of the abutment screw, fracture of suprastructure, fracture of abutment and implant fracture[10].

Clinical and scientific evidence supports implant-supported fixed full-arch dentures as a reliable treatment option for rehabilitating edentulous patients. The main focus of previous longitudinal studies, especially in the 1990s, was the success of osseointegration and implant survival[11]. A review by Papaspyridakos et al. claims that studies mainly used implant and peri-implant soft-tissue parameters for measuring success[12]. In contrast, the present study focused mainly on prosthodontic parameters.

The current study analyzed the medical records of 140 patients rehabilitated with implant-supported full-arch prostheses with immediate loading, made by the passive fit technique, with 1 to 8 years under load. It found that 25 patients (17.9%) had problems: 14 (56%) veneer fractures, 5 (20%) implant losses, 3 (12%) cylinder cementation losses, and 3 (12%) fractures of the prosthesis fixation screw. There were more complications in the upper arch than in the lower. Other previous studies corroborate that prosthetic tooth fractures are the main issue after different follow-up periods.

A meta-analysis conducted by Bozini et al. included 19 studies of prosthodontic complication rate for implant-supported fixed prosthesis in edentulous patients after observation periods of 5 to 23 years. The statistical analysis revealed estimated cumulative rates of veneer fractures over an observation period of 5, 10, and 15 years of 30.6%, 51.9%, and 66.6%, respectively. The estimated rates of abutment and prosthetic screw loosening after 15 years were 13.4% and 15%, respectively. The estimated rates of abutment and prosthetic screw fracture after 15 years were 6.3% and 11.7%, respectively. Complications may be influenced by various factors such as parafunctional habits, number of implants supporting the prosthesis, opposing arch condition, and type of suprastructure retention (screw versus cement)[13]. In the referred study, the analysis of various factors potentially influencing complications did not produce any results, and parafunctional habits were not considered.

The retrospective study by Able et al. at the Latin American Institute of Dental Education and Research from 2004 to 2013, on 290 patients rehabilitated with fixed full-arch prostheses on immediate-load dental implants, manufactured according to the passive adjustment technique, with mean follow-up 4.4 years, observed a 98.6% survival rate for prosthetic rehabilitations. Regarding complications, five implants failed and were removed during this period, and the implant survival rate was 99.6%. Prosthetic complications were found in 67 participants (23.1%), with fracture of the prosthetic tooth in 41 (61%), loosening of the prosthetic screw in 15 (22.3%), and cylinder cementation loss in 7 (2.45%)[4]. In the present study, 25 patients (17.9%) had complications, with prosthetic tooth fracture in 14 (56%) and loss of cylinder cementation in 3 (12%).

Ventura et al. reviewed the literature to identify factors responsible for increasing the incidence of fractures of acrylic teeth in implant-supported rehabilitations. Statistically significant differences were found among the variables; men suffered more fractures than women, maxillary prostheses fractured more than mandibular ones, prostheses that did not have mechanical retention for teeth and acrylic suffered more fractures, prostheses with cantilevers 10 mm or longer fractured less than those with cantilevers shorter than 10 mm, natural dentition caused a greater number of fractures than the full mucosa-supported dentures, and prostheses supported by four implants fractured more than the others (five, six or eight implants). Regarding the arch, maxillary prostheses fractured more than the mandibular ones[14], in agreement with the findings of

the current study and Eliasson et al[15].

In the current study, the following 25 patients presented complications:

- 10 (33.3%) of the 30 patients with implant-supported complete dental prostheses as antagonist, of whom 7 had complications in the upper arch and 3 in the lower arch;
- 9 (12%) of the 75 patients with conventional complete denture as antagonist, all 9 complications being in the lower arch;
- 4 (23.5%) of the 17 patients with natural teeth as antagonist, of whom 3 had complications in the upper arch and 1 in the lower arch; and
- 2 (11.1%) of the 18 patients with natural teeth plus implants as antagonist, both having complications in the upper arch.

The results showed more statistically significant complications when the antagonist was also an implant-supported full-arch prosthesis ($p \leq 0.05$), corroborating Davis et al[16]. In this clinical situation, the maintenance requirements seem to be much greater than with natural teeth or complete dentures as antagonists.

This study was based on data available in clinical records and presented some limitations. The presence of bruxism, alveolar bone loss and wear or aesthetics of the prosthetic material were not evaluated.

CONCLUSIONS

The rehabilitation of completely edentulous patients with implant-supported full arch dentures made using the passive fit technique proved to be predictable in the long term. A greater number of complications were observed in the upper arch, and when the antagonist was also an implant-supported complete denture. The most frequent prosthetic complication was veneer fracture.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the research, authorship, and/or publication of this article.

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