

Association between dental extractions and implant installations - a retrospective clinical study

Associação entre exodontias dentárias e instalações de implantes – estudo clínico retrospectivo

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ABSTRACT

Aim: The retrospective study aimed to draw, the profile of a series of patients who received immediate implants, emphasizing the causes for exodontia. **Materials and Methods:** This 10-year retrospective study (2006-2016) conducted a data survey on patients subjected to exodontia and immediate implant installation. The study was based on the analysis of the clinical data collected from the records of dental offices of Implantology specialists. The instrument contained questions regarding the patients' systemic condition, dental causes for exodontia, and types of implants installed. **Results:** Out of 846 teeth extracted from the 407 patients analyzed, 242 were replaced with single implants, 276 with implants for upper protocols, and 328 with implants for lower protocols. The highest rate of implant installations occurred between 2010 and 2014, corresponding to 51.4% of the sample, in which 64.1% of patients were women and 58.3% were aged 41 through 60 years. The highest incidence of extractions presented

periodontal (19.2%), prosthetic (17.4%) and endodontic causes (15.2%). Among the prosthetic causes, caries was present in 111 cases. For periodontal causes, generalized chronic periodontitis was present in 200 teeth. In endodontic causes, root fracture was evident in 114 teeth and more prevalent in single-tooth exodontias ($p < 0.001$). In addition, the highest rate of tooth losses (32.4%) occurred from strategic exodontias for single-tooth replacement or upper and lower protocols ($p < 0.001$). Conclusion: Immediate implants proved to be an important alternative for the rehabilitation of compromised teeth, which was shown by the success of the technique and patient satisfaction.

Keywords: Immediate implants, exodontia, retrospective study, evidence-based dentistry.

RESUMO

Objetivo: O estudo retrospectivo teve como objetivo traçar o perfil de uma série de pacientes que receberam implantes imediatos, enfatizando as causas da exodontia. **Materiais e Métodos:** Este estudo retrospectivo de 10 anos (2006-2016) conduziu um levantamento de dados em pacientes submetidos a exodontia e instalação imediata de implantes. O estudo baseou-se na análise de dados clínicos coletados nos prontuários de consultórios odontológicos de especialistas em Implantodontia. O instrumento continha questões referentes à condição sistêmica do paciente, causas dentárias de exodontia e tipos de implantes instalados. **Resultados:** Dos 846 dentes extraídos dos 407 pacientes analisados, 242 foram substituídos por implantes únicos, 276 por implantes para protocolos superiores e 328 por implantes para protocolos inferiores. A maior taxa de instalação de implantes ocorreu entre 2010 e 2014, correspondendo a 51,4% da amostra, na qual 64,1% dos pacientes eram mulheres e 58,3% tinham idade entre 41 e 60 anos. A maior incidência de extrações apresentou causas periodontais (19,2%), protéticas (17,4%) e endodônticas (15,2%). Entre as causas protéticas, a cárie esteve presente em 111 casos. Para causas periodontais, a periodontite crônica generalizada estava presente em 200 dentes. Nas causas endodônticas, a fratura radicular foi evidente em 114 dentes e mais prevalente nas exodontias unilaterais ($p < 0,001$). Além disso, a maior taxa de perdas dentárias (32,4%) ocorreu por exodontias estratégicas para a substituição de um único dente ou protocolos superior e inferior ($p < 0,001$). **Conclusão:** Os implantes imediatos mostraram-se uma alternativa importante para a reabilitação de dentes comprometidos, o que foi demonstrado pelo sucesso da técnica e satisfação do paciente.

Palavras-chave: Implantes imediatos, exodontia, estudo retrospectivo, odontologia baseada em evidências.

1 INTRODUCTION

As a clinical science, Dentistry has sought treatment options that require in most cases a multidisciplinary decision for teeth with uncertain prognosis, in which their structures are extremely compromise. This works for both the prevention and execution of clinical procedures to solve situations related to root caries and pulp and periodontal diseases, aiming to recover the dental element and adjacent structures (periodontium and bone tissue). Currently, dentists have treatments such as endodontics, paraendodontic surgeries, root resections, or the replacement with dental implants and respective

restorations. These treatments aim to rehabilitate the stomatognathic system of patients to maintain the tooth structure or replace it with osseointegrated implants.

In addition to factors related to the clinical treatment itself, there are others that influence the choice of therapy, such as patient choice, systemic factors (physical and psychological health), and financial issues of the final therapy, aiming to meet the expectations of both patient and professional for the best resolution of the clinical case.

According to Torabinejad et al. (2007) ^[1], the decision for a treatment is difficult for both patient and professional, and it should be based on scientific studies and clinical evidence. When selecting the treatment, it is also important to consider the preservation and maintenance of biological structures such as bone and gingival tissues. Therefore, exodontia and the immediate replacement with osseointegrated implants present positive factors such as lower rate of bone resorption than in the first six months of exodontia without immediate implant installation, preference for peri-implant aesthetics (maintenance of gingival and support tissues and interdental papilla), and biological and psychological advantages of immediate implants, which provides a shorter rehabilitation waiting time ^[2].

The present retrospective study aimed to draw, using data collected from the dental records, the profile of a series of patients who received immediate implants, emphasizing the causes for exodontia, type of implants installed, immediate loading or not, and type of prosthetic rehabilitations performed.

2 MATERIALS AND METHODS

This cross-sectional retrospective study, based on a structured data collection instrument, was performed with dentists specialized in Implantology who had been trained for at least eight years, in the city of Passo Fundo, RS, Brazil and nearby regions. Twenty professionals registered at the Regional Council of Dentistry were drawn electronically with the Excel™ software from a list provided by this professional association. After the draw, the professionals were invited to participate in the research, signing a Free and Informed Consent Form. The cross-sectional survey consisted of a form with questions regarding data from patients who received immediate implants and the reasons for extraction. The data analyzed corresponded to the years from 2006 to 2016 (10 years).

The researchers provided instructions to the dentists selected regarding the clinical cases that fit the study, determining the inclusion and exclusion criteria, which allowed

the professionals to make a previous selection of the medical records of their patients. In the second visit, with a previous appointment scheduled, one of the people in charge of the survey attended the clinic and had access to the pre-selected clinical records, filling in the forms with the data provided. The form (structured instrument for data collection) addressed issues of the daily dental clinic, assessing factors related to general and oral health of patients in the following aspects: reason for the visit, behavioral factors, and endodontic, periodontal, and prosthetic involvement.

One single calibrated examiner analyzed the records of patients. A previous intra-examiner calibration was performed in 20 dental records, with Kappa test at 0.80. The form addressed aspects of the daily dental clinic, determining the exodontia of tooth structure due to its high involvement, addressing data related to reasons for the visit (pain, trauma, tooth mobility, aesthetics, caries, and strategic exodontia for upper and lower Branemark protocols) and systemic and behavioral factors. Endodontic causes for exodontia include root resorption, persistent pain, root fracture, and associated causes. Periodontal causes were localized and generalized chronic periodontitis, localized and generalized aggressive periodontitis, and associated causes. Prosthetic causes include failure or fracture in crown restorations, extensive crown and/or root caries, unfavorable intermaxillary relationships (dental extrusions) and associated causes. Strategist causes was related if teeth with a good prognostic, but it was necessary to do the planning of implants (protocols). Causes related to the evolution of implant design are external and internal Hexagon implants, one Morse implants, diameter and length of the implant, immediate implant loading, success rate, and preservation time of the case. This study considered that, for each tooth extracted, an osseointegrated implant was installed in its place.

All exodontias performed between 2006 and 2016 were assessed, in which the inclusion factor was the compromised tooth structure without the possibility of conservative rehabilitation, replacing the tooth immediately with dental implants. The exclusion factors were sites of extracted teeth that did not receive immediate implants, teeth with extensive periapical lesions and little bone remnant near anatomic structures, teeth with extensive bone losses requiring auxiliary treatments (bone grafts prior to implant treatment), patients under 18 years old, and patients with debilitating diseases that would prevent immediate implant installations.

The research project was submitted to and approved by the Research Ethics Committee of the University of Passo Fundo, RS, Brazil (CEP: 1.592.929). Before

completing the form, the professionals of the private clinics involved in the research signed a Free and Informed Consent Form.

The data collected were tabulated in an Excel™ electronic spreadsheet and submitted to descriptive statistical analysis and 0.05% chi-square test using the SPSS 23™ software.

3 RESULTS

After performing the analysis previously described, data were collected on 846 teeth extracted from 407 clinical cases selected. The following tables show the data for the sample studied.

Table 1. Demographic data – Period of assistance and age group (years).

PERIOD OF ASSISTANCE	N	%	Age	N	%
2006-2009	258	(30.5)	25-40	120	(14.2)
2010-2014	435	(51.4)	41-60	493	(58.3)
2014-2016	158	(18.1)	61-85	233	(27.5)
TOTAL	846	100.0	TOTAL	846	100.0
SEX	N	%			
Female	542	(64.1)			
Male	304	(35.9)			
TOTAL	846	100.0			

A descriptive analysis in this 10-year cross-sectional study shows that the greatest demand of patients for dental care due to tooth losses and replacement with immediate implants occurred between 2010 and 2014 (51.4%). The age group with the highest incidence of this therapy was between 41 and 60 years (58.3%). Overall, dental care was more frequent for the female sex (64.1% - Table 1).

Table 2. Factors related to the health of patients.

	N	%
Controlled diabetes	12	1.4
Treated hepatitis	6	0.7
Chemo/radio/biophosphate	19	2.3
Hypertension/heart disease	151	17.8
Psychic disorders	38	4.5
More than one disease	61	7.2
No disease	559	66.1
TOTAL	846	100.0

The study analysis found that most patients were free of any health problems (66.1%), which is a positive factor for the clinical success of implants. Hypertension and heart diseases were the most frequent conditions for the patients assessed (17.8%), followed by the presence of more than one disease (7.2%) and psychic disorders (4.5%).

Table 3. Types of implants installed associated with single-tooth rehabilitation and upper and lower protocols.

Protocol	Upper protocol	Lower protocol	TOTAL	Single implants	Total
External Hexagon	138 (29.7%)	261 (56.2%)	399	65 (14%)	464 (54.8%)
Internal Hexagon	30 (24.8%)	30 (24.8%)	60	61 (50%)	121 (14.3%)
Cone Morse	108 (41.3%)	37 (14.2%)	145	116 (44.4%)	261 (30.9)
TOTAL	276 (32.6%)	328 (38.8%)	604	242 (28.6%)	846 (100%)

p=0.0001 p = 0.0001

The present study classified the different types of oral rehabilitation in relation to exodontia in single implants and upper and lower protocols. Single implants represented 242 cases, with 28.6% of the sample. The upper protocol corresponded to 32.6% of cases and the lower protocol corresponded to 38.8% of the sample.

Regarding the design and connection system of the implants, the external hexagon implants (54.8) stood out as the first choice, followed by cone Morse (30.9%) and internal hexagon (14.3%) implants. Regarding immediate implant installation, single implants corresponded to 28.6% of cases followed by the upper protocol (32.6%), and the lower protocol prevailed in 38.8% of cases.

Table 4. Reasons of exodontia related to age group.

Age	Strategic exodontia	Endodontic causes	Periodontal causes	Prosthetic causes	Associated causes	TOTAL
25-40	41	26	11	22	20	120
41-60	160	83	78	86	86	493
61-85	73	20	73	39	28	233
TOTAL	274	129	162	147	134	846

p=0.0000

This table shows that strategic exodontias were the causes most prevalent in the age group of 41-60 years with 160 of the 493 cases. Prosthetic and associated causes also had a high incidence both with 86 cases. Strategic exodontias were also evident in the age group of 25-40 years (41 cases), followed by endodontic causes (26) in 120 cases. In the age group of 61-85 years, periodontal causes (162) and strategic exodontia (274) prevailed.

Table 5. Causes of exodontia associated with the performance of upper and lower protocols and single implants.

REASONS EXODONTIA	Upper protocol	Lower protocol	TOTAL	Single implants
Strategic	112	122	234	40
Endodontic	28	26	54	75
Periodontal	44	96	140	22
Prosthetic	52	46	98	49
Associated	40	38	78	56
TOTAL	276	328	624	242
p = 0.0030				= 0.0001

Regarding exodontias for performing upper and lower protocols, strategic exodontia was the most frequent cause, in which some teeth with uncompromised structures were removed along with others for performing the upper (112 - 40.5%) and lower (122 - 37.2%) protocols of the cases. For single implants, the highest rate of exodontia was for endodontic causes 75 (31%), followed by associated 56 (23.1%) and prosthetic 49 (20.2%) causes.

Table 6. Prevalence of endodontic causes associated with upper and lower protocols and single implants, using the chi-square test at 0.05%.

Endodontic causes	Upper Protocol	Lower Protocol	Total	Single implants	Total
Root resorption	10	19	29	11	40
Persistent pain	8	9	17	14	31
Root Fracture	21	16	37	77	114
Associated causes	3	0	3	23	26
Other causes	234	284	518	117	635
Total	276	328	604	242	846
p = 0.1400 < 0.05 – power: 0.99				p = 0.0001 < 0.05 – power: 0.99	

There was no significant association of endodontic causes with the performance of upper and lower protocols by the chi-square test. A total of 518 cases did not present endodontic causes ($p=0.1400 < 0.05$). In addition, endodontic causes were not the reason for single-tooth extractions in 117 of the 242 cases assessed. Root fracture presented a higher incidence of endodontic causes in 114 of the cases (37 protocols and 77 single implants). In the upper protocol, the prevalent reason for exodontia was root fracture in 21 cases and the lower protocol showed root resorption in 19 of the 44 cases assessed for endodontic reasons.

There was a significant association of single implant installation with endodontic causes, evidenced by the chi-square test ($p = 0.0001 < 0.05$). It was assessed that 48.3% of cases did not present causes of tooth loss related to endodontic problems (117 of the 242 cases assessed). The greatest cause of tooth loss was root fracture, with 77 cases, and the lowest incidence was root resorption, with 11 cases.

Table 7. Prevalence of periodontal causes associated with upper and lower protocols and single implants, using the chi-square test at 0.05%.

Periodontal causes	Upper protocol	Lower protocol	Total	Single implants	Total
Chronic periodontitis	62	114	176	24	200
Aggressive periodontitis	5	18	23	5	28
Associated causes	11	0	11	13	24
Other causes	198	196	394	200	594
Total	276	328	604	242	846
p = 0.0001 < 0.05 – power: 0.99			p = 0.0001 < 0.05 – power: 0.99		

There was a significant association of periodontal factors with upper and lower protocols and single implants verified by the chi-square test ($p = 0.0001 < 0.05$), in which the major causes of tooth loss were not related to periodontal problems in 394 of the 604 cases assessed for protocols (65.2%) and in 200 of the 242 cases assessed for single implants (82.6%). In the general survey (chronic and aggressive periodontitis and associated causes), chronic periodontitis affected 83.8% of cases. In the lower protocol, chronic periodontitis was present in 114 of the 176 cases.

Single implants were not associated with periodontal causes in 200 of the 242 implants installed (82.6%). Chronic periodontitis was present in 24 of the 42 cases assessed as periodontal cause for tooth loss. The lowest rate refers to aggressive periodontitis with five of the 42 cases involved. These data were statistically significant by the chi-square test at 0.05%.

Table 8. Prevalence of prosthetic causes associated with upper and lower protocols and single implants, using the chi-square test at 0.05%.

Prosthetic causes	Upper protocol	Lower protocol	Total	Single implants	Total
Failure or fracture	14	11	25	17	42
Extensive caries	40	28	68	43	111
Intermaxillary relationship	6	14	20	0	20
Associated causes	25	14	39	31	70
Other causes	191	261	452	151	603
Total	276	328	604	242	846
p = 0.0040 < 0.05 – power: 0.99			p = 0.0001 < 0.05 – power: 0.99		

Extensive caries were present in 68 of the protocol cases assessed in the sample and in the upper protocol, it affected 40 of the 85 cases performed (47%). Other causes corresponded to 191 upper protocols and 261 lower protocols.

In 62.3% of cases, the reason for single-tooth losses (151 of the 242 cases assessed) was not classified in any of the causes mentioned. Dental caries were the major cause for exodontia, with 43 of the remaining 91 cases, corresponding to 47.2% of the sample minus 151 cases. The lowest incidence occurred for dental fracture, with 18.6% of cases and affecting 17 of the 91 cases assessed (Table 8).

4 DISCUSSION

In the present 10-year retrospective study, positive clinical experiences showed the immediate implant technique as a viable option to provide an effective and safe treatment. In the current literature, reports of high success rates were found for immediate implants, corresponding to 94% to 100%, granting approval of the technique, although this scenario suffers external and systemic influences that may change such result. [2-5]

The factors addressed in this study showed the main causes of tooth losses in the dental aspect aiming at immediate implant installation (endodontic, periodontal, prosthetic, associated, and strategic causes), as well as other potential factors that could influence immediate implant installation (age group, systemic and economic factors and types of prosthetic rehabilitation).

The study presented a significant sample of specific clinical cases of exodontia and immediate implant installation, presenting a significant sampling power (0.99). This research was performed by a single calibrated examiner who assessed the clinical cases

of dental records of Implantology specialists who had been working for more than eight years in the field.

It was observed that the age group with the highest incidence of implant installation was 41 to 60 years, showing a direct relationship in both functional and aesthetic aspects. This allows observing that with the current increased life expectancy, patients are also looking for greater social interaction, revealing aspects of personal satisfaction with their appearance, which have a positive influence on quality of life. ^[6,7]

Referring to this age group (41-60 years), strategic causes were the main reasons for exodontia (160) for protocol implants, followed by prosthetic and associated causes, both with 86 of the 493 cases. The retrospective analysis showed that both sexes were included in this opinion, especially the female sex (64.1%). In this study, implants were installed in patients aged 61-85 years in 233 cases. Busenlechner et al., 2014 ^[4] consider that the advanced age of patients does not indicate implant failure.

The replacement of teeth assessed periodontally with dental implants occurred with a higher incidence in patients aged 41 through 60 years, corresponding to 55% of cases (140 of the 252 tooth losses due to periodontal causes). Tooth replacements with protocols, resulting from periodontitis (including chronic and aggressive periodontitis and associated causes), were 37.8% of cases (35.2% chronic and 2.17% aggressive). As for single implants, 17.3% of tooth replacements were due to periodontal causes, with 17.8% because of aggressive periodontitis. Some studies have shown that healthy adult individuals presented 10% likelihood to develop peri-implantitis, and patients with aggressive periodontitis were five times more likely to present implant failures, showing lower success and survival rates. ^[8,12,17]

At the ITI Fourth Consensus Conference (November 2009), the advantages and disadvantages of the various moments in time for implant placement after tooth extraction were reported. They concluded that immediate implant placement is a more difficult technique than delayed implant placement to allow initial stability and a good prosthetic position. However, based on the esthetic index, 80% of the immediate implant sites show satisfactory results. The survival rates of post-extraction implants are high and comparable to those of implants placed in healing sites. ^[24]

The causes of strategic exodontia were the major reasons for exodontia associated with implant installation and immediate loading, corresponding to 161 of the 525 (30.6%) cases analyzed. According to the literature, the most frequent causes of immediate loading implant installation were not related to strategic exodontia (indicated in the study).

Busenlechner et al. 2014 ^[4] attribute the main reasons for exodontia followed by immediate loading to other factors such as endodontic failure, caries, periodontal disease, prosthetics, fractures, perforations, orthodontics, aesthetics, or other reasons. According to Touré et al. 2011 ^[9] strategic exodontia is important when referring to poorly positioned teeth, extrusions, economic issues of the patient, treatment time, among others.

Among the main causes of tooth losses related to prosthetics, dental caries had the highest incidence rate, with 111 teeth in the 407 patients assessed (13.1%), and pain was not associated with the carious process, because the study showed a pain index in 3.7% of cases. These carious lesions probably resulted from poor prosthetic or restorative adaptations, which complicated hygiene. The causes referred to insufficient crown retention and inadequate intermaxillary relationship (2.36%), prosthesis fracture (2.6%), insufficient root length (2.83%), and more than one of these causes, with 5.43% of the cases ($p < 0.00$), by the chi-square test. These data diverged from the study by Touré B. et al. 2011 ^[9], in which crown fracture corresponded to the cause of tooth losses in 15.1% and caries in 5.2% of cases.

The protocols (upper/lower) resulting from prosthetic causes represented only 24.83% of the cases performed. Specifically, 11.2% were due to caries (14.4% upper protocol and 10.14% lower protocol) and 4.1% due to prosthesis failure or fracture. For single implants resulting from tooth losses due to prosthetic failure, both extensive caries and the association of these factors were present in 37.6% of cases. Similar data to our study are observed. ^[10]

The descriptive statistical analysis showed that the highest occurrence of tooth losses in 32.8% of cases (274) were not any of the reasons related to periodontal, endodontic and prosthetic problems. The results possibly refer to issues in which extractions were strategic for single-tooth replacement (40 cases) or upper (112) and lower (122) protocols for several reasons, such as extrusions, tooth migrations ^[11], treatment time, general health ^[12], and psychological health ^[13], among others.

The immediate implant technique has provided Implantology with advantages for both patients and professionals regarding several aspects such treatment agility, considering that, at the moment of surgery, a temporary implant is already installed, reducing treatment time and providing aesthetics and immediate function to the patient. It also leads patients back to social interactions, according to studies ^[2,5,13,14,25].

This retrospective 10-year follow-up study showed that, from the 846 immediate implants installed, 525 received immediate loading, corresponding to 62.1% of cases.

This may be associated with factors mentioned by Flanagan 2016 ^[15], who analyzes implant loss due to the colonization of several anaerobic and facultative bacterial species at the site of implant installation in the apical portion of the implant, causing peri-implantitis and having *Enterococcus faecalis* as the main originator.

Sousa et al. 2015 ^[16] considered that patients with a history of periodontal disease showed a significant increase in bone loss due to a higher incidence of peri-implantitis, with implant losses and biological complications. Additionally, the indicators of failure of immediate implant with immediate loading were the following: periodontal disease, smoking, systemic diseases, infections, aging, parafunctions, short implants, insufficient number of implants, lack of integration with implant and soft tissues, and inadequate prosthetic design.

In both upper and lower protocols, immediate loading was beneficial for immediate patient rehabilitation and it was present in 69.7% of cases, with 38% in the upper arch and 61.9% in the lower arch. The success of this technique proved to be satisfactory, justifying the choice for this treatment. These data agree with Barbier et al. 2012 ^[17] who, in a prospective clinical trial, showed results indicating the success of the immediate installation and loading of five to six implants in the edentulous maxilla.

The installation of single implants with immediate loading showed a smaller number, corresponding to 42.9% of cases (242 cases). This may be associated with bone loss at the implant site requiring auxiliary treatments ^[12], contaminated sites, proximity to important anatomic structures, lack of professional knowledge ^[18], economic issues ^[19], psychological factors ^[12,20,21] and others. These data agree with the observations of the study by Torabinejad (2006) ^[1], in which bone loss at the fractured tooth site would affect aesthetics due to the bone defect caused. From the 124 single implants installed, the technique reached osseointegration in 72.5% of cases. Other factors that could interfere with this technique were thin gingival biotype, changes in bone wall thickness, and systemic, oral, and behavioral health issues of the patient such as diabetes, smoking, and oral hygiene. ^[1,4,22]

Another relevant factor for the success of immediate or late implants would be the preservation of the clinical case. This study found a high rate of 80% of cases (single implants and protocols). Upper protocols showed preservation of 84.8% of cases, lower protocols showed 82.8%, and single immediate implants had 72.5% of the cases reported. Professional follow-up is important for the success of the procedure, because hygiene, occlusal traumas, condition of prosthetic components, and bone assessment of the implant

will be analyzed in this period. Voza et al. 2011 ^[23] affirm that the main loss of implants attributed to poor hygiene and occlusal overload, requiring protected occlusion.

LIMITATIONS

We suggest that further studies should investigate larger samples and perform longitudinal follow-ups of reasons of tooth extraction and implants in order to improve the results reliability.

5 CONCLUSION

Based on the methodology used and the sample assessed, the following may be inferred:

- The treatment with immediate implants is predictable and presents high success rate. The success of the immediate implant affected by several factors related to the causes of tooth loss;

- Periodontitis was the main cause of search for treatments related to protocols and tooth fractures were the main cause for treatments related to single implants. The largest searches were by female patients aged between 41 and 60 years;

- The greatest cause of tooth loss in lower protocols were periodontal causes (chronic periodontitis), upper protocols had prosthetic causes (caries), and single implants presented endodontic causes (root fractures);

- The implants most commonly used were external hexagon implants, followed by Cone Morse implants.

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