A retrospective clinical trial of the early success rate of osseointegrated implants

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Abstract

Introduction: Dental implants have become an alternative to treat edentulism, however, some variants involving the implant itself and the receptor site can hinder treatment success. Dental implant failure is classified into late or early, depending on when it occurs. **Objective:** To determine the early success rate of implants installed during a specialization course in Implantodontics carried out between 2009 and 2012. **Methods:** The records of patients treated between 2009 and 2012 were analyzed. The following inclusion criteria were applied: P-I Brånemark Philosophy implants installed by means of the two-stage surgical technique, with implants submerged for a minimum period of three months. The selected patients underwent implant placement in the maxilla and mandible, subjected or not to bone graft. Evaluation was implemented at implant reopening. Implant survival after prosthetic loading was not considered. **Results:** The success rate was of 97%, with the presence or absence of bone graft, with implant positioning significantly influencing the final results. **Conclusions:** The success rate observed by this study not only corroborates the literature, but also reveals that the operator's experience does not necessarily interferes in treatment outcomes. The findings also show that the posterior region had the highest number of failures, whereas bone graft sites had a higher success rate in comparison to other studies.

Keywords: Dental implant. Osseointegration. Epidemiological studies.

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Introduction

With the development of Implantodontics, osseointegrated implants have become the first option for treating edentulism. In this context, new techniques and material have been continuously developed to promote osseointegration in an effective, stable, early and lasting manner.

However, some factors negatively affect the success of this type of rehabilitative treatment, among which is the relationship between the characteristics of implant *versus* receptor site.[14] The inherent characteristics of implants are: surface treatment, morphology and biocompatibility.[1,18] As for the receptor site, bone quality and amount are key for treatment success. Furthermore, the surgical technique, initial stability of the implant, the surgeon's experience and reverse planning should also be analyzed.[14,18] The presence or not of systemic changes and harmful habits that may hinder bone-implant interaction should also be considered.[10]

Implant failure is classified into early or late. The former happens before an implant fulfills its function, i.e., it is related to the healing process. The latter happens after chewing efforts are required, thus characterizing a breakage of a pre-existing osseointegration.[10]

In this context, the objective of this study was to establish the failure rate of implants installed during an specialization course in Implantodontics of the Brazilian Association of Dentistry (Cascavel/PR), between 2009 and 2012.

Material and Methods

The records of patients treated in the specialization course of the Brazilian Association of Dentistry (Cascavel/PR) between 2009 and 2012 were analyzed. The study included males and females aged between 18 and 70 years.

The following inclusion criteria were applied: PI Brånemark Philosophy™ implants (Exopro, Campinas/SP, Brazil) installed by means of the two-stage surgical technique. These implants, developed by professor Per-Ingvar Brånemark, present the following characteristics: cylindrical and symmetrical body with round threads and decreasing depth minimized to the apex; semi-rugous surface with circular and irregular micro threads with depth of 1 μm to 5 μm, exposed to subtraction by mechanical ultra cleaning; tapered apex with threads; central opening and distal chambers with three or four inputs responsible for the functional management of bone tissue; and nanometric topography.[6]

The following exclusion criteria were applied: patients with incomplete records; those who had not yet been submitted to the second surgical phase; patients whose implants were installed in one surgical phase, only; or who gave up treatment.

The selected patients underwent implant placement in the maxilla and mandible, subjected or not to bone graft (autogenous, homogenous or xenogeous). Autograft had the mandibular ramus, mentum, tuberosity of the maxilla or cranial vault as donation sites. BioOss lyophilized bovine bone (Geistlich Pharma of Brazil, São Paulo, SP, Brazil) and bone grafts from bone bank were also used. Patients' preoperative preparation included antibiotic prophylaxis with 1 g of amoxicillin and preemptive analgesia with 4 mg of dexamethasone.

After analysis and planning of cases and procedures of asepsis and antisepsis, implant placement was performed under local anesthesia with 4% Articaine with epinephrine 1:100,000 through full thickness mucoperiosteal flap. Receptor site preparation was carried out with drills provided by the manufacturer whose instructions were strictly followed. After implant placement, suture was performed with 4-0 Nylon, with implants submerged for a minimum period of three months and a maximum period of 26 months.

Data collection included information about: patient's age and sex; underlying diseases; smoking habits; number of implants; implant loss; previous bone graft procedures, material and donation site; reopening and implant loss time.

Evaluation was implemented at implant reopening. Implant survival after continuous chewing efforts was not considered. According to Albrektsson and Zarb's adaptation,[1] implants were considered successful when meeting the following criteria: absence of painful symptoms, absence of persistent infection and absence of clinical mobility in any direction after reopening. Implants were monitored for 30 days after the prosthetic crowns had been installed.

Data were analyzed by means of absolute (n) and relative (%) frequency values, as well as by the parameters of mean and standard deviation. Fisher's exact test and chi-square test were used to verify the association between the qualitative variables and the implant outcomes. Student's "t" test was used to compare the "Success" and "Failure" groups with the quantitative variables. Significance level was set at 5% ($P < 0,05$) for all tests, with statistical procedures carried out in the SPSS software (version 13.0).

Results

This analysis was based on the assessment of the medical records of 132 patients, 93 women and 39 men aged between 18 and 70 years old, with a mean age of 47.33 years. A total of 430 implants were analyzed, with 13 cases of failure (Fig 1). Among these, 193 implants were inserted in the maxilla (44.8%) and 237 in the mandible (55.1%), with 307 installed in the posterior region and 123 in the anterior region. All cases of failure occurred in the posterior region (Table 1). Despite these findings, the result was statistically insignificant ($P = 0.190$; chi-square) due to the small number of failures. The minimum period for reopening was of three months, whereas the maximum was of 26 months, with an average of 7.90 ± 3.89.

Non-grafted areas received 399 implants (78.8%), whereas grafted sites received 91 implants (21.2%). Additionally, 63.7% of bone grafts were block grafts, 35.2% sinus lift and 1.1% particulate grafts. The most prevalent donation site was the menton, followed by the mandibular ramus. Implant loss comprised 4.4% of the sample (Fig 3), with statistically significant difference in comparison to implants installed in areas without bone graft ($P = 0.287$; Fisher's Test).

Out of the total, 143 (33.3%) implants were distributed among patients with systemic changes (Fig 2) of which the most prevalent was hypertension (31.72%). Seven implants were installed in patients with diabetes mellitus (1.6%), with only one case of failure (14.28%). However, due to the limited sample, this data is statistically insignificant ($P = 0.236$; Fischer's Test). Smokers accounted for 1.2% of implants, without any failures ($p= 0.857$).

Discussion

Dental implant failure is classified into early or late, depending on the moment when failure occurs: before or after prosthesis placement. According to Misch et al,[12] an

Table 1 - Association between implant topographic location and final outcome.

			Result		Total
			Success	Failure	
Topographic location	Lower anterior	n	42	0	42
		%	100.0%	0.0%	100.0%
	Lower posterior	n	188	7	195
		%	96.4%	3.6%	100.0%
	Upper anterior	n	81	0	81
		%	100.0%	0.0%	100.0%
	Upper posterior	n	106	6	112
		%	94.6%	5.4%	100.0%
Total		n	417	13	430
		%	97.0%	3.0%	100.0%

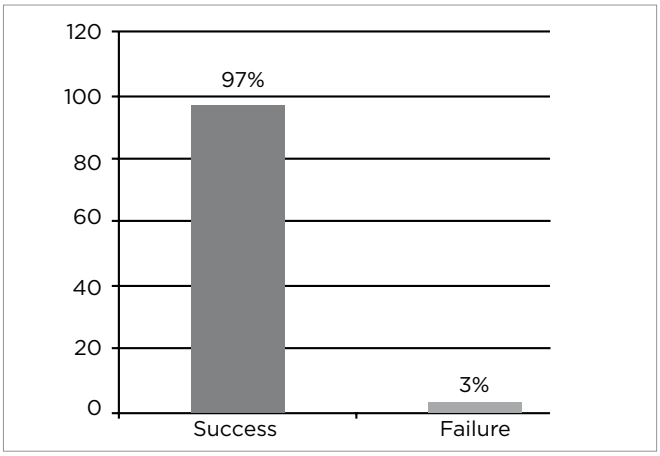

Figure 1 - Success rate of the analyzed implants.

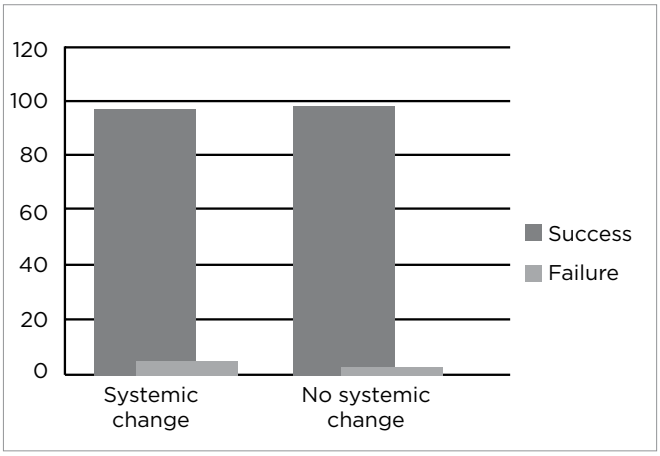

Figure 2 - Results obtained in patients with systemic diseases.

Figure 3 - Success rate of implants installed in areas submitted to bone graft.

implant is considered successful in the absence of mobility at the time of reopening and beginning of the prosthetic phase, absence of radiolucent radiographic image adjacent to the implant and when suppuration or symptomatology associated with the implant are not present. The potential risks of early failure include bone amount and quality, receptor site, presence of bone grafts, genetic predisposition, metabolic disorders, smoking habits,[4,21] implant biocompatibility and morphology, and surgical technique.[1,5] As for late failure, we can also add planning and development of the prosthetic phase.[13,18]

Some authors claim that systemic changes can affect treatment success, however, the subject is still controversial.[12,13] Although it has been suggested that the presence of diabetes mellitus, even in compensated patients, can affect implant survival, no conclusive data is able to prove such interaction. In this study, failure was observed in 14.28% of implants inserted in diabetes mellitus patients, however, due to the limited sample, data was not significant. Other studies have recently reported that cardiovascular diseases do not affect implant failure, especially early.[13]

The histological changes that promote osseointegration are activated by local aggression of the alveolus during surgical preparation. Tissue repair happens as a result of blood clot formation between the surface of the implant and the bone wall, where mesenchymal cells differentiate themselves into osteoblasts or fibroblasts, thus promoting bone integration or formation of fibrous scar, respectively.[17,20] Primary stability is essential for this process and results from bone quality and amount, implant geometry and the surgical technique.[3,17] Smoking habits negatively interfere in bone quality. The negative action of tobacco is mainly related to peripheral vasoconstriction and decreased blood flow, directly affecting the initial phase of healing. In addition to vasoconstriction, nicotine increases platelet aggregation as well as fibrinogen and hemoglobin

levels, and hinders neutrophil and leukocyte activities, thus affecting the healing process.[21]

The literature demonstrates that smokers have a higher implant failure rate,[9,14] especially when installed in the maxilla.[14] However, Baqain et al,[4] claim that tobacco alone is not a significant risk factor. Sverzut et al[21] and Ardekian et al[3] assert that tobacco is not considered a statistically significant risk factor for early implant failure. In the present study, five implants were installed in patients with smoking habits, without cases of failure. However, due to a limited sample, this fact proves to be inconclusive.

Success rates vary considerably in the literature. In spite of favorable conditions, a small number of implants is fated to failure.[17] Oliveira[14] mentions that the success rate for single dental implants ranges from 91 to 98.5%. Serrão et al[18] found a success rate between 97.3% and 98%, varying according to the implant surface treatment. According to Canullo et al,[6] the survival and success rates of late implant placement and load range between 96.3% and 96.5%, whereas with immediate loading the percentages vary from 97.1% to 97.7%. In the study conducted by the authors, the index was of 96.64%. A study conducted by Olate et al[13] found a success rate of 96.2% for 1649 implants. Sverzut et al,[21] AlGhamdi[2] and Olate et al[13] affirm that early failure affects approximately 1.5% to 21% of implants. Baqain et al[4] assert that early failure rates vary from 0.7% to 3.8%. The present study, which evaluated 399 implants, found a failure rate of 4%. In agreement with data provided by the literature, the present study presented a success rate of 97%. Alghamdi[2] reports that surgical trauma seems to be the most common cause of implant failure.

The surgical technique may be affected, among other factors, by the ability of the operator. Some authors have pointed out that the surgeon's skills are directly related to implant loss, especially when early failure is taken into account.[9,14] In contrast, other authors claim that this variant does not affect final treatment outcomes. More recent studies have evidenced that the surgeon's experience does not influence implant success rates.[10] These statistics can be explained by the technological innovations of implants and surgical techniques[20] and by the supervision of experienced and trained professionals during specialization courses on surgery. This study corroborates with those authors and, in association with the literature, assumes that the success rate of implant placement carried out by experienced professionals is statistically similar to that achieved by undergraduate professionals, thus demonstrating that the success rate seems to be more influenced by other factors. Likewise, Oliveira[14] reached levels similar to those of other analyses, which suggests that students' education during the specialization course is enough to provide the patient a satisfactory treatment from a functional and esthetic point of view.

The receptor site can also affect implant success. For Alghamdi,[2] the areas with greater losses are, respectively, the anterior region of the maxilla, posterior region of the mandible, posterior region of the maxilla and the anterior region of the mandible. According to Baqain et al,[4] bone types I and IV are more likely to present early failures. However, Olate et al[13] assert that implant positioning in the maxilla and mandible does not generate statistically significant differences. For these authors,[13] bone quality is not related to early implant loss, being more closely linked to late loss. They analyzed 1628 implants and found no statistical differences in implant success installed in the mandible or maxilla, however, implants installed in the anterior region showed a higher failure rate (4.3%) when compared with implants installed in the posterior region (2.8%). In the study by Canullo et al,[6] failure reached a rate of 2.85% for implants installed in the mandible and 3.8% for implants installed in the maxilla. In the same research, 528 implants were inserted in the mandible, with 11 cases of posterior failure (3.14%) and four cases of anterior failure (2.25%). A total of 633 implants were

installed in the maxilla, with 24 cases of failure: 13 in the posterior region (4.02%) and 11 in the anterior region (3.56%). Differently from data found in the literature, out of the failures found in this study, seven occurred in the mandible (3.6%), six occurred in the maxilla (5.4%), and all of them occurred in the posterior region.

Rehabilitation with osseointegrated implants require minimal bone amount to achieve stable anchorage. Some cases even require previous bone graft. Nevertheless, implant placement in bone-grafted sites have lower success rates in comparison to non-grafted sites,[7,15] probably due to poor vascularization and the lower amount of cells in grafted bones.[15] The literature shows that the success rate of implants inserted in grafted areas varies from 49% to 100% in the maxilla, and between 61% and 98% in the mandible.[7] The study conducted by Serrão et al[18] revealed a success rate of 97.8% for implant placement in non-grafted areas, whereas the index found in grafted areas was of 80%. Canullo et al[6] examined 1,161 implants, out of which 39 failed (3.36%). 135 had been inserted in grafted areas, with a failure rate of 5.19% (7 cases of failure). The present analysis had a success rate of 97.3% for implants inserted in non-grafted areas, and a rate of 95.6% for grafted areas, thus contradicting data from the literature which demonstrate higher failure rates for grafted sites.

Surface treatment may also be related to implant success.[5,20] The topographical modifications vary in micro and nanometric scales.[11] Some studies revealed that implants subjected to these processes have an increased bone contact,[11] thus providing more intense osseointegration and, as a consequence, shortening waiting time and allowing early loading.[20] However, other authors did not identify differences in bone response for implants with micro or nano-topography. Thus, the benefit of nanometric modification of implant surface is still controversial,[5] however, the literature confirms that surface treatment generally improves the response of osseointegration when compared to machined surface implants.

As for early implant loss, infection can be considered as one of its main causes.[8,16,19] The infection rate varies from 1% to 3%,[3] and, for this reason, several antibiotic therapies have been recommended to decrease the risk of complications.[16,19] Nevertheless, the use of antibiotics includes risks.[19] Thus, the antibiotic of choice should not only have the least possible side effects, but also to be effective against the main bacteria responsible for infection.[8] According to Ardekian et al,[3] antibiotic prophylaxis reduces the risk of infection in 50% of cases. Karaky et al[18] evaluated three therapeutic regimens: antibiotic prophylaxis; postoperative use of antibiotics; as well as pre and postoperative antibiotic therapy. No statistical differences were found among the three groups, thus concluding that the therapeutic regimens to be adopted should be limited to prophylaxis, as the latter reduces the costs and the possibility of bacterial resistance. However, from a methodological point of view, a fourth group (control group) should have been employed, without the use of any antibiotic regimen, so that the real need for systemic antibacterial agents could be evaluated.

The overall failure of endosseous implants varies from 1.9% to 3.6%.[14,18,20] Early failure happens due to some interference in the healing process, whereas late failure occurs due to a difficulty in maintaining the pre-established osseointegration.[1,3,21] The prevalence of early failures (approximately 1.9%)[18] is higher in young and healthy women and evolves with less bone loss when compared to late failure.[10] The main cause of these cases is failure in osseointegration. Late failure (3.6% to 4.3%)[18] is related to male patients of more advanced ages, with higher prevalence of systemic problems in addition to moderate to severe bone loss, which makes treatment more complex.[10] The main reasons of late failures are: peri-implantitis, occlusal overload and implant fracture.[9,10]

Conclusion

The success rate obtained in this study corroborates the literature and evidences that the operator's experience does not necessarily affects final treatment outcomes. The findings also demonstrate that the area with the greatest failure rate was the posterior region and that bone-grafted sites showed higher success rates in comparison to other analyses. However, due to the limited sample, additional studies are warranted to further investigate these variants.

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