Risk factors for dental implant failure and medicolegal implications

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Abstract: Dental implants have become a routine intervention worldwide, with a high success rate both functionally and aesthetically. Nowadays edentation is no longer accepted and removable prosthesis are considered uncomfortable and are becoming more difficult to tolerate by the patient.

As these interventions are becoming more and more often, the protocol that these patients must follow grows even more standardized. The success rate is high, which only makes the cases of implant failure ever more difficult to manage. Due to the patient's expectancies, the impact that further treatment and expensive interventions can cause on these patients can be significant, leading even to medico-legal implications in some cases.

The aim of this paper is to identify the most frequent causes of dental implant failure and the means of prevention that are available for the physicians, thus avoiding unwanted complications.

Key Words: dental implants, implant failure, local complications.

INTRODUCTION

A dental implant represents a titanium root inserted in the bone of the jaw, placed to replace the missing teeth. A crown is attached to the implant reconstructing the missing teeth. The titanium implant will fuse with the jaw bone using the osteointegration process.

Placing dental implants for missing teeth represents the preferred method of dental rehabilitation [1-3]. They are functioning as the natural teeth; the chewing forces are preventing the bone loss. Dental bridges will address only to the cosmetic, but it will not prevent the bone loss. The American Academy of Implant Dentistry stated that more than 35 millions of people have all their teeth missing on one or both jaws.

Also in the USA, 15 million people have crowns or bridges as dental treatment for their missing teeth. Only 3 million people underwent dental implant surgery, but the number is increasing with 500.000 persons each year.

The dental implant represents a safe surgical procedure with a high success rate according to the literature [4]. The dental implant and prosthetic market in the USA reached 6.4 billion US dollars in 2018.

The first surgical placement of an implant was discovered in Mayan and Egyptian human remains which replaced missing teeth with shaped shells.

The osseointegration process of the titanium implants was observed for the first time by a Swedish orthopaedic surgeon. P. I. Branemark, in 1952. His first studies were performed on the rabbit tibia and fibula. Then he focused his clinical work to the teeth implantation because of the important number of subjects with missing teeth [5].
The Branemark implant system was first commercialized in 1981, and it is believed that more than 7 million systems were mounted all around the world.

3D Cone Beam Computed Tomography (CBCT) and proper planning of the surgical procedure have made dental implant the most predictable surgery in the modern dentistry.

Preoperative CBCT exam will allow the surgeon to precisely assess the bone reserve and the if the patient needs or not a bone augmentation procedure to sustain the implants [6].

The aim of the paper is to determine the medical and management factors that can cause the failure of the implant and their medico-legal implications.

MATERIAL AND METHODS

We analyzed a group of 21 patients with dental implant failure, referred to our clinic, between 2010 and 2018. An informed consent was obtained from each patient regarding the acceptance to take part in the study, according to the World Medical Association Declaration of Helsinki, while ensuring their identity remains classified.

We have counted a number of 14 (66.67%) females and 7 (33.33%) males. The age of the patients was between 27 and 64 years old with a mean of 47 years old. All the patients underwent a sinus lift procedure concomitant with the dental implant placement. The number of implants placed in one patient varies between 2 and maximum 5.

A number of 5 patients were diagnosed with diabetes mellitus, 3 of them used insulin treatment and 2 of them were treated with oral antidiabetic medication.

The complications that we found were:
- peri-implantitis - 4 patients;
- acute bacterial maxillary rhinosinusitis - 6 patients;
- acute fungal maxillary rhinosinusitis - 5 patients;
- implant migration into the maxillary sinus - 3 patients;
- orbital abscess - 1 patient;
- malar abscess - 2 patients.

The patients that presented with peri-implantitis were treated by the dental surgeon.

In the case of patients with acute bacterial maxillary rhinosinusitis, a conservative treatment with broad-spectrum antibiotics was performed, 4 of the patients responded positively, and in the second stage, the patient underwent functional nasal permeabilization surgery (nasal septum surgery and volumetric reduction of the inferior turbinates) and the particles of bone augmentation that floated into the maxillary sinus were removed.

The sinusal cavity was washed using the Hydrodebrider probes with saline solution and antibiotics. In the case of 4 patients that did not respond positively to the antibiotic treatment (the control CT scan showed complete opacification of the maxillary sinus), the dental surgeon removed the implants and the bone augmentation materials and we performed functional nasal permeabilization surgery. The sinusal cavity was washed using the Hydrodebrider maxillary probes with saline solution and antibiotics. The patients were observed for 6 months, they did not present any episode of rhinosinusitis, and after that period the sinus lift procedure was performed and the implants were mounted.

In the 5 patients with acute fungic maxillary rhinosinusitis, we treated the acute infection using broad-spectrum antibiotics and then we performed functional endoscopic sinus surgery in order to remove the fungus ball together with the bone augmentation materials and to assure the patency of the sinusal ostium (septal deviation, inferior turbinate hypertrophy, concha bulosa). We enlarged under endoscopic control the maxillary ostium and we washed under pressure the sinusal ostium using...
the Hydrodebrider probes with saline solution, betadine solution, hydrogen peroxide, antibiotic solution.

We encountered a number of 3 patients with 1 implant migrated into the maxillary sinus. We performed endoscopic sinus surgery with the endoscopic removal of the implant after enlarging the natural ostium.

One patient presented with unilateral maxillo-fronto-ethmoidal rhinosinusitis with orbital abscess as complication. We performed functional endoscopic sinus surgery and we removed the pus, degenerated mucosa, the bone augmentation material and then decompressed endoscopically the orbit. We washed the sinusal cavity using the Hydrodebrider with saline, hydrogen peroxide and antibiotic solutions.

We encountered 2 patients with acute maxillary rhinosinusitis in complications, we performed functional endoscopic surgery for the involved maxillary sinusal cavity, washing under pressure the sinusal cavity with the hydrodebrider. The malar abscess was drained and washed using hydrogen peroxide solution and betadine.

**RESULTS**

From the 21 patients studied, in 14 cases we succeeded to save the implants using proper antibiotic therapy, balancing the diabetes mellitus and performing functional endoscopic sinus surgery with removal of the migrated bone augmentation material and washed under pressure the sinusal cavities with the Hydrodebrider.

In 4 cases we were forced to remove the implants and the bone augmentation material because of the bacterial colonization. The patients underwent a 6-month follow-up program that consisted of anamnestic about sinusal events and fiberoptic nasal exam every 3 months, after that the bone augmentation surgery was performed and new implants mounted.

**DISCUSSIONS**

We tried to synthesise the risk factors for dental implant failure and their medicolegal implications.

Patient-related factors are general health conditions such as diabetes mellitus, osteoporosis and an undisciplined patient that does not follow medical recommendations and follow-up.

**Diabetes Mellitus**

Diabetic patients are a particular category characterized by an increased risk of periodontitis, edentation, late and poorly wound healing, increased infection rate, and poor response to standard antibiotic therapy.
therapy. These negative aspects are particularly found in patients with unbalanced diabetes, uncontrolled, with a constant hyperglycemic state.

Hyperglycemia is the central element of micro- and macrovascular damage, and the longer the duration of diabetes and control is weaker, the more severe are the complications [7-9]. In a poorly controlled diabetic patient, the problem of dental implants involves additional risk factors such as poor osseointegration, peri-implantitis, implant failure, localized infections.

Several studies have found that the use of antibiotics with large spectrum and the local use of chlorhexidine have favorable effects in post-implantation development [10].

Another important aspect is that the diabetic patient who is not optimally controlled and has a longer duration of illness will present osseointegration following implantation in the medium term [11].

There is no data in the literature demonstrating differences between implant techniques, whether it is bone augmentation procedures such as guided bone regeneration and sinus lifts in patients with diabetes. However, even if in the past the diabetic patient did not benefit from the dental implant, today the paradigm has changed, and it is even more appropriate to note if we consider that these patients suffer most of the time from partial or even total edentation.

The primary goal is to give the diabetic patient the opportunity to feed properly. As glycemic control is better, glycosylated hemoglobin (HbA1C%) being in the long-term in the target of 6.5-7%, both the success rate of dental implants and the chances for minimal complications are greater. In this context, it can be said that the dental implant in the diabetic patient is safe and even recommended.

Undisciplined patient that does not follow medical recommendations and follow-up.

Mobile temporary dentures can be used for provisionals in case of rehabilitation of the total edentulism, to achieve teeth for our patient during the healing period of implants. In this case, the mucosal part of the denture should be lined with soft silicone material, which has the role of alleviating shocks on the mucosa and bone during mastication, especially if dental implants were inserted or bone augmentations were made in the area to improve the maxillary bone volume.

The immediate goal of postoperative healing for implant surgery is to obtain a perfect mucosal closure, characterized by the absence of any continuity solution. Subsequently, during the maturation of the tissue, obtaining a corresponding amount of keratinized tissue plays a significant role in sealing the neck region of the dental implants. At the same time, to achieve quality bone regeneration translated by the appearance of lamellar bone, it is essential that the inserted biomaterial (support material) is not physically or chemically traumatised (forces and ph) during the healing period. Therefore, the role of regular controls and periodic relining (filling) of the mucosal surface of the denture is a determining factor in the success of the treatment.

If the patient constantly does not respect the medical recommendations and the follow-up exams the dental implant will fail.

**Chronic maxillary rhinosinusitis**

Chronic maxillary rhinosinusitis is not an absolute contraindication of the dental implant. It is important to assess the factors that determined chronic rhinosinusitis. If the determined factors are of dental origin the sanitization of the oral cavity must be performed prior to dental implant planning and mounting. If a nasal obstruction factor is determined (septal deviation, inferior turbinate hypertrophy, concha bullosa, etc) functional endoscopic surgery may be performed.

**Acute maxillary rhinosinusitis**

Acute maxillary rhinosinusitis represents an absolute contraindication of the dental implant. the acute infection must be medically treated and the factors that determined the acute infection must be removed

**Bone augmentation**

Bone augmentation material in the maxillary sinus, if present, must be removed because of the risk of fungal infection with Aspergillus spp on the material fragments. The sinus must be washed under pressure using the Hydrodebrider in order to remove the bacterial, fungal biofilm and the small fragments of bone augmentation material. The washing solutions that we use are saline, betadine solutions, hydrogen peroxide and antibiotic solutions.

Augmenting the maxillary sinus floor by the ENT surgeon endoscopically during functional endoscopic sinus surgery represents an iatrogeny because the augmentation material will float into the sinus and will create inflation of the sinus mucosa, creating a proper medium for bacterial and fungal infections.

**Hyperbaric oxygen therapy (HBOT)**

Hyperbaric oxygen therapy (HBOT) represents the treatment with 100% oxygen at pressures higher than atmospheric pressure. That therapy will cause barotrauma of the paranasal sinuses and barosinusitis will occur. During the compression phase, a negative pressure gradient causes inflammation of the sinusal mucosa and of the ostial openings, occluding the sinuses. If a chronic rhinosinusitis is present the HBOT treatment can worsen the sinusal chronic infection.

HBOT will also cause dental and bony barotrauma due to the compression and decompression process.

**In conclusion,** we analyzed and determined the
risk factors for dental implant failure. The failure of the dental implant can be determined by the undisciplined patient that does not comply with the follow-up exams and treatments.

Acute maxillary rhinosinusitis is an absolute contraindication for the dental implant.

Chronic maxillary rhinosinusitis does not represent an absolute contraindication for the dental implant but is important to identify in then objective nasal obstruction is observed it is better to solve the obstruction prior dental implant surgery.

HBOT is a contraindication for a patient that underwent dental implant surgery due to the sinusal barotrauma that will cause or worsened rhinosinusitis and dental barotrauma.

Augmentation of the maxillary floor during functional endoscopic sinus surgery is prohibited because the augmentation material will float into the sinus, causing inflation and determining bacterial of fungal colonization.

If a floating augmentation material is observed it must be removed immediately.

An important risk factor is the exposure of the dental surgeon to a legal event. We identified three distinct possible scenarios that will arise a possible malpraxis accusation:

First scenario is represented by a medical error of dental implant placing that will fail. In that case the dental surgeon will suffer a malpraxis charges. If demonstrated the damages will be paid by the malpraxis insurance company.

The second possible scenario is a medical error associated with an ethical charges that can be a missing informed consent or surgical gestures that are beyond his competence. In that case, if the allegations are demonstrated the doctor will have to pay the damages because the insurance company will not cover it.

The third scenarios will be only an ethical error that is not combined with a medical error. If the ethical error (that can be a missing informed consent or surgical gestures that are beyond his expertise) is demonstrated, the damages will be paid only by the doctor.

Conflict of interest. The authors declare that there is no conflict of interest.

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Detail has been removed from these case descriptions to ensure anonymity.

References