



REVIEW ARTICLE

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## FACTORS INFLUENCING OSSEOINTEGRATION SUCCESS: A LITERATURE REVIEW

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### ABSTRACT

**Introduction:** Osseointegration is a cellular biological process that corresponds to the physical union of the biomaterial dental implant with the natural bone of the living organism in which the device was implanted. **Objective:** The aim of the present study was to classify the factors that influence the success and failure of osseointegration. **Materials and methods:** A detailed search strategy was carried out in the PubMed, BBO and Google Academics databases over the last 10 years using as descriptors: 'dental implants' AND 'implants complications', 'implants failures' e 'implants' AND 'survival'. The inclusion criteria was clinical articles with controls of more than 5 years, laboratory and literature review on the relevant subject. We excluded studies whose language was not Portuguese and English; expanded abstracts, non-conclusive studies, non-scientific journals, and articles with animal tests. **Conclusion:** Evidence confirms that materials for endosteal implants are efficient and with a high success rate, intercurrents occur due to inadequate hygiene care and deleterious habits, as well as incorrect planning, as well as poor bone quality, often lacking primary stability of the implant installed.

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## INTRODUCTION

Osseointegration is a cellular biological process that corresponds to the physical union of the biomaterial dental implant with the natural bone of the living organism in which the device was implanted. It corresponds to a process similar to healing, forming a stable union, which functions as a basis for complex oral rehabilitations. The installation of dental implants followed by their complete osseointegration is considered a safe and highly reproducible process, being the base on which it depends the specialty Implantology (Alves-Rezende, 2012 and Martins, 2011). The insertion of the specialty Implantology is a major advance in contemporary

dentistry, capable of satisfactorily rehabilitating patients with total or partial dental absences, multiple or unitary, with safety and high quality standard, which infers in the satisfaction of both the professional who works in the area, and of the patient who undergoes this type of intervention (Luterana, 2006). The osseointegration technique presents predictable, reproducible and stable results over time, with success levels close to 90% considering all types of treatment with osseointegrated implants.<sup>(4)</sup> Despite the high percentage of success, every professional may face some inevitable failure, around 5% to 10%, and in these situations should be prepared to elucidate his patient about the probability of failure, possible complications and methods that minimize them (Zavanelli, 2011). However, it is prudent to be aware that the practice of this specialty involves surgical intervention and, consequently, tissue manipulation in complex living beings, with different organisms, habits and different responses to interventions

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(Carvalho, 2008 and Ramos Silveira, 2018). The presence or absence of osseointegration is an essential step in rehabilitating the oral health of patients through dental implants. This process is subject to interference from several factors such as the failures causes, as well as the mechanisms responsible for implant defect or loss, and local, systemic and genetic factors may coexist (Santiago Júnior, 2017 and Oliveira, 2015). In addition, these factors may be related to the patient, the professional, the technique, the material used or the correlation between them. It is important to emphasize that the disorders may be present at any stage of the treatment and that, because the failure is multifactorial in nature, there is a difficulty in its diagnosis and intervention. In view of the above, the purpose of this review is to classify the factors that influence the success and failure of osseointegration.

## MATERIALS AND METHODS

A detailed search strategy was carried out in the PubMed, BBO and Google Academics databases over the last 10 years using as descriptors: 'dental implants' AND 'implants complications', 'implants failures' e 'implants' AND 'survival'. The inclusion criterion was clinical articles with controls of more than 5 years, laboratory and literature review on the relevant subject. We excluded studies whose language was not Portuguese and English; expanded abstracts, non-conclusive studies, non-scientific journals, and articles with animal tests. The articles initially found were allocated in the Mendeley © program to identify the duplicates and to exclude them. We found 113 articles that corresponded to the descriptors. Ten duplicates were identified and excluded. After reading the titles, only 24 articles were fit to proceed to the reading of the summaries. After reading the abstracts, 8 papers were selected to compose the basis of the literature review. A search in the list of references of included studies was performed.

### Literature Review

The implant materials as well as the insertion technique used influence the bone tissue around the dental implants. The main factors that influence treatment success or failure include dental implant design, insertion technique, treatment protocol, surgical procedure, and presence or absence of primary stability. In addition to these factors related to treatment, in the literature, local and systemic factors have been related to the bone stability around the implants (Block, 2015 and Falcão, 2019). Bone is a dynamic organ that is optimized depending on the loading condition above it. The bone achieves this optimization through the remodeling process. Several studies have confirmed the importance of implant design and the direction of force applied to the implant system (Heinemann, 2015 and Ogle, 2015). The replacement of teeth lost by endosteal implants for the rehabilitation of edentulous or partially edentulous patients has become a standard of service in the last decades (Papež, 2018 and Jank, 2016). Osseointegrated dental implants have a long-term success rate greater than 90%, but may be threatened by peri-implant mucositis and peri-implantite inflammatory conditions induced by bacterial biofilm (Papež, 2018 and Jank, 2016). Dental implants have become a treatment modality accepted by the scientific community for totally and partially edentulous patients. In fact, the placement of implanted prostheses, particularly in the lower jaw, significantly reduced edentulism (Heinemann, 2015 and Rittel, 2018).

Conventional protocol is the most efficient way to minimize the risk of implant failure. Traditional clinical guidelines recommend the placement of implants in healed sites, followed by 3 to 6 months of submucosal healing before functional loading (Guobis, 2016 and Moraschini, 2015). The staging protocol may be physically and psychologically challenging for patients, given the additional procedures associated with the second surgical phase, the long waiting time for restoration of function and esthetics, and inconvenience due to multiple visits. Thus, a shorter approach with immediate loading was developed to minimize these problems (Naujokat, 2016 and De Bruyn, 2000).

With immediate loading, the prosthesis attached to the implants can become functional within 48 hours after surgery. Immediate loading of dental implants restored by a full arch-fixed prosthesis demonstrated excellent results (Ogle, 2015 and Bielemann, 2018). The few complications, interventions less associated with morbidity and simplified rehabilitation contributed to the increased clinical use of this technique. Stabilizing implants after placement and limiting micro-movements to no more than 100 µm contribute to the success of osseointegration (Guglielmotti, 2019 and Pellegrino, 2018). Immediate loading of the implant with a temporary restoration has been proposed as a simpler, more predictable, cheaper and less time-consuming method. Primary stability is one of the most important parameters for the immediate loading of an implant and is an important requirement for the long-term success of dental implants. Other important factors include bone quality and implant properties, initial bicortical stabilization, number and optimal distribution of implants, and use of postoperative and operative care (Pellegrino, 2018 and Koszuta, 2015). Different insertion torque values are found in the literature, with 45 N / cm being the most commonly used and considered the safest and most therapeutic for immediate loading (DeSerres, 2017). However, lower torque values are related to primary stability and have been increasingly used for immediate loading, despite the low degree of scientific evidence regarding these insertion torque values (DeSerres, 2017 and Chrcanovic, 2015). Several risk indicators were identified, including poor oral hygiene, history of periodontitis, diabetes, and smoking. Peri-implant diseases share causes and risk factors similar to chronic periodontitis. Both are initiated by the accumulation of microbial biofilms on hard surfaces that are teeth or dental implants.

Systemic diseases can impair host barrier function and immune defense against periodontal pathogens that create the opportunity for probable destructive and peri-implantite periodontal disease (Moraschini, 2015; Fretwurst, 2018 and Raphael, 2016). The use of substances harmful to health, such as smoking, has shown negative effects to the process of normal and continuous osseointegration (Fretwurst, 2018 and Takamiya, 2014). Titanium implants have been used in dentistry for over 40 years. The success rate varies between 95% and 98% after osseointegration (Zavanelli, 2011 and Özkurt, 2011). About ten years ago, zirconia implants were introduced into dentistry. In particular, the use of rough surfaces has been described to significantly improve osseointegration (Ouanounou, 2016). In several studies, a good osseointegration of zirconia implants could be demonstrated (Khan, 2018; Pieralli, 2016; Ribeiro, 2015 and Rodriguez, 2018). However, titanium intolerance has recently been correlated in patients with implant failure (Osman, 2016). In orthopedic surgery, zirconia is a well-known material for joint

replacements, but in dentistry, there were concerns about the properties of materials over a long period. Therefore, the first dental zirconia implants were single-piece implants (Rodríguez, 2018). From a surgical point of view, as well as a prosthetic perspective, the piece zirconia implants have several disadvantages, such as healing problems and undesirable load during the healing period, causing complications (De Bruyn, 2000 and Pellegrino, 2018). At present, we have implants manufactured in titanium, zirconia and alumina. The most used material is titanium. Although titanium and zirconia have similar success rates in osseointegration, with similar aspects in relation to the bone structure around the installed device, the zirconia device is mainly indicated for installation in areas with esthetic prerequisites and in patients who are hypersensitive to titanium, which directly influences the bone repair around the implant (Özkurt, 2011).

## Conclusion

Oral rehabilitation is important for the health and quality of life of the patient, with dental implants being a major breakthrough in modern dentistry. It aesthetically and functionally satisfies the patient, returning the ability to chew and smile in a safe and appropriate way. Scientific evidence confirms that materials for endosteal implants are efficient and have a high success rate, with complications occurring due to incorrect hygiene care, inadequate habits and incompatible with health. As well as by inadequate planning of the case to be treated, through a failure in the anamnesis or by inexperience of the operator. Another important factor to consider is the poor bone quality, which does not offer primary stability to the implant installed

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