SEVEN
publicações acadêmicas

IMMEDIATE COMPLICATIONS IN THE SURGICAL PHASE ASSOCIATED WITH IMPLANT DENTISTRY: CAUSES AND MANAGEMENT

https://doi.org/10.56238/sevened2025.014-002

Michael Everton Pasa[1] and Luciano Serpe[2]

ABSTRACT

Implant dentistry is an area that has been increasingly used as an option for the oral rehabilitation of edentulous patients. However, the surgical procedure of installing osseointegrated dental implants also presents risks of immediate complications during its execution. In this context, the present study aimed to review the literature on the main immediate complications that may occur in the surgical phase of implant dentistry procedures, highlighting their causes and the appropriate management for their resolution. This is an integrative literature review, with searches carried out in the digital databases PubMed, *Scientific Electronic Library Online* (SciELO), *Implante Institute*, Revista Odonto Ciências, Google Scholar, *Journals IWW* and *Brazilian Journal of Implantology and Health Sciences* (BJIHS), covering the period from 2004 to 2024. In all, 18 studies were selected for the analysis. The results showed that several complications can occur during the procedure, which can be classified as complications involving soft tissues, such as hemorrhages, nerve injuries, tissue emphysema, aspiration or ingestion of surgical instruments, and injury to the sublingual salivary gland; and complications involving hard tissues, such as inadequate positioning or angulation of the preparation of the implant bed, injury to adjacent teeth, fracture of the atrophic mandible, lack of primary stability, perforation of the maxillary sinus and nasal cavity, penetration of the implant into the posterior region of the mandible, overheating of bone structures, perforation of the cortical and basal plate, in addition to bone dehiscence or fenestration. Such complications have multifactorial causes and may be related to both failures in the professional environment and specific conditions of the patient. Regarding management, it varies, depending on the nature of the complication, the affected region, and the severity of the condition. Thus, it is concluded that the dental surgeon working in the area of implantology must have extensive training and adopt strict protocols, including detailed prior planning of the surgery and good safety practices, in order to minimize such occurrences, in addition to in-depth knowledge about the management of possible complications, in order to act promptly to treat them and avoid aggravations.

Keywords: Implantology. Surgical complications. Oral rehabilitation.

[1] Undergraduate student of Dentistry
Leonardo da Vinci Educational Society
E-mail: michael_pasa@hotmail.com
ORCID: https://orcid.org/0009-0001-8598-1631
[2] Prof., Dr. and Advisor
Leonardo da Vinci University Center, Brazil
Email: lucianoserpe@yahoo.com.br
ORCID: https://orcid.org/0000-0001-6701-9361

1 INTRODUCTION

Implant dentistry is an area that has evolved significantly in recent decades, with the creation of effective solutions for the oral rehabilitation of patients with tooth loss. Dental implants offer functional and aesthetic benefits, which contribute to the self-esteem and quality of life of individuals. However, any surgical procedure involving implants is subject to complications that can compromise the success of the treatment (Misch, 2015).

According to Siqueira *et al*. (2020), implantology stands out as one of the most successful specialties within dentistry, presenting a wide variety of materials, devices, equipment and surgical techniques, in addition to enabling the treatment of different clinical cases and integration with other areas. Despite the high success rates, over 90%, this specialty is still subject to failures, therapeutic failures and the need for retreatment. For this reason, it is essential to maintain continuous care and the constant improvement of the technical approaches employed (Freire *et al*., 2017).

Lourenço, Morano and Daruge (2007) emphasize that complications in implant dentistry refer to unexpected events during treatment, whether in the operative or postoperative phase, which, when properly managed, most of the time do not compromise the final result. However, the absence of an effective intervention can lead to the failure of the procedure. Regarding the occurrence of complications, Alves *et al*. (2017, p. 21) state that, according to a survey with several authors, "[...] Complications in rehabilitation with osseointegrated implants occur in approximately 14% of cases, with 1% of these complications occurring in the operative phase, followed by prosthetic (3%) and inflammatory complications in (10%)".

Surgical complications in implant dentistry can be classified as late or immediate, according to the moment in which they occur in relation to the procedure. Regarding late complications, they are those that occur in the postoperative period of dental implants. Among these complications, infection stands out, which is often observed when microorganisms contaminate the implant region during or after surgery. Other late complications are wound dehiscence and fenestration, osseointegration failure, peri-implant bone resorption, implant platform exposure, and implant fracture (Storck *et al*., 2024).

On the other hand, immediate complications, i.e., those that occur during the surgical procedure, mainly include hemorrhages, nerve injuries, perforation of adjacent anatomical structures, emphysemas, aspiration or ingestion of foreign bodies, bone dehiscence and fenestration, and maxillary fractures (Greenstein *et al*., 2008). The etiology of these complications is often associated with factors such as inadequate planning, poor surgical

technique, systemic and health conditions of the patient, and local anatomical characteristics (Esposito *et al*., 2010).

The detection of possible surgical risks during planning, the adoption of preventive strategies, and in-depth knowledge of anatomical structures are essential to minimize risks and optimize clinical results in the rehabilitation process. Thus, this article aims to review the literature on the main immediate complications that may occur during the surgical phase of implant dentistry procedures, highlighting their causes and the appropriate management for their solution.

Thus, it seeks to identify and critically analyze the etiological factors involved, as well as to describe the preventive conducts and management protocols most indicated in the specialized literature. By understanding these aspects, it is intended to contribute to the optimization of clinical results and to the reduction of complications that may compromise the predictability and success of oral rehabilitation treatments through osseointegrated implants.

2 METHODOLOGY

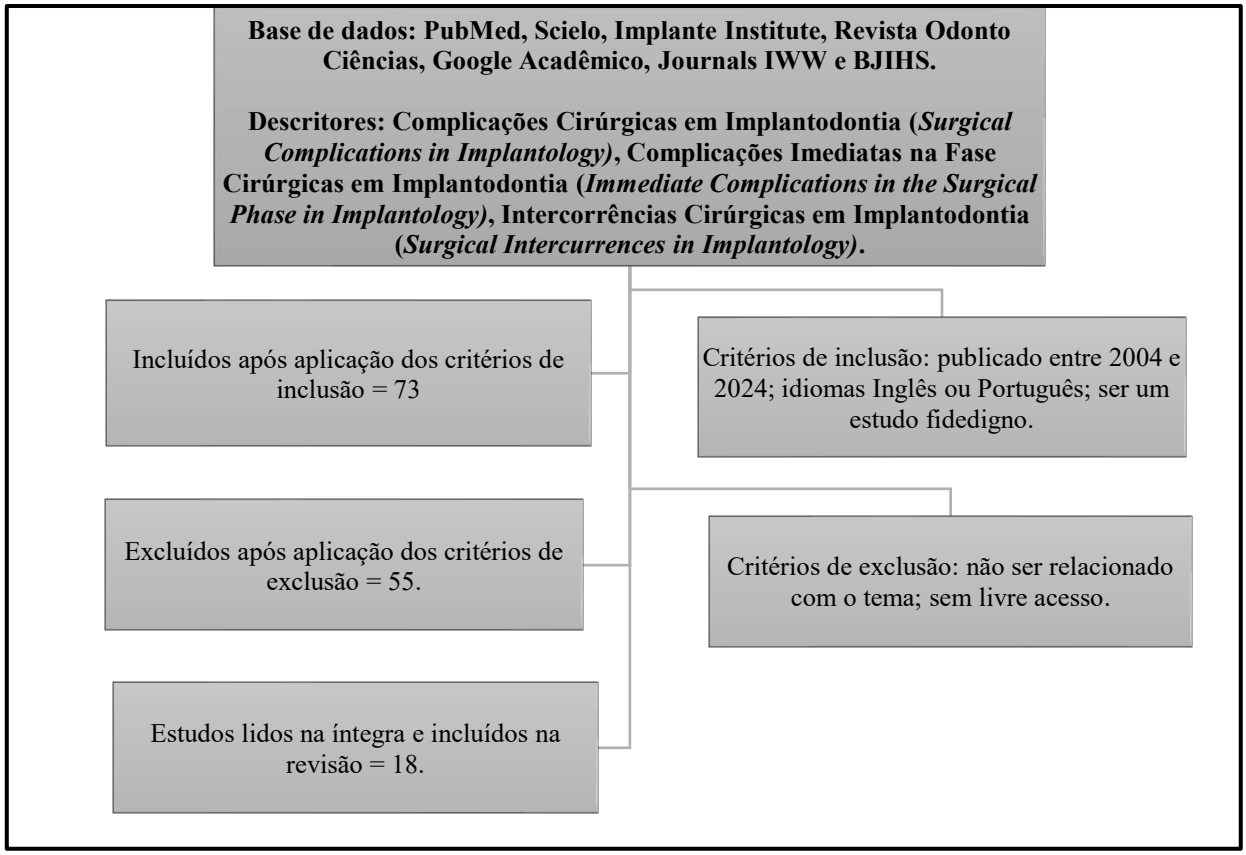
For the preparation of this article, an integrative literature review was carried out, which allowed the collection, analysis and synthesis of relevant evidence extracted from scientific publications of recognized credibility, integrating theoretical and practical knowledge applicable to the clinical context (Souza *et al*., 2009). According to Ercole, Melo and Alcoforado (2014), the integrative literature review is a methodological approach that seeks to gather, organize and interpret information from different studies related to a given theme. This strategy enables a broad understanding of accumulated knowledge, including research with different methodological approaches.

The literature survey was carried out based on a search in the electronic databases PubMed, *Scientific Electronic Library Online* (SciELO), *Implante Institute*, Revista Odonto Ciências, Google Scholar, *Journals IWW* and *Brazilian Journal of Implantology and Health Sciences* (BJIHS). The descriptors used, in isolation and combination, in Portuguese and English, were: "*Surgical Complications in Implantology*", "Immediate *Complications in the Surgical Phase in Implantology*" and "*Surgical Intercurrences in Implantology*".

For the selection of the studies that composed the *research corpus* , inclusion and exclusion criteria were applied. The inclusion criteria, which are aimed at identifying the desirable characteristics for selection, defined were: study published between 2004 and 2024, covering the last 20 years, at the time of the survey; publication in English or Portuguese; be a study of reliable content (articles, dissertations, etc.). On the other hand, the exclusion criteria, which aim to eliminate studies with certain characteristics, applied were:

studies that were not related to the research theme (immediate complications in the surgical phase of implantology, their possible causes and management strategies), after reading the title and abstract; studies that did not have free access to all their content. The selection process is presented in the flowchart in Figure 01, below.

Figure 01 - Flowchart of the selection of studies



Source: The authors (2025).

Thus, 73 studies were initially included in the research, identified from the survey in the selected databases. Exclusion criteria were then applied, resulting in the elimination of 55 studies that did not meet the established requirements. Thus, 18 studies made up the *corpus* of the review. Now, it is possible to present the results obtained through the analysis of the selected surveys.

3 RESULTS

The data set resulting from the studies selected for the research is presented in Chart 01.

Table 01 - Summary of related studies

Authors	Goal	Type of research - Methodology	Conclusion
Greenstein *et al*. (2008)	Address surgical complications associated with dental implant placement and discuss how to prevent and manage them.	Article - Literature review.	Serious complications in dental implants are rare and can be avoided with careful pre-planning and attention to detail. Early identification and proper management reduce postoperative risks.
Pelayo *et al.* (2008)	To study intraoperative complications in implant surgery.	Article - Literature review.	The success of the rehabilitation treatment depends on adequate surgical planning, correct techniques, postoperative follow-up, respect for osseointegration, control of occlusal loads and strict maintenance of hygiene.
Annibali *et al.* (2008)	Propose a classification that considers the moment of the events and the distinction between the terms accidents and complications.	Article - Literature review.	In implant dentistry, local complications during surgery can compromise the result of the treatment, requiring the dentist to focus on prevention through diagnosis, planning, appropriate techniques and efficient postoperative management.
Ferreira *et al*. (2010)	To conduct a literature review on surgical complications and intercurrences in implantology, their causes, management and preservation.	Article - Literature Review.	Complications in implant rehabilitation usually result from technical failures of the professional, systemic conditions of the patient, and errors in surgical planning and indication.
Pereira (2010)	To understand the pre-surgical, transsurgical and post-surgical factors that may be responsible for accidents and complications in implant dentistry.	Dissertation - Literature review.	Events in each phase of treatment (pre, trans or post-surgery) must be known so that the success of the treatment is predictable.
Kim (2011)	Presenting complications associated with surgery and dental implant treatment.	Article - Literature review.	Although rare, complications in dental implants can occur, and the use of images, anatomical knowledge and surgical techniques is essential to prevent or recognize them early.
Camargo and Sickels (2014)	Analyze common and more serious surgical complications associated with implant placement.	Article - Literature review.	The prevention of all surgical complications is impossible, however, many can be minimized with proper planning and techniques.
Freire *et al*. (2017)	To conduct a literature review on the complications that may occur in patients undergoing dental implant installation.	Article - Literature review.	Complications in dental implants are linked to lack of anatomical knowledge, systemic conditions of the patient, failures in planning and surgical technique. It is up to the dental surgeon to recognize, diagnose and treat them, aiming to restore the patient's health and quality of life.
Alves *et al*. (2017)	To conduct a literature review evaluating the main complications in the field of implant dentistry.	Article - Literature review.	The success of osseointegrated implants depends on strict compliance with clinical criteria, from planning to postoperative care and daily patient hygiene.
Menezes (2017)	To perform a literature review on accidents and complications in dental implant treatment, from the preoperative to the late postoperative period.	Dissertation - Literature review.	Even with advances in implant dentistry, there are still risks, requiring professionals to be prepared to prevent and manage complications, aiming at greater success in treatments.
Sillam (2018)	Present the main complications during and after dental implant surgeries	Dissertation - Literature review.	Oral implantology has a high success rate, but it depends on the professional's skill, self-assessment, compliance with

	and identify the means of prevention to predict and avoid them.		guidelines and continuous attention at all stages.
Pereira (2018)	To present the types of accidents, discuss and analyze clinical cases related to accidents in the surgical phase of implantology.	Dissertation - Literature review and randomized clinical cases.	The conclusion emphasizes that complications can occur during and after surgery, and are essential for adequate training, attention to the patient's history, surgical protocols, and biosafety to reduce risks and ensure safety in treatment.
Batista and Poluha (2021)	To review the literature on failures and complications in osseointegrated implant therapy.	Article - Literature review.	Complications in implantology can occur in the various phases of treatment. It is up to the professional, through thorough planning, to seek predictability and efficient conduct for each case.
Landi *et al.* (2021)	Identify the main factors that lead to complications in implant dentistry.	Article - Literature review.	Complications in implant dentistry are multifactorial and can arise at any stage of treatment, from anamnesis and planning to surgical execution and patient cooperation in the postoperative period.
Kale *et al*. (2021)	To present a brief overview of the complications with dental implants associated with surgical procedures and their management.	Article - Literature review.	Surgical complications are common in dental implant treatments, and the professional should be cautious, organized and precise, and if any complication occurs, it should be treated seriously.
Soares (2022)	Present an overview of the causes of complications in implant dentistry and provide clinical concepts for their prevention.	Dissertation - Literature review.	Failures are associated with several etiologies, making the technical and scientific knowledge of the professional essential to avoid complications.
Gungor (2023)	To present a review of the literature on etiological factors, clinical manifestations, diagnoses and strategies for managing complications in implant dentistry.	Article - Literature review.	Understanding complications and implementing preventive strategies are crucial to obtain better results with rehabilitative treatment, as well as ensuring patient satisfaction.
Storck *et al*. (2024)	To analyze surgical complications in implant dentistry and prevention possibilities	Article - Literature review.	The analysis of the complications reported in the study reveals that, although there are variations in data and approaches, there is a consensus on the need for precise techniques, adequate training, and defined clinical protocols to minimize failure.

Source: The authors (2025).

Now, it is necessary to briefly summarize each of the selected studies, highlighting their contributions on the immediate complications of procedures involving implants. The study conducted by Greenstein *et al*. (2008) aimed to review the literature on the most frequent complications associated with implants, both in soft and hard tissues, and to provide practical recommendations for professionals in the area, aiming to improve the safety and efficacy of the procedures.

The results obtained indicate that, despite the low incidence of surgical complications, problems such as hemorrhages, sensorineural disorders, tissue emphysema, infections,

wound dehiscence, aspiration and ingestion of surgical instruments, postoperative pain, injuries to adjacent teeth, lack of primary stability, inadvertent penetration of the maxillary sinus or nasal cavity, sequelae of sinus lift and bone fracture may occur. The authors further highlight the importance of proper planning and training to minimize risk and that, although most implant procedures are successful, rapid recognition of complications and appropriate training are essential to ensure successful treatment (Greenstein *et al*., 2008).

Pelayo *et al*. Sánchez et al. (2008) conducted a literature review study with the objective of reviewing intraoperative complications associated with dental implant surgery. The authors pointed out that dental implant placement is a surgical procedure that, although controlled and scheduled, is not without complications. There are different common surgical complications in implantology, such as hemorrhagic accidents, which are more frequent in the interforaminal region; nerve damage, due to transposition or lateralization of the inferior alveolar nerve, or excessive intrusion of drills or fixtures into the mandibular canal; and mandibular fractures secondary to implant placement, especially in atrophic mandibles; in addition to incorrect positioning of the implants, causing damage to an adjacent tooth.

Other complications identified in the study were lack of primary stability, caused by overwork in the preparation of the implant bed, low bone quantity or quality, and, more frequently, by immediate post-extraction implantation, in addition to the migration of implants to the maxillary sinus or nasal cavity. The authors emphasize the importance of pre-surgical planning and appropriate techniques to minimize risks, concluding that complications can be reduced with careful planning and close follow-up at all stages of treatment (Pelayo *et al*., 2008).

The article by Annibali *et al*. (2008) aimed to propose a classification that would differentiate the moment of occurrence of adverse events, distinguishing between accidents, which occurred during the surgical phase, and complications, manifested as pathological conditions in the postoperative period. To this end, the authors conducted a review and analysis of the existing literature on complications in implant dentistry, proposing a new classification based on the chronology of events in early and late stages. In the study, events classified as early-stage, considered accidents, include infection, edema, ecchymosis, hematoma, emphysema, bleeding, flap dehiscence, and sensory disturbances. Late-stage events, classified as complications, include perforation of the mucoperiosteum, maxillary sinusitis, mandibular fractures, failure in osseointegration, bone defects, and periapical injury in adjacent teeth.

According to the authors, this classification contributes to clarifying terminology, facilitating the categorization of adverse events, and assisting in the description of diagnostic

procedures, as well as surgical techniques for prevention and treatment. They also conclude that local complications during implant surgery can be determinant for the success of the treatment, and that adequate planning, the use of correct techniques, appropriate instruments and effective postoperative management are crucial factors for the prevention of these complications in the rehabilitation process (Annibali *et al*., 2008).

According to Ferreira *et al*. (2010), oral rehabilitation with osseointegrated implants is a consolidated practice in dentistry, indicated for functional and aesthetic treatments in cases of total, partial, multiple and single edentulism, with increasing demand. Thus, the authors conducted a literature review with the objective of understanding the complications associated with implant rehabilitation, as well as their probable causes, management, and preservation strategies. The results showed that the main immediate complications are sensorineural damage, technical failures in the implant installation, improper access to the maxillary sinus, fractures, hemorrhages, infections, wound dehiscence, with their possible causes and management.

The authors also point out that the success of treatment with dental implants is linked to restored longevity, function, and aesthetics, while failure is often related to surgical complications, postoperative complications, and failures in the prosthetic phase. Finally, they argue that implantology, like any clinical procedure, is subject to failures, and that professional training, adequate planning and consideration of the patient's health conditions and habits are essential to minimize risks and obtain good results (Ferreira *et al*., 2010).

For Pereira (2010), the search to improve the quality of life in the face of tooth loss led to the development of dental implants, which aim to restore masticatory function, in addition to the aesthetic and emotional aspects of patients. Thus, the author conducted a literature review study with the objective of understanding the pre-surgical, transsurgical and post-surgical factors that may be responsible for accidents and complications in implant dentistry.

Pre-surgical factors are linked to lack of planning, including anamnesis, clinical examinations, medical contraindications, and laboratory tests. Regarding transsurgical factors, they are the lack of antiseptic and aseptic protocols to avoid infection during surgery, errors in drilling and positioning of implants, bone overheating, primary stability, displacement of the implant to the maxillary sinus, aspiration or ingestion of surgical instruments, nerve damage and bleeding that may occur during the surgical phase (Pereira, 2010).

Postoperative factors are pain on palpation, percussion or function, implant mobility, bone loss and implant exposure, wound dehiscence, and peri-implant infections. The author also recommends that this postoperative period corresponds to the time required for bone-implant healing, which can take 4 to 6 months in the mandible and maxilla, respectively. In

his conclusion, he reaffirms that the positive result depends on the careful evaluation of multiple factors in all phases of treatment, and it is essential to consider each one separately to minimize possible failures (Pereira, 2010).

According to Kim (2011), dental implant surgery is a routine, safe procedure with a high success rate, but it requires attention to possible complications, which can range from implant failures to life-threatening situations Based on this, his study aimed to present, through a literature review, the surgical complications associated with surgery and dental implant treatment.

Complications and treatments were categorized according to complications associated with surgery, such as hemorrhages in the mandibular region, sensorineural disorders, injury to adjacent teeth, flap dehiscence and exposure of graft material or membrane barrier, bisphosphonate-related osteonecrosis; and regarding surgical complications associated with maxillary sinus lifting, such as perforation of the Schneider membrane, hemorrhages in the maxillary region, loss of implant or graft materials in the maxillary sinus, and postoperative maxillary sinusitis (Kim, 2011).

In addition, the study makes a correlation between the events that occurred and possible causes and treatments, emphasizing the importance of knowledge of anatomical structures to minimize risks during procedures, as well as continuous training of the dental surgeon and careful practice at each stage of treatment, which can significantly reduce the incidence of problems associated with the placement of dental implants (Kim, 2011).

The authors Camargo and Sickels (2014) conducted a literature review with the objective of analyzing the common and severe surgical complications associated with implant placement, emphasizing prevention and appropriate management. According to the authors, a number of complications can occur during or after dental implant placement, with most of them related to the initial surgical phase, while others can arise much later. Regarding the results of the study, the authors indicated that many complications can be attributed to failures in the preoperative evaluation of the patient before the procedure, and that, in most cases, these complications can be avoided with proper planning.

Among the complications addressed in the study, bleeding in the mandible and maxilla regions stands out, associated with failure to recognize anatomical structures; postoperative infections resulting from implant placement, with or without grafts, attributed to bacterial contamination; injury to the inferior alveolar nerve and the lingual nerve, due to incorrect preparation and placement of the implant; failure to position the implant, which can result from a number of factors, such as residual bone structure, the inclination of adjacent teeth, and the lack of prior prosthetic planning; injuries to adjacent teeth, associated with failure in

planning and operator skill; fractures in the mandible region, with severely compromised bone structure; displacement of the implant in adjacent spaces in the maxilla region, and, less commonly, in the mandible region; lesions in the sublingual salivary glands; and, finally, the swallowing and aspiration of surgical components (Camargo; Sickels, 2014).

Camargo and Sickels (2014) also emphasize the importance of a safety checklist before the procedure, with relevant information about the patient's dental and medical health history, as well as their current clinical condition, as this will help to plan, propose the appropriate treatment and prevent such complications. They also point out that, with regard to short-term surgical complications, the dental surgeon and the office team must be prepared to deal with these unforeseen events and solve them quickly.

For Freire *et al*. (2017), the increase in life expectancy and quality of life brings the concern with maintaining aesthetic and masticatory functions, especially due to the loss of teeth throughout life. Although dental implants are an effective alternative, with a high success rate (above 90%), complications can still occur. Thus, the objective of this study was to review the literature on the complications that may occur in patients undergoing dental implant placement.

Among the complications most commonly evidenced during treatment, the following stand out: intrasinus introduction of the implant, peri-implantitis, iatrogenic hemorrhage, damage to the external hexagons of the implant, exposure of the *cover screw*, fracture of the implant, mobility of the implant, mandibular fracture, implants in unfavorable position and angulation, wound dehiscence, swallowing of instruments, infection and neurosensory disorders. These failures may be associated with technical deficiencies of the professional, systemic conditions and health status of the patient. Thus, it is necessary to plan and monitor the possible complications arising from surgical procedures with osseointegrated implants, which is the responsibility of the dental surgeon (Freire *et al*., 2017).

According to Alves *et al*. (2017), despite the great success of osseointegrated implants, the failure rate is still significant, ranging from 1.5% to 10%, which results in longer treatment time, additional costs, and discomfort for patients. Thus, the objective of this study was to review the available literature on complications in implant dentistry, with a view to identifying the factors that can lead to implant failure and improve clinical performance. The results showed that complications related to rehabilitation treatment with osseointegrated implants occur in 13.9% of the cases, with 1% occurring in the surgical phase, followed by the postoperative phase, with inflammation in 10.2%, and the prosthetic phase, with 2.7%.

Regarding complications, the authors argue that they are divided into three groups: those related to the treatment plan (systemic factors, angulation and incorrect location of the

position of the implants), those related to the local anatomy (nerve injuries, fenestrations, sinus complications, infections generated in teeth adjacent to the implant) and those related to the surgical procedure (bone overheating and lack of primary stability) (Alves *et al*., 2017).

As for the etiology of failures, they are multifactorial, often linked to factors such as planning and technical knowledge on the part of the professional, systemic conditions, health status at the time of treatment, and harmful habits of the patient. Therefore, the success of therapy with osseointegrated implants depends on the observation of the criteria established in the planning, in order to ensure a good prognosis, which, if neglected, can hinder or even prevent the achievement of a functional and aesthetically satisfactory rehabilitation (Alves *et al*., 2017).

In the study by Menezes (2017), the objective was to review the literature on accidents and complications in treatment with dental implants, from the preoperative to the late postoperative period. Regarding the operative phase, the main complications highlighted were: bone fenestration with displacement of the implant, nerve injuries, hemorrhage, ingestion and aspiration of objects, and the accidental introduction of a foreign body into the maxillary sinus was the most prevalent in the literature, followed by injury to the inferior alveolar nerve. In the postoperative period, the following stood out: pain, infections, peri-implantitis and wound dehiscence, with infection being the most commonly identified complication in rehabilitation cases.

The author also emphasized the need for the dental surgeon to carefully plan all stages of treatment, with emphasis mainly on the initial phases, in order to know the patient's history, with updates of clinical, laboratory and imaging exams, for the adoption of planning measures and the individualization of the case. Based on this information, it is possible to make prior and systemic adjustments related to the patient, or even the contraindication for rehabilitative treatment with dental implants (Menezes, 2017).

Sillam (2018) conducted a literature review with the aim of identifying the main complications that can occur during and after osseointegrated dental implant surgery, as well as the means to prevent them. First, the author highlighted the need for the professional to know the maxillofacial anatomy to avoid injuries during the procedure. Regarding the main intraoperative complications, lesions in bone tissues and adjacent soft tissues due to increased temperature during osteotomy and/or trepanation, implant instability, perforation of the Schneider membrane and its classifications, introduction of the implant into the maxillary sinus or nasal cavity, swallowing or aspiration of instruments are mentioned.

Postoperative complications include osseointegration failures, fractures, tissue emphysema, nerve injuries, wound dehiscence, infections, periapical injury in adjacent teeth,

hemorrhages, and ecchymosis. Regarding the prevention of complications, the preoperative consultation stands out, followed by medical and clinical dental exams, complementary radiographic exams (panoramic, computed tomography, periapical, orthopantomography) and the delimitation of bone quantity and quality to obtain good planning. The author concludes that dentists should be aware of the risks and possible complications of the treatment, highlighting the importance of a rigorous preoperative evaluation and mastery of maxillofacial anatomy to prevent and properly manage any complications (Sillam, 2018).

In the research by Pereira (2018), based on a literature review, the objective of the study was to present the types of accidents in the surgical phase in implantology. Nerve injuries, aspiration and swallowing of objects, hemorrhages, displacement of implants to the maxillary sinus, fracture of implants and damage to adjacent teeth were described as intercurrences that may occur during the surgical procedure, with suggestions and alternatives for their prevention. In addition, the importance of anamnesis and complementary exams for the elaboration of a detailed plan was emphasized, as well as the multidisciplinary skills of the professional to define and perform the surgical technique and the appropriate treatment aimed at preventing accidents.

The author also highlights the relevance of clarifying and guiding the patient prior to treatment, addressing possible accidents and complications that may occur in all stages of rehabilitation treatment. Thus, factors such as theoretical and clinical training, attention to details pertinent to the patient's history, surgical protocols, biosafety, and postoperative follow-up are crucial to minimize risks and ensure the predictability of treatment (Pereira, 2018).

Batista and Poluha (2021) conducted a bibliographic study with the objective of reviewing the literature on failures and complications in the rehabilitation process with osseointegrated implants, assisting the dental surgeon in clinical practice. The results revealed that implant failures are multifactorial and have failure rates ranging from 1.5% to 10%. Planning proved to be a primordial stage, in which all the information on the patient's clinical history, systemic condition and deleterious habits are centralized, which should be categorically used to support and define the treatment.

In the transoperative phase, some complications were more frequently listed, such as lesions of the inferior alveolar nerves and the lingual nerve, which accounted for 64.4% and 28.8%, respectively, of the surgical complications. Hemorrhagic conditions had an incidence of 24%, with the main risk regions being the mandible, the lingual fossa and the lingual cortex. They also highlighted that, although correct planning does not completely prevent the occurrence of these failures and complications, detailed knowledge of all phases of implant-

prosthetic treatment will allow the dentist to conduct the treatment more effectively and safely (Batista; Poluha, 2021).

Landi *et al.* (2021) conducted a literature review with the objective of elucidating and evaluating the factors that lead to complications in implant dentistry. The authors argued that oral rehabilitation with implants has been shown to be an effective treatment option, especially in the Brazilian context, where there is a high incidence of total (11% of the population) and partial edentulism (23% of the population, in addition to the frequent use of dental prostheses (33% of the population). Technological advances and the predictability of procedures have expanded the indication of osseointegrated implants. However, the increase in demand has also led to an increase in cases of accidents and complications.

The results indicate that implant complications may be related to the patient's medical conditions, such as diabetes mellitus, which can affect implant stability and osseointegration, and smoking, which impairs healing and is associated with failure rates of 10.3%. Functional and parafunctional habits can also impact the longevity of treatment due to occlusal loads. Patients undergoing chemotherapy or radiotherapy in the head and neck region have lower implant survival rates, as well as those using bisphosphonates, which interfere with bone healing (Landi *et al*., 2021).

Landi *et al.* (2021) highlight treatment planning and the professional's ability to anticipate possible complications, evaluate complementary tests, and consider individual anatomical variations. During the surgical phase, complications such as implant migration to the intrasinus region and perforation of the Schneider membrane are mentioned, with occurrence rates of 10 to 34%. Hemorrhages can occur due to tissue handling, milling, implant installation, or systemic patient problems. In addition, implant longevity can be compromised by peri-implantitis and implant fracture. Thus, through the study, it was concluded that complications in implant dentistry are multifactorial and can occur at any stage of treatment, depending on the professional's skill, adequate planning and the patient's cooperation in the postoperative period.

In the article by Kale *et al*. (2021) a literature review was developed with the objective of presenting a summarized view of the complications with dental implants associated with surgical procedures and as a result the strategies for their management. These complications can be divided into those related to anatomy, planning, and the surgical procedure itself. Anatomical complications include hemorrhages, which may occur during surgery or postoperatively, with or without bruising; temporary or permanent sensorineural disturbances in the inferior alveolar and lingual nerves; damage to adjacent teeth, more common in single implants; rupture of the buccal and basal cortical plaque during the preparation of the implant

bed; and perforation of the sinus membrane, especially when the implant is placed in the posterior region of the maxilla due to the proximity of the maxillary sinus.

Complications related to the treatment plan involve the inadequate location and angulation of the implants, as well as the definition of the spaces between them. Another important factor is the lack of clear communication with the patient about the treatment plan, including informed consent about the risks and complications at all stages of rehabilitation. Surgical complications include failures due to bone overheating during osteotomy; lack of primary stability, which requires the use of larger implants and healing without load; jaw fracture due to patient health problems or atrophic jaws; ingestion or aspiration of instruments during the procedure; emphysema caused by air insufflation in the subcutaneous or mucosal tissues; displacement of the implant to the maxillary sinus; soft tissue injuries due to incorrect handling or inadequate flap; implant contamination prior to insertion; and placement of the implant in sites with fresh bone graft or in infected sites (Kale *et al*., 2021).

According to Soares (2022), dental implants are an effective oral rehabilitation option, recovering function, aesthetics, and self-esteem. However, it is prone to failure, especially when performed without proper planning, correct choice of materials, appropriate surgical technique, and monitoring of restorative functions. In this sense, the author conducted the literature review study, with the objective of presenting an overview of the causes of complications related to implant procedures and providing clinical concepts about their prevention and treatments.

Regarding the results, the author performed a comprehensive analysis of the fundamental principles for the planning of dental implants, including anamnesis, clinical, laboratory and complementary examinations. Patient-related complications were addressed, such as systemic diseases (e.g., diabetes mellitus), harmful habits (smoking), and inadequate oral hygiene. In the surgical phase, the possibility of migration of the implant to the intrasinus region, perforation of the Schneiderian membrane, swallowing or aspiration of objects, failures in primary stability, and iatrogenic hemorrhage were highlighted (Soares, 2022).

Complications associated with the rehabilitation phase were also discussed, such as mechanical failures, phonetic and aesthetic changes, as well as complications that affect the longevity of the implant, such as peri-implantitis. In view of these aspects, the author concludes that failures in implantodontic procedures have multiple etiologies, reinforcing the importance of a careful evaluation of the patient, combined with the technical and scientific knowledge of the professional, for the elaboration of an appropriate treatment plan and the prevention of possible complications (Soares, 2022).

For Gungor (2023), dental implants have revolutionized dentistry by offering an effective and aesthetic solution, but their success depends on individualized planning, precise execution, and proper postoperative care. The literature review presented by the author aimed to study the causes, etiological factors, clinical manifestations, diagnoses and strategies for the management of complications in implantology.

The study initially addresses the success and failure factors of dental implants, considering functional, psychological and physiological aspects of the patient. It then describes intraoperative surgical complications, such as anesthetic complications, incision errors, improper implant positioning, drill fractures, bone overheating, excessive bleeding, soft tissue and nerve injuries, damage to adjacent teeth, bone fractures, dehiscence, fenestration, lack of primary stability, maxillary sinus perforation, and aspiration of objects (Gungor, 2023).

In the postoperative period, complications such as hematomas, edema, infection, emphysema, failure in tissue coverage, mucositis, peri-implantitis, gingival hyperplasia, periapical lesions, bone loss, chronic sinusitis, implant fracture, fistulas, and suppuration stand out. In the prosthetic phase, there is loss of implants, problems with soft tissues, mechanical, aesthetic and phonetic failures. The increase in these complications is attributed to inadequate indications, inexperienced practice, lack of knowledge of complications, lack of multidisciplinary approach, technical deficiency, and absence of adequate postoperative monitoring (Gungor, 2023).

Storck *et al*. (2024) highlight that complications in implant dentistry are diverse and can compromise treatment, leading to increased time, costs, patient dissatisfaction, and embarrassment to the professional. Based on the literature review, the study aimed to analyze surgical complications in implantology and the possibilities of prevention.

The study analyzes surgical complications in implantology, pointing to failure rates of 1% to 3.7% in the operative phase, 9.72% in the postoperative phase and 2.7% in the prosthetic phase, associated with the lack of a multidisciplinary approach in the rehabilitation plan. To reduce these rates, the authors recommend strategies such as rigorous surgical planning with guides and digital planning, assessment of bone quality and adequate distribution of occlusal loads, professional training, strict antisepsis and asepsis protocols, use of prophylactic antibiotics, maintenance of oral hygiene, and monitoring of healing (Storck *et al*., 2024).

In the postoperative period, the relevance of continuous follow-up is highlighted, which makes it possible to identify complications early and adopt timely corrective interventions, favoring the durability of the treatment. Thus, the need to personalize treatment according to

the particularities of each patient, adopt well-established clinical protocols, invest in professional training combined with modern technologies, and maintain regular monitoring is highlighted, aiming to reduce the chances of failures in dental implant treatments in the long term (Storck *et al*., 2024).

From the bibliographic survey, it is possible to synthesize the main immediate complications that occur in the surgical phase of implant dentistry, as well as to evidence the possible causes and the best management practices to maximize the success of the treatment, as shown in Chart 02 below.

Chart 02 - Synthesis of Immediate Complications in the Surgical Phase in Implant Dentistry, Causes and Management

Complications	Possible Causes	Possible Handling
Soft Tissues		
Bleeding	Soft tissue management; Extension of flap reflection; Lesions and increased pressure in blood vessels and capillaries; Soft or hard tissue trauma; Patient anatomy and systemic health.	• In patients using anticoagulants, the need to suspend the medication should be evaluated, considering the risk of thromboembolism (Landi, *et al*., 2021). • To control soft tissue bleeding, inject anesthetic with epinephrine and direct compression with sterile gauze (Greenstein *et al.*, 2008). • In cases of arterial bleeding, direct pressure, ligation of the vessels, or deep sutures are recommended (Greenstein *et al*., 2008). • When hemorrhage occurs in bone, anesthetic with epinephrine can be used in nutritional channels or occlusion with gauze or bone graft material (Greenstein *et al*., 2008). • The use of epinephrine for cardiac patients is limited, and definitive measures should be taken to avoid the rebound effect (Greenstein *et al*., 2008). • Bleeding in areas such as the oral floor or maxillary sinus requires prolonged compression (Greenstein *et al*., 2008), and minor bleeding can be controlled with electrocautery (Gungor, 2023). • If bleeding persists after suturing, the flap must be reopened, clots removed, and new sutures applied to stabilize the tissues (Annibali *et al.,* 2008). • After controlling the hemorrhage, it is indicated to refer the patient to the hospital for monitoring and possible management of the airways (Greenstein *et al*., 2008). • Endovascular angiography can be useful in diagnosing and isolating the source of bleeding (Kim, 2011). • Avoid incisions in the mucosa to drain hematoma, as they can aggravate bleeding (Kim, 2011), and use cold compresses in the postoperative period to reduce complications (Annibali *et al.*, 2008).
Nerve Damage	Neuropraxia: mild injury, usually caused by prolonged nerve compression or traction (temporary loss of sensation). Axonotmesis: severe compression or traction of a nerve (intrafascicular edema, ischemia, or demyelination, with the possibility of return of sensation). Neurotmesis: severe injury, indicating nerve rupture (requires microsurgical intervention and	• Usually postoperative management after sensorineural changes (Most frequent: infraorbital nerve, inferior alveolar nerve, mental and lingual nerve) (Greenstein *et al*., 2008). • Preoperative radiographs and CT scans are essential to prevent nerve damage during implant placement. If there are postoperative changes, the exams should be repeated to verify the position of the implant (Kim, 2011). • Intraoperative periapical radiographs help to obtain length measurements for work and avoid injury to the inferior alveolar nerve (Kim, 2011). • The clinician should ascertain the depth and extent of the neurosensory dysfunction and document (lips, adjacent mucosa, tongue, saliva, etc.) (Sillam, 2018). • If the bone compresses the nerve, the implant should be removed slightly (a few turns) and the condition monitored for possible regression. (Greenstein *et al*., 2008). • If the implant is intruded into a nerve canal, partial or complete removal is suggested (Greenstein *et al*., 2008). • The use of low-level laser therapy can be used as a form of treatment for nervous tissue regeneration (Menezes, 2017). • Numbness and prolonged paresthesia (16 weeks) suggest referral for microsurgery (Greenstein *et al*., 2008). • If the implant is not in the nerve canal and sensation is altered, there may be inflammation, and steroid or anti-inflammatory therapy is indicated. If there is no improvement within 2 months, refer for microsurgery (Greenstein *et al*., 2008). • Adjunctive medications such as clonazepam, carbamazepine, or vitamin B complex can relieve neuritis through neural anti-inflammatory actions (Kim, 2011). • The infraorbital nerve can be damaged during flap elevation before creating the window for maxillary sinus elevation, and it is important

	prognosis is usually not favorable).	to observe the space between the surgical window and the alveolar crest (Greenstein *et al*., 2008). • Using "*stops*" on the drills helps to avoid excessive penetration, maintaining a 2mm distance between the implant and any nerve canal, in addition to respecting a space of 3mm in front when placing the implants (Kim, 2011).
Tissue emphysema	Inadvertent introduction of air into the soft tissues below the skin or mucous membranes (unilateral enlargement of the facial and/or submandibular regions).	• Treatment of tissue emphysema includes light massages, heat compresses, antibiotics, and analgesics (Annibali *et al*., 2008). • With adequate control, the clinical picture should regress between 3 to 10 days, and the patient should receive support and comfort (Kale *et al*., 2021). • In case of risk of mediastinal involvement or airway problems, the patient should be monitored and, if necessary, referred for hospital care with intravenous antibiotics. (Greenstein *et al*., 2008).
Aspiration or ingestion of surgical instruments	Failure during the performance of the procedure.	• If a sharps object is aspirated or ingested, it can be eliminated through the gastrointestinal tract, but a chest x-ray should be performed to check for asymptomatic aspiration. If the object is small and causes partial airway obstruction, the patient should be urgently taken to an emergency center, given supplemental oxygen during the transfer, and subjected to tests such as laryngoscopy or bronchoscopy. If the obstruction is greater, abdominal compression or Heimlich maneuver can be performed (Ferreira *et al*., 2010). • Preventive measures are anchoring the instruments with silk thread and the use of large gauze inside the patient's mouth to prevent the object from accessing the oropharynx region (Greenstein *et al*., 2008).
Sublingual salivary gland injury	Traumatic injury during implant placement.	• Initially, it can be treated with the use of antibiotics and analgesics, followed by microsurgery to treat possible obstructions of the salivary duct (Camargo; Sickels, 2014).
Hard Fabrics		
Position and angulation of implant bed preparation	It is associated with inadequate surgical and prosthetic planning and/or the non-use of a surgical guide.	• Prior planning with measurements is essential for proper positioning. A space of 3 to 7 mm should be maintained between implants or between teeth and implants to preserve biological space. The distance between two implants should be 3 to 5 mm, to prevent bone loss and overheating, and the minimum distance between the implant and remaining teeth should be 1.5 mm. (Alves *et al*., 2017); • If it occurs, the implant should be removed and reinstalled again in a favorable position and angle, preferably with the use of surgical guides. (Ferreira *et al*. 2010).
Injury to teeth adjacent to the implant and endodontic considerations	Incorrect positioning of an implant can result in impingement to the adjacent tooth, compromised blood supply, or overheating during osteotomy.	• Before the procedure, it is essential to radiographically evaluate the anatomical findings to avoid complications during surgery and implant placement, such as angulation of adjacent teeth and lacerations of the roots, preventing accidental root canal (Greenstein *et al*., 2008). • The use of surgical guides can help in the preparation and placement of the implant, thus avoiding damage to adjacent nerves (Kim, 2011). • A bone space of 1.5 to 2 mm must be respected between the implant and the adjacent tooth (Kim, 2011). • Osteotomy should be performed with abundant irrigation to prevent overheating, and the area should be washed with sterile serum and aspirated prior to implant insertion in order to remove debris and avoid impaction (Greenstein *et al*., 2008). • Lack of parallelism between the implant and the tooth or accidental injury to the adjacent tooth may require endodontic treatment, periapical surgery, apicoectomy, or extraction of the injured tooth (Greenstein *et al*., 2008).

		• If endodontic pathologies are identified in neighboring teeth during radiographic examinations, it is necessary to treat them before implant placement to avoid contamination of the site (Pereira, 2018).
Atrophic jaw fracture	Caused by trauma and stress in weakened places.	• Requires clinical examination and radiographs for initial evaluation of the mandible and/or trauma fracture (Greenstein *et al*., 2008). • For implant placement in severely resorbed jaws, it is recommended to avoid perforations in the lower border, use short implants, and ensure at least 5 mm of bone between the implants, in addition to 2 mm between the implant and the buccal and lingual plate, avoiding excessive tightness (Kale *et al*., 2021). • When the fracture does not present mobility, treatment involves reducing masticatory forces, with a liquid and pasty diet, and removing the prostheses for 4 to 6 weeks (Ferreira *et al*., 2010). • Reduction of bone mass, degree of mobility and small fractures can be treated with bone grafting or stabilization/immobilization with osteosynthesis plates (Pelayo *et al*., 2008). • In severe fractures, the implant should be removed to favor complete bone regeneration (Gungor, 2023). • When placing implants in atrophic jaws, periodic follow-ups, including clinical and radiographic examinations, are required due to the possibility of fractures secondary to implant placement (Greenstein *et al*., 2008). • Guidance for the patient on occlusal load during the osseointegration period is crucial for treatment (Annibali *et al*., 2008).
Lack of primary implant stability	Excessive wear on the implant bed, poor bone quality and quantity around the implant, and failure to choose or place the implant.	• During the procedure, sequential drilling with sharp drills should be followed, speed controlled, and abundant irrigation should be ensured to avoid failures in implant bed preparation (Greenstein *et al*., 2008). • Using a longer and wider implant can help with implant stability (Greenstein *et al*., 2008). • Bone addition and inclusion before implant inclusion are factors that collaborate in case of lack of implant stability (Pelayo *et al*., 2008). • If the implant is still loose, it will be necessary to remove it, and the site should be reconditioned (enlarged) with a bone graft, with the implant reinserted after several months (Greenstein *et al*., 2008).
Inadvertent penetration of the maxillary sinus and nasal cavity	Improper drilling with instruments (e.g., drills); perforation during the elevation of the Schneiderian membrane; displacement of the implant into the cavity.	• Before maxillary sinus lift surgery, it is essential to assess sinus anatomy, lateral wall thickness, wall inclination, septal location, and membrane thickness through radiographic imaging, to minimize perforations (Kim, 2011). • If a drill improperly penetrates the maxillary sinus or nasal cavity, but there is sufficient bone length for implant stability, the situation can be tolerated, requiring the use of antibiotics and decongestants (Greenstein *et al*., 2008). • Small tears (< 5 to 8 mm) can be treated by bending the membrane against itself during lifting. Large perforations require repair with collagen or fibrin adhesives. In severe cases, it is recommended to interrupt the surgery and wait 6 to 9 months for membrane regeneration (Kim, 2011). • If perforation of the membrane occurs during maxillary sinus lifting, it should be occluded with a bioresorbable barrier before placing the graft material (Pelayo *et al*., 2008). • If the membrane ruptures at the periphery of the osteotomy and it is difficult to reconnect, the osteotomy can be expanded beyond the original window to reestablish contact with the membrane (Greenstein *et al*., 2008). • Excessive bleeding during osteotomy can be controlled with gauze saturated in anesthetic solution (epinephrine 1/50,000) in the membrane. Bone bleeding can be contained with direct pressure, hemostatic instruments, or cauterization. Another option is to displace the membrane and use a mosquito hemostatic instrument to compress the bone and occlude the blood vessel (Greenstein *et al*., 2008).

		• If the implant is accidentally displaced into the sinus cavity during the procedure, the removal can be performed through the Caldwell-Luc surgical approach (Ferreira *et al*., 2010), transnasal approach with endoscopic surgery (Camargo; Sickels, 2014) or aspiration through an alveolar bone defect (Freire *et al*., 2017).
Inadvertent penetration of the implant into the posterior edentulous region of the mandible	Bone quality and quantity	• If the implant is placed in the posterior region of the mandible, the hemorrhage must first be controlled and then osteotomy performed on the lateral body of the mandible (window) to remove the implant. After removal, the bone window can be fixed with a microplate and screws or with a demineralized bone graft. (Camargo; Sickels, 2014).
Overheating of bone structures	It occurs during the preparation of the surgical sockets, due to the friction between the drill and the bone tissue during the milling process.	• To avoid problems, the milling temperature should be kept below 47°C for a maximum of 1 minute. During bed preparation, intermittent movements of the contra-angle, abundant irrigation with sterile saline, sharp drills, and surgical protocols should be followed (Alves *et al*., 2017). • The use of rotating instruments with speed up to 2500 rpm during preparation can generate less heat, thus reducing bone damage (Kale *et al*., 2021).
Perforation of the cortical and basal plate	Incorrect preparation or placement of the implant position.	• If perforation occurs in the sublingual fossa region, the implant should not be placed in this location. Perforations in the vestibulo-maxillary region can be treated with guided bone regeneration. For small perforations of the cortical and basal plate in the interforaminal region of the mandible, shorter implants should be used, and bone grafts and membranes may be added for correction. Sites at risk of plaque perforation should not be indicated for implants (Kale *et al*., 2021).
Bone dehiscence and fenestration	Failure to prepare the bed, breakage or rupture of thinned sockets during milling or threading of the implant.	• Attention should be paid to the surgical planning, considering inclinations, bone thickness and density, avoiding angulation errors by checking the occlusal plane and guides. Areas at risk of fracture or fenestration should be carefully evaluated (Gungor, 2023). • If severe bone dehiscence or fenestration occurs, the implant placement in place should be canceled (Gungor, 2023). • In simple cases, it can be treated using covering membranes, the internal periosteum of the flap, or guided regeneration techniques with biomaterials and grafts (Gungor, 2023).

Source: The authors (2025).

With this in mind, it is now possible to discuss the results found through the analysis of the selected materials with regard to immediate complications in implant dentistry surgeries, as discussed below.

4 DISCUSSION

Through the analysis of the bibliographic material, it is possible to affirm that the success of dental implant therapy depends directly on the correct execution of all phases of rehabilitation treatment, especially in the surgical phase, in which immediate complications can severely compromise the final prognosis of oral rehabilitation. According to the authors Greenstein *et al*. (2008) and Pelayo *et al*. (2008), immediate complications, although not common, have occurred more frequently in clinical practice, reflecting the evolution of

technologies, materials and equipment, which have made this rehabilitation technique more accessible.

The increase in the number of patients undergoing surgical procedures is directly related to the increase in intraoperative complications. When these complications arise immediately, characterizing the so-called surgical accidents, as conceptualized by Annibali *et al*. (2008), it is essential that the dental surgeon acts in an agile and efficient manner, aiming to reduce the adverse consequences as much as possible.

Among the most frequent complications, it is possible to divide them into those that affect soft tissues and hard tissues. In the case of soft tissues, such as the mucosa, blood vessels, gums, lips, soft palate, nerves, salivary glands, among others, the survey showed the following complications: hemorrhages, nerve injuries, tissue emphysema, aspiration/ingestion of foreign objects, and salivary gland injury. Each of these complications requires a different action by the dental surgeon, according to the type of accident and its severity.

In the case of hemorrhages, they result from inadequate tissue management, trauma, or systemic conditions, especially in patients using anticoagulant medication. Control depends on the severity of the hemorrhage and may involve compression, epinephrine anesthesia, suture, bandages, and, in severe cases, angiography or hospital admission (Greenstein *et al*., 2008; Kim, 2011; Annibali *et al*., 2008). Nerve injuries, on the other hand, mainly affect the inferior alveolar, mental, and lingual nerves, significantly compromise quality of life, and may require removal of the implant, use of medications, microsurgeries, or laser therapy (Sillam, 2018; Kim, 2011; Menezes, 2017).

Tissue emphysema, although rare, requires attention due to the risk of progression to the mediastinum, and is managed with massages, thermal compresses, and medications, in mild cases; severe cases require hospitalization (Annibali *et al*., 2008; Kale *et al*., 2021; Greenstein *et al*., 2008). Accidents involving aspiration or ingestion of instruments are potentially fatal and require preventive measures and, if they occur, immediate hospital interventions, with examinations or emergency removal depending on the degree of obstruction (Menezes, 2017; Greenstein *et al*., 2008; Ferreira *et al*., 2010). Finally, trauma to the sublingual salivary gland, usually due to technical errors when installing implants in the posterior region of the mandible, can cause the formation of ranulas, requiring drug or surgical treatment (Camargo; Sickels, 2014).

Another type of surgical complications highlighted in the research are those related to hard tissues, which concern the mineralized structures of the oral region, such as the teeth and maxillomandibular bones. Among the immediate complications that can affect these

elements, the following stood out in the study: incorrect position and angulation of the implant bed preparation; lesions to the teeth adjacent to the implant; fracture in the atrophic mandible; lack of implant stability; improper penetration of the maxillary sinus and nasal cavity; penetration of the implant into the posterior edentula region of the mandible; overheating of bone structures; perforation of the cortical and basal plate; and bone dehiscence and fenestration. As in soft tissues, immediate complications in hard tissues have distinct causes and require measures that vary according to the type and severity of the occurrence.

Complications resulting from inadequate positioning and angulation of the implant are attributed to poor surgical planning, inexperience of the professional, and absence of surgical guides, requiring careful prior planning based on measurements and anatomical characteristics (Alves *et al*., 2017). Lesions in adjacent teeth, due to vascular involvement, bone overheating or compression by the implant, may require endodontic treatments, periapical surgeries or tooth extractions, and careful radiographic evaluation is essential to avoid accidental root canal treatment and to previously treat possible endodontic pathologies (Kim, 2011; Greenstein *et al*., 2008; Pereira, 2018).

Fractures in atrophic jaws, resulting from excessive milling, occlusal forces, or improper installation, require rigorous evaluation of the positioning and distancing of the implants, and may require bone grafts, stabilization with plates, or removal of the implant in severe cases (Kale *et al*., 2021; Ferreira *et al*., 2010; Gungor, 2023). Impaired primary stability, caused by excessive bed preparation or improper implant choice, must be managed with correct milling techniques, appropriate choice of implants, and use of bone grafts (Greenstein *et al*., 2008; Pelayo *et al*., 2008).

Inadvertent penetration into the maxillary sinus or nasal cavity represents an important complication, requiring treatment with antibiotics, decongestants, bioabsorbable barriers, and, in cases of implant displacement, surgical removal via Caldwell-Luc or endoscopy. Prior evaluation of the anatomy of the maxillary sinus and the Schneider membrane is essential to avoid these occurrences (Greenstein *et al*., 2008; Ferreira *et al*., 2010; Camargo; Sickels, 2014; Soares, 2022; Kim, 2011). Bone overheating, associated with inadequate osteotomy, can cause necrosis and osseointegration failure, and is avoided by adequate irrigation, use of sharp drills, and speed control (Alves *et al*., 2017; Kale *et al*., 2021; Pereira, 2010).

Perforations of the cortical and basal plate, common in critical areas such as the sublingual fossa and interforaminal region, should be avoided by careful planning, and the use of grafts and membranes is indicated in case of occurrence, or even contraindication of implants in the area (Kale *et al*., 2021). Finally, bone dehiscence and fenestrations, caused by failures in bed preparation, should be treated with membranes, periosteum, or guided

regeneration techniques; in severe cases, it is recommended to cancel the implant (Gungor, 2023).

Thus, it is observed that numerous immediate complications may occur during the surgical phase in implant dentistry, which are of multifactorial origin and require different therapeutic approaches, according to the nature of the occurrence, the anatomical region involved and the severity of the condition. In view of this scenario, it is important for the dental surgeon specialized in implant dentistry to be properly prepared to intervene in an agile and effective manner, especially in situations of greater complexity, which can not only significantly compromise the patient's quality of life, but also represent a potential risk to his life.

Therefore, it is essential that the professional, in addition to specific technical training, has interdisciplinary knowledge that allows him to properly manage the immediate complications associated with oral rehabilitation surgeries by implants. In other words, it is necessary that the dental surgeon, in addition to having knowledge about how to perform the procedure and good practices to avoid complications during surgery, understands the different forms of management, which involve interdisciplinary knowledge, in case of an accident, in order to offer the appropriate treatment according to the picture presented. An example of this type of interdisciplinary knowledge is the Heimlich maneuver, cited by Ferreira *et al*. (2010), a first aid technique for airway clearance, which can prevent a fatality.

Another point highlighted by the analyzed studies is the need for adequate planning before surgery, in order to offer individualized care that considers all the vicissitudes of the patient. This planning involves carrying out a complete anamnesis, including the patient's health history, and performing complementary imaging and laboratory tests, in order to identify possible variations and complications that may occur during the implant procedure.

In agreement, Esposito *et al*. (2010) considers that prior planning with a complete anamnesis before the procedure is essential to reduce the risk of accidents. This anamnesis allows the identification of certain conditions, such as the use of anticoagulant medications, which favors the occurrence of hemorrhages (Landi *et al*., 2021), as well as health conditions, such as diabetes mellitus, and patient habits, such as smoking (Soares, 2022), which can affect the effectiveness of the procedure, or even contraindicate its performance.

Dreossi *et al*. (2021) emphasize that imaging exams play an essential role in the surgical planning process, as they allow a more accurate assessment of local conditions. Methods such as periapical radiographs, panoramic and, above all, high-resolution computed tomography are indicated to provide a comprehensive view of the case. Associated with the diagnostic closure study, these resources are consolidated as crucial stages in planning, as

they offer important subsidies to predict possible complications, adequately guide the patient about the treatment and possible changes throughout its execution.

Thus, as highlighted by Storck *et al*. (2024), the technical training of the dental surgeon, both in terms of the execution of the procedure and the management of any accidents, combined with the adoption of well-defined clinical protocols and adequate prior planning, is essential to minimize risks and ensure the predictability and success of oral rehabilitation treatment.

5 CONCLUSION

Immediate complications in the surgical phase of implant dentistry represent a significant challenge to the safety and success of the treatment, requiring from the surgeon not only technical skill, but also deep anatomical knowledge and careful preoperative evaluation. Implant dentistry is an oral rehabilitation resource that effectively contributes to improving the quality of life of individuals, both functionally and aesthetically. In recent years, this has become an increasingly viable and affordable treatment option. On the other hand, it is also subject to occurrences during the procedure, which may be minimal and not affect the success of the treatment, or lead to complete implant failure and even be life-threatening.

In this review, it was possible to identify the main complications, divided into those that occur in soft tissues, such as hemorrhages, nerve injuries, subcutaneous emphysema, among others, and those that occur in hard tissues, such as incorrect implant positioning, bone fractures, and other unforeseen situations, their causes, and prevention and management strategies. Such complications have a multifactorial cause and their treatment depends on some factors, such as the nature of the occurrence, the anatomical region involved, and the severity of the condition.

In addition, it was found that the anticipation of possible complications, through detailed and individualized surgical planning, including anamnesis and complementary exams, especially imaging, combined with a solid technical knowledge on the part of the dental surgeon in the procedure and the adoption of good safety practices, can contribute to the reduction of these adverse events. As for the management of possible immediate occurrences during the surgical procedure, these are varied and require the dentist to have interdisciplinary knowledge, in some cases, and the ability to act quickly to solve them.

Thus, it is concluded that success in implantology is not restricted only to the implant installation itself, but depends on the integration between the detailed initial diagnosis, individualized planning, precise surgical execution and postoperative care. Evidence-based clinical practice, patient collaboration, combined with the ethical and technical commitment

of the professional, constitute the foundation for surgical predictability and longevity of dental implant treatment.

REFERENCES

1. Alves, L. M. N., et al. (2017). Complicações em implantodontia: Revisão de literatura. Journal of Orofacial Investigation, 4(1), 20–29. https://revistas.faculdadefacit.edu.br/index.php/JOFI/article/view/158

2. Annibali, S., et al. (2008). Local complications in dental implant surgery: Prevention and treatment. Oral & Implantology, 1(1), 21–33. https://pmc.ncbi.nlm.nih.gov/articles/PMC3476500/

3. Batista, D. L., & Poluha, R. L. (2021). Complicações em implantodontia e prótese sobre implante: Revisão de literatura. Archives of Health Investigation, 10(9), 1431–1434. https://archhealthinvestigation.com.br/ArcHI/article/view/5391/7255

4. Camargo, I. B., & Van Sickels, J. E. (2015). Surgical complications after implant placement. Dental Clinics, 59(1), 57–72. https://pubmed.ncbi.nlm.nih.gov/25434559/

5. Dreossi, G. B., et al. (2021). Planejamento reverso em implantodontia – Revisão de literatura. Revista Odontológica de Araçatuba, 42(2), 53–57. https://revaracatuba.odo.br/revista/2021/04/TRABALHO08.pdf

6. Ercole, F. F., De Melo, L. S., & Alcoforado, C. L. G. C. (2014). Revisão integrativa versus revisão sistemática. REME-Revista Mineira de Enfermagem, 18(1), 12–14. https://periodicos.ufmg.br/index.php/reme/article/download/50174/41438

7. Esposito, M., et al. (2010). The effectiveness of immediate, early, and conventional loading of dental implants: A Cochrane systematic review of randomized controlled clinical trials. International Journal of Oral & Maxillofacial Implants, 25(5), 897–918. https://periodicos.ufmg.br/index.php/reme/article/download/50174/41438

8. Ferreira, G. R., et al. (2010). Complicações na reabilitação bucal com implantes osseointegráveis. Revista Odontológica de Araçatuba, 31(1), 51–55. https://repositorio.unesp.br/server/api/core/bitstreams/06dee52b-80cf-41d5-b5bc-6e95fb0083ab/content

9. Freire, C. N. B. M., et al. (2017). Complicações decorrentes da reabilitação com implantes dentários. Revista Uningá, 51(3), 63–68. https://revista.uninga.br/uninga/article/view/1361

10. Greenstein, G., et al. (2008). Clinical recommendations for avoiding and managing surgical complications associated with implant dentistry: A review. Journal of Periodontology, 79(8), 1317–1329. https://pubmed.ncbi.nlm.nih.gov/31199745/

11. Gungor, M. (2023). Complications and solution suggestions before and after treatment in dental implantology. Brazilian Journal of Implantology and Health Sciences, 5(5), 4390–43411. https://bjihs.emnuvens.com.br/bjihs/article/download/988/1128/2824

12. Kale, P. P., et al. (2021). Management of surgical complication during dental implant placement. Journal of Head & Neck Physicians and Surgeons, 9(1), 13–19. https://journals.lww.com/jhns/fulltext/2021/09010/management_of_surgical_complication_during_dental.3.aspx

13. Kim, S.-G. (2011). Clinical complications of dental implants. Implant Dentistry—A Rapidly Evolving Practice, 2(1), 467–490. https://www.intechopen.com/chapters/18432

14. Landi, B. M., et al. (2021). Complications in implantology. Revista Odontológica de Araçatuba, 42(2), 35–41. https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1252912

15. Lourenço, S. V., Morano-Júnior, M., & Daruge-Júnior, E. (2007). Complicações cirúrgicas e protéticas em implantodontia. Revista Odonto Ciência, 22(58), 352–358.

16. Menezes, S. L. (2017). Acidentes e complicações na implantodontia [Dissertação de Especialização, Faculdade Sete Lagoas]. https://faculdadefacsete.edu.br/monografia/files/original/da482d820c3e74ea2e8e995102ed9083.pdf

17. Misch, C. E. (2015). Dental implant prosthetics (2nd ed.). Elsevier Health Sciences.

18. Pelayo, J. L., et al. (2008). Intraoperative complications during oral implantology. Medicina Oral, Patología Oral y Cirugía Bucal, 13(4), 239–243. https://pubmed.ncbi.nlm.nih.gov/18379448/

19. Pereira, A. B. (2018). Intercorrência na implantodontia - Fase cirúrgica [Dissertação de Especialização, Faculdade Sete Lagoas]. https://faisa.edu.br/monografia/items/show/2287

20. Pereira, M. (2010). Acidentes e complicações na implantodontia [Dissertação de Especialização, Faculdade Sete Lagoas]. https://faisa.edu.br/monografia/items/show/5722

21. Sillam, D. C. M. (2018). Complicações intra e pós-operatórias em cirurgia de implantes dentários [Dissertação de Mestrado, Instituto Superior de Ciências da Saúde - Egas Moniz]. https://search.proquest.com/openview/46f2838e7a6432f81fb0ed170416967f/1?pq-origsite=gscholar&cbl=2026366&diss=y

22. Siqueira, A. G., et al. (2020). Complicações protéticas na implantodontia: Uma revisão de literatura. Journal of Multidisciplinary Dentistry, 10(2), 98–105. https://www.jmdentistry.com/jmd/article/view/267

23. Soares, A. de L. (2022). Riscos e complicações associadas à falha do implante dentário [Dissertação de Mestrado, Faculdade EDUFOR]. https://edufor.com.br/repositorio/wp-content/uploads/tainacan-items/3842/3889/Riscos-e-complicacoes-associadas-a-falha-do-implante.pdf

24. Souza, M. T. de, et al. (2010). Revisão integrativa: O que é e como fazer. Einstein, 8(1), 102–106. https://pt.scribd.com/document/56528038/A2-Revisao-integrativa-o-que-e-e-como-fazer

25. Storck, I. J. V., et al. (2024). Complicações cirúrgicas em implantodontia: Identificação das causas e estratégias para minimização do insucesso. Brazilian Journal of Implantology and Health Sciences, 6(9), 4110–4120. https://bjihs.emnuvens.com.br/bjihs/article/view/3710