Potential Risks and Prevention in Implant Dentistry

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INTRODUCTION

The discovery and universal application of osseointegration has revolutionized the prosthodontic rehabilitation of partially or fully edentulous patients. An implant that has not achieved osseointegration can certainly be considered a failure from a restorative or functional perspective. Fortunately, many complications that are associated with implant placement are reversible, even in situations where we must remove the implant and start over. Failures, however, can sometimes have devastating consequences on a patient's (or surgeon's) physical, psychosocial, and financial well-being. The purpose of this work is to review the risk factors and possible complications of implant dentistry and minimize their occurrence in addition to provide prompt patient care. Consideration will be given to preoperative planning and the avoidance of complications during the treatment planning phase, intraoperative phase and acute complications, as well as early and delayed postoperative complications leading to failure.

Patient Assessment

There are many important factors to assess when evaluating a patient for implant rehabilitation. Even before the actual clinical assessment is performed, the clinician should have a reasonable idea whether the patient is a good candidate for a successful outcome based on their expectations.

The patient's ability to cooperate with treatment and subsequent hygiene maintenance should be a primary concern when evaluating for implant reconstruction. The immediate surgical outcome, although a concern, does not mean much if the patient does not possess the skills or understanding to the long-term success of implant rehabilitation.

Additionally, the patient's expectations are key in determining whether the patient will consider their own treatment as a success.

There have been several systemic conditions cited in the literature that traditionally have been accepted as risk factors for integration failure. Several articles cite specific conditions that are considered absolute or relative contraindications to implant placement. Typically, these include diabetes, osteoporosis, corticosteroid therapy, chemotherapy,radiation treatment to the head and neck, exposure to certain medications and habits such smoking.

A study by Klokkevold and Han [1] analyzed data from 35 articles that included failure rates in diabetic patients and smokers. The findings suggest that smoking significantly contributed to failure, but there was no difference for the diabetic patient.

In a study reviewing 4,680 implants, Moy et al. [2], however, found that there was a significant increase in implant failure for the diabetic patient and the smoker. Also, additional conditions related to increased risk for failure included patients age greater than 60 years, head and neck radiation therapy, postmenopausal estrogen therapy, and exposure to anti-resorption and anti-neoplastic medications. Conversely, gender, hypertension, coronary heart disease, pulmonary disease, steroid therapy, chemotherapy, and not being on hormone replacement therapy (in postmenopausal women) were all not associated with increased incidence of implant failure.

Although the literature supports the fact that there may not be any absolute contraindications to implant placement, the clinician needs to understand how certain systemic conditions may affect implant osseointegration. This will help direct proper judgment with respect to treatment planning in patients with systemic diseases. For example, in the diabetic patient, decreased vascularity and circulation of the recipient bed due to microvascular abnormalities contribute to impaired wound healing, and abnormalities in neutrophil chemotaxis and phagocytic activity may make the diabetic patient more susceptible to infections. In the case of metabolic

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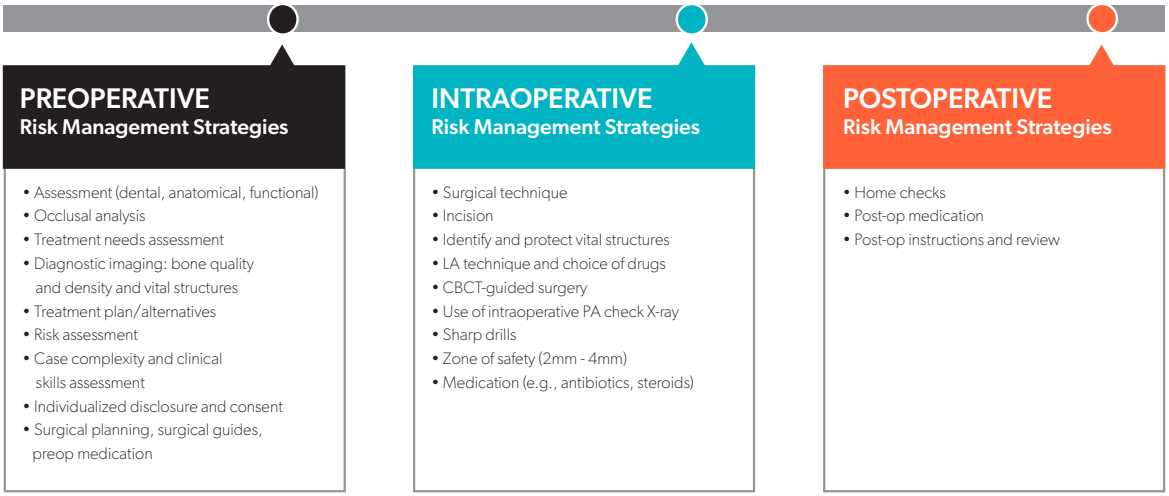


Figure 1:
The preoperative, intraoperative, and postoperative risk management strategies and protocols for implant placement in the mandible.

bone diseases (osteoporosis, hyperparathyroidism, Paget's disease, etc.), one must consider the potential for proper bone mineralization that is important to integration.

In most instances, the literature does not distinguish the difference between implant failure and medical complications associated with implant placement. However, the clinician should differentiate the possible conditions that may cause implant failure versus conditions that may directly cause harm to the patient. For instance, a patient who has had radiation therapy to the jaws or has been treated with a bisphosphonate/anti-neoplastic medication, may be at risk for osteoradionecrosis or medication-related osteonecrosis, respectively. In these patients, "The option of implant therapy should be chosen restrictively, and the patient should be informed specifically, considering the current level of uncertainty with regard to the consequences." [2]

In general, if a patient has the proper physical and mental attributes to maintain implants after restoration, has reasonable expectations, and can safely undergo the surgical procedure without placing undue risk on their physical well-being, they are a candidate for implant rehabilitation. The informed consent discussion should be tailored to each patient, taking care to identify issues that may cause increased risk of failure or medical/physical risk to the patient.

Additionally, anatomic considerations are equally as important when evaluating a patient for implant placement. Alterations in the trajectory of the inferior alveolar canal, as well as changes in bone level, will predispose certain patients to higher risks or nerve injury. Perforation of cortical bone into the sublingual space may increase the risk of bleeding causing potential airway compromise. In the maxilla, violation of the sinus and nasal cavities is also a concern. (Fig. 1)

Clinical Assessment of the Patient

Thorough clinical examination prior to implant treatment planning is imperative to assess not only the recipient site itself, but also to evaluate the patient's current dentition and dental/gingival health, signs of parafunctional habits, malocclusion, or other factors that may be of importance with respect to implant failure. The clinician must keep in mind that the recipient site may be optimal for implant integration, but if the implant cannot be restored to proper function and aesthetics, then it may be deemed a failure.

The idea of placing implants in a patient with a history of periodontal disease has been a topic of controversy in the literature. Behind these studies, there exist several factors that make it difficult to compare outcomes. For example, each study may have different parameters with respect to the definition of periodontitis, the severity and treatment of periodontitis, the outcomes measures, the periodontal status at the time of placement, etc. Because of this variability, one cannot say for certain that a patient who experiences tooth loss due to periodontitis has a higher risk of developing peri-implantitis or integration complications.

Bruxism has been implicated in implant component fractures. Although no actual causal relationship exists, the consensus in the literature recognizes an association between implant fracture and parafunctional habits. When developing an implant treatment plan for a patient with bruxism, the clinician should plan to minimize eccentric forces, eliminate cantilevers, and potentially place additional implants to share the occlusal load.

When considering implant fracture, two other main causes have been implicated: manufacturing error and poor prosthetic fit. Although these factors also may contribute to implant fracture, they are much less cited when compared with parafunctional habits. Implant fractures are commonly preceded by multiple incidents of broken abutment screws and bone loss and may give the clinician an indication that there is an underlying problem.

Balshi et al. [3] performed an analysis of 4,045 implants placed in function for 5 years. He found eight fractured implants (0.2%). Six were supporting posterior prostheses, and all patients were diagnosed with parafunctional habits. Most of

these patients also had preceding problems with loosening or fractured prosthetic or abutment screws prior to fracture.

When examining the soft tissues surrounding the areas of interest, traditionally it was thought that there must be a proper amount of keratinized gingiva present for proper maintenance of implants. Recent studies, however, show that the amount of keratinized gingiva may only be a matter of cosmesis. There are no studies that show an increased loss of implants in areas of inadequate (<2 mm) keratinized mucosa. Kim et al. [4] suggest that there may be an increased risk of gingival recession and marginal bone loss in areas of deficient keratinized mucosa, but this does not necessarily cause adverse effects unless it is in the esthetic zone and esthetics are affected.

Buccal soft tissue recession was also reported to be greater over a 5-year period in patients with inadequate keratinized gingiva. These studies may suggest that patients with inadequate keratinized mucosa around implants may have greater challenges with hygiene leading to subsequent periodontal issues that may or may not impact the overall success of the reconstruction.

Bone quality has been implicated as one of the most important factors for initial implant osseointegration but is unfortunately difficult to evaluate preoperatively and it is a factor that cannot be changed prior to surgery. It is widely accepted that type 2 and 3 bone is the most favorable for initial osseointegration, but many times, the surgeon may be faced with type 1 or 4 bone at the time of surgery, even if the patient has a fairly normal anatomic and radiographic examination.

Sometimes it is not difficult to predict based on the patient's presentation. For instance, a patient with a severely atrophic mandible will most likely have nearly all cortical bone in the anterior mandible. Surgeons need to familiarize themselves with these presentations to make adjustments for bone quality. For example, a tapered implant may be preferred, healing time may be extended, or a two- versus one-staged procedure may be indicated.

Prosthodontic and Surgical Treatment Planning

Implant reconstruction treatment planning is a team concept. The restorative dentist and surgeon must both provide input for a successful outcome. Failure to include the restorative dentist in the treatment planning phase could lead to prosthodontic failures because of unrestorability of the implant due to location, angulation problems, or esthetic failures. Both parties should communicate their preferences with respect to implant location.

Many times, it is helpful when the restorative dentist provides a surgical guide to assist with implant location and angulation. Surgical guides are not always necessary depending on the location of the implants and the skill of the surgeon but can be very helpful for complex cases and esthetic zone cases, especially those involving multiple implants. Recently, there has been great attention paid to computer-aided treatment planning, surgical guide fabrication, and computer-guided surgery. Currently, there exist no clinical trials indicating the superiority of such techniques. There may be some benefit of obtaining CT imaging with treatment planning sites that may have significant anatomic limitations, but in general, most of the information provided on the CT scan can be obtained by a good clinical examination, mounted models, and plane radiographies. (Fig. 2)

Treatment planning not only addresses location of implants but also time between extraction and implant placement, time to implant loading, and time to final restoration. All these factors may play a role in the initial integration and implant stability. The alveolar ridge undergoes hard and soft tissue dimensional change after tooth extraction. Several studies have looked at the amount of bone loss that occurs over time after extraction with loss of horizontal width between 30 and 50% at 3 to 12 months after extraction.

Immediate and early implant placement has become an accepted technique to attempt to offset this anatomical change. However, Boticelli et al. [5] placed 21 immediate implants in 18 patients, and upon re-entry at 4 months found resorption of the bone around the implants: approximately 50% on the buccal plate and 30% on the lingual.

Although studies suggest that bony resorption continues to take place regardless of when the implant is placed after extraction, there is no evidence to suggest that early or immediate placement techniques have a significantly lower rate (or higher rate) of integration success as those placed in a more delayed fashion.

Timing to loading of implants is also well debated in the literature, and presumably influences the overall success of implant integration. Jokestad and Carr [6] performed a systematic review of the literature examining timing to loading of implants. Only 22 papers were thought to be adequate

Figure 2

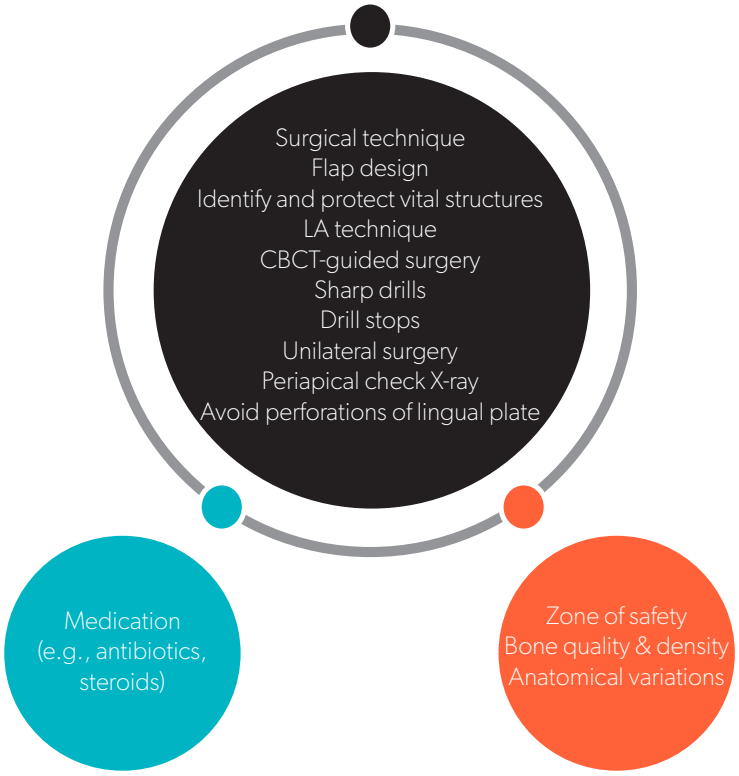
Objectives of CBCT Diagnostic Imaging
• Determine bone density and quantity at each implant site
• Identify vital structures such as IAN
• Determine ideal implant location
• Identify variations in anatomical structures (i.e., multiple IAN or bifid MN)
• Determine an adequate safety zone (ZOS)
• Select optimum implant length and diameter
• CBCT-guided surgical stent design for restoratively-driven implant placement

Objectives of CBCT Diagnostic Imaging
• Location, severity, and mechanism of injury
• Proximity of the injury to the cell body
• Time elapsed since injury
• Early medical and surgical management of injury

for inclusion in the study. Due to the heterogeneity, variable clinical applications, variable outcomes, and lack of quality of evidence, the authors could not make a definitive conclusion. They stated that the average outcome was in favor of delayed loading, but there are no indications that immediate or early loading cannot be a safe procedure. With so many variables to consider (bone quality, type of implant, timing of implant placement relative to extraction, patient factors, prosthetic plan, stability of implant at time of insertion, etc.), one cannot, at this point, prove any superiority to anyone loading plan.

Another factor to consider with respect to timing of implant placement and loading includes the augmented ridge or sinus. Aghaloo and Moy performed a systematic review of the literature to determine which hard tissue augmentation procedures are the most successful in furnishing support for implant placement. [7] The study included 90 articles that were acceptable for data extraction and analysis. Regarding sinus augmentation, the authors found that sinus augmentation with allogeneic/nonautogenous composite grafts had the best retention for implants (93%). Autogenous grafts were a close second at 92%, followed by alloplastic grafts at 82%.

Figure 3: Intraoperative risk management strategies



When looking at alveolar ridge augmentation, Aghaloo et al. [8] reported the most success for implant survival in sites augmented with guided bone regeneration, onlay veneer grafting, and distraction osteogenesis. The authors, however, did acknowledge the limited number of acceptable studies and the variation in those studies that prevented the development of a definitive conclusion regarding the best hard tissue augmentation to support implant survival. (Fig. 3)

INTRAOPERATIVE COMPLICATIONS

Intraoperative complications during implant surgery can happen despite the most meticulous planning and preparation. For the most part, few are of large consequence and can be corrected with minor surgery or alteration in the prosthodontic plan. Few are life threatening or leave the patient with a permanent disability, but the chance of such complications is not zero. It is the responsibility of the clinician to include a discussion of risks during the informed consent process. The discussion should include risks of bleeding, pain, swelling, infection, damage to adjacent teeth, sensory disturbance, failure of integration, failure to obtain restorability, displacement of implants (for instance, in the maxillary sinus), and the possibility for the need for additional procedures. (Fig. 4)

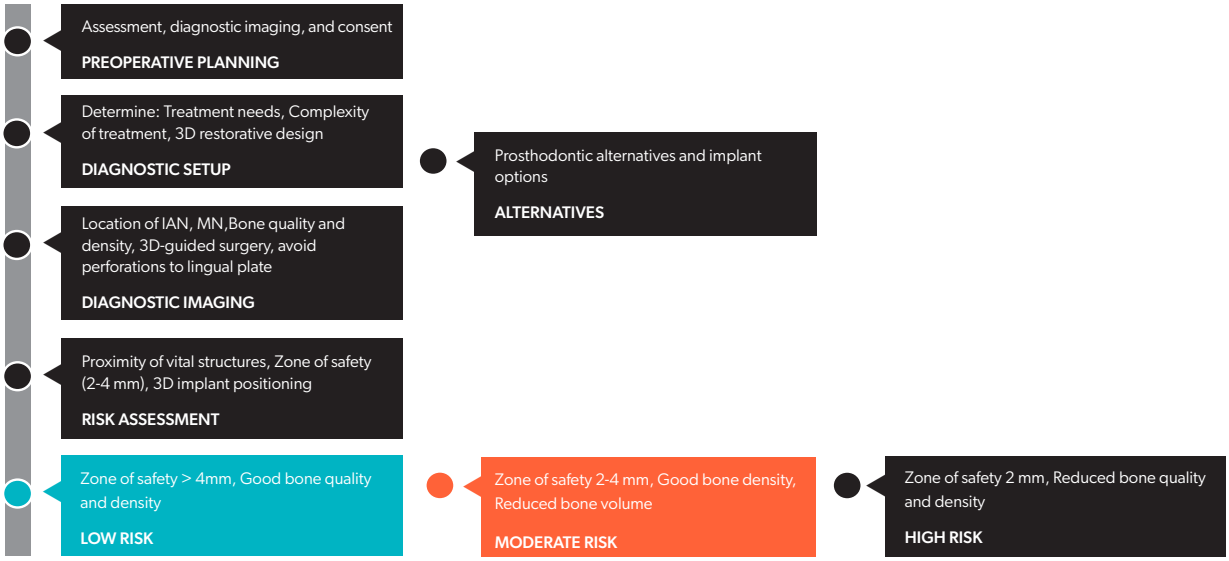
Poor placement with respect to adjacent dentition can be a frustrating problem. This can cause an aesthetic problem with the shape or emergence of the crown, and the periodontal health of the adjacent tooth can be affected as well. Planning for implant surgery in locations of anatomic difficulty requires meticulous preoperative planning. Occasionally, complications happen regardless of preparation. In the posterior mandible for instance, care must be taken to plan for the positioning of the implant to avoid the inferior alveolar nerve. Most authors agree that placing the implant within 2 mm of the superior cortex of the inferior alveolar nerve (IAN) can cause a permanent sensory disturbance.

Damage can be caused by the implant drill or submerging the implant itself too apically. Goodacre et al. [9] reported an overall immediate (post stage 1) neurosensory disturbance of 6.1% upon reviewing 13 reports in the literature. The range in incidence was 0.6–39.0%. Most data indicate that the incidence decreases significantly over time. In the case where it appears that there is not sufficient bone height superior to the IAN on plain radiography, alternate imaging techniques may be utilized to obtain a more precise measurement of the existing bone. Of course, if an inadequate height of bone exists, augmentation procedures or a nerve repositioning procedure may be undertaken, however, these procedures also carry risk with regard to sensory disturbance.

Some surgeons would argue that obtaining contemporary forms of imaging (CT, cone beam imaging), and computer-assisted design/computer-assisted manufacturing (CAD/CAM) fabrication of surgical guides would negate this potential complication; however, there are no current published studies that directly compare these groups.

Theisen et al. [10] suggested that displacement of implants in the posterior mandible can be attributed in part by the quality

Figure 4: Preoperative risk management strategies for implant surgery in the mandible.



of the medullary spaces of bone in that anatomic region. They propose that the cancellous portion of bone in the posterior mandible is more abundant but less dense than in the anterior mandible, and this lack of bone density causes minimal resistance upon penetration of the cortex. In these cases, the drill tends to "drop" into spaces during the preparation, thus rendering the inferior alveolar nerve susceptible to damage if the drill is not properly controlled.

When the implant is seated, there is also less resistance, and the implant may be seated deeper than the prepared osteotomy, particularly while tightening the healing abutment or cover screw. The true incidence of inferior alveolar nerve damage during implant placement is not truly known, but diligent preoperative planning and meticulous, controlled surgical technique will minimize this complication. Nonetheless, patients should be made aware of the potential for altered sensation as part of the informed consent process. (Fig. 5)

The displacement of dental implants is not just confined to the inferior alveolar canal, although that particular region probably poses the chance for the most serious long-term effects. The maxillary sinus has seen its share of displaced substances. Teeth and dental implants are probably the two most common objects that find their way into the maxillary sinus, and several reports in the literature discuss these incidents.

Migration of implants into the maxillary sinus can be an acute or delayed event. More commonly, an implant is displaced at the time of placement, although several reports describe implants that have migrated into the maxillary sinus several years after initial integration and restoration. Lida et al. [11] reported the migration of an implant into the sinus 10 years after initial placement.

It is unclear what causes the migration of such implants, but the most accepted theory is a combination of osteopenia and excessive occlusal forces. After such an incident, whether acute (at the time of initial surgery) or delayed, the implant should be retrieved via lateral antrostomy, and the surgeon may elect to augment the sinus at the same time if reconstruction is needed.

Several reports of severe sublingual hematoma formation have been reported in the literature. Most articles reviewed involved patients undergoing two mandibular interforaminal implants to support an overdenture, however, one incident was related to an implant placed posterior to the mental foramen. Most patients experienced some degree of airway compromise necessitating intubation or a surgical airway. The reported etiology was lingual plate dehiscence with vascular injury. Three of four recent case reports reviewed noted significantly elevated systolic blood pressure at the time of

Figure 5

Predisposing factors for iatrogenic trigeminal nerve injury
• Inadequate assessment and treatment plan
• Inadequate or poor surgical technique or divergence from planned surgery
• Inadequate or inappropriate post-op management

hematoma formation. Most were observed at the time of implant placement; one was delayed 3 hours after placement of the implants.

In most instances, treatment included hospital admission with airway management, steroids, and antibiotics.

Surgical treatment was aimed at airway management and not necessarily drainage of the hematoma or ligation of the offending vessels. It has been suggested that in such instances, arterial ligation may be technically difficult due

to the engorgement of the tissues and the retraction of the offending vessel into the deeper tissues of the floor of the mouth and should only be performed if uncontrollable bleeding.

A secure airway and access to vessels via a neck approach requires sterile conditions, and this is performed in the operating room. In all recently reported instances, the hematomas resolved after several days of close observation with a range in hospital stay from 3 to 11 days. Peñarrocha-Diago et al. [12] have performed anatomic studies that suggest that branches of the submental or sublingual arteries are most at risk for injury in the floor of the mouth due to their potential intimate proximity to the lingual cortex of the mandible.

The rare, sometimes fatal, complication of air embolism has been associated with implant placement. In all cases, air was introduced into the cancellous marrow spaces in the mandible, forming an air embolism into the venous system. The air embolus then travels to the superior vena cava and subsequently into the right atrium resulting in cardiopulmonary collapse, leading to cardiac arrest. In all reported cases, implant drill with a combination of air and water internal irrigation were used. This complication can be prevented by using implant drills that are not air driven and do not have irrigation systems that are driven by air pressure.

This complication is not limited to implant surgery, as several incidents have been reported in patients undergoing other dental procedures. Again, in these cases, air–water irrigation drills have been implicated as the source of the introduction of air into the venous system.

Early Postoperative Complications

Although the incidence of postoperative infections following implant surgery is low, the idea of antibiotic prophylaxis remains controversial. Several conflicting reports regarding the use of antibiotic coverage either preoperatively or postoperatively currently exist in the literature.

Binahmed et al. [13] performed a two-center prospective study administering either a single preoperative dose of antibiotics before implant surgery or a 1-week postoperative regimen. It is unclear if the patients were randomized. In the study, 215 patients were enrolled, and 747 implants were placed. There were slightly more patients and implants placed in the group that received a single preoperative dose (125 patients vs. 90 patients: 445 implants vs. 302 implants). There were no control patients who were not given antibiotics. The authors found no statistical difference between the groups, indicating that long-term postoperative antibiotics are of no advantage over a single preoperative dose.

Kashani et al. [14] performed a similar study and concluded the same outcomes. Again, this study evaluated a single preoperative dose compared to a 1-week postoperative regimen, and there were no controls receiving no antibiotic therapy.

Mazzocchi et al. [15] performed a retrospective study including 437 consecutively treated patients undergoing implant placement. This population of patients did not receive antibiotic therapy but received anti-inflammatory therapy for 3 days following surgery. The authors found similar outcomes to success rates published in the literature and concluded that the use of antibiotics for routine implant placement may not be beneficial. In this study the published outcomes acted as a control, but there was no direct comparison between patients receiving antibiotics and those who were not.

There are no large, randomized clinical trials to compare antibiotic prophylaxis with no antibiotic coverage at the time of implant surgery, but it appears from the published literature that a single preoperative antibiotic dose is similar in implant success outcomes to a 1-week postoperative course.

DELAYED POSTOPERATIVE COMPLICATIONS

Fibrous Integration

Fibrous integration occurs when osseointegration fails. In many cases the patient is asymptomatic, and the fibrous integration is discovered at the second stage surgery for implant uncover or abutment placement. In these cases, the patient usually experiences pain upon manipulation or tightening of the healing or final abutment. Subsequently, the clinician finds that the implant is mobile. The two most often assumed causes of fibrous integration are overheating of the bone during initial implant surgery or overpreparation of the osteotomy site. In the latter instance, the implant typically will not have a torque greater than 20 newton cms at the time of placement. It has been shown that temperatures greater than 48°C will cause necrosis of surrounding bone.

A study by Bernabeu-Mira [16] showed in vitro, more heat is generated in the superficial portion of the osteotomy and concluded that external irrigation at room temperature can provide sufficient cooling during implant preparation.

Sinusitis

Most reports of chronic sinus disease or infection in the case of dental implants are usually related to sinus augmentation. It is a rare finding to see chronic sinus symptoms with successfully integrated maxillary implants near a nonaugmented sinus, even when the apices of the implants violate the floor of the maxillary sinus. Raghoebar et al. [17] reported a case of rhinosinusitis in a 69-year-old woman who underwent reconstruction of a completely edentulous maxilla with six implants and an implant-supported overdenture.

There were no sinus augmentation procedures performed to facilitate implant placement. The patient complained of rhinorrhea, nasal congestion, and paranasal headaches. Thorough examination via naso - endoscopy revealed that two implants extended through the nasal floor, the nasal mucosa, and the ostium of the maxillary sinus was hyperemic. Instead of removing the implants, the surgeon amputated the apical portion of the implants that extruded through the nasal floor, and the patient's symptoms resolved.

When implants, placed in areas when the maxillary sinus pneumatizes, fail, removal could result in the development of an oro-antral communication requiring an additional surgical procedure for repair.

Mandible Fracture

Mandible fracture due to implant reconstruction is an uncommon complication, and has been reported almost exclusively in the atrophic, edentulous mandible. Several factors need to be addressed when treatment planning for these cases. Imaging needs to clearly delineate not only the height of the mandible, but also the width. A minimum height of 7–10 mm and a minimum width of 6–8 mm of bone is required for implant placement. In most reports, mandible fracture occurred after the restoration of the implants, and the prosthesis was in function for a period of months to years.

Peri-implant Disease

Peri-implant disease is probably the most frustrating finding with respect to late implant complications. Heitz-Mayfield [18] suggested that peri-implant disease is the result of an imbalance between bacterial load and host defense. She further defines the disease as two entities, peri-implantitis, and peri-implant mucositis.

What makes these entities so frustrating is the fact that there are no clear clinical guidelines with respect to the cause of the problem, and there are no clear clinical guidelines to successfully treat these problems with any overwhelming success.

A recent review of the literature [18] attempted to evaluate diagnosis and risk indicators of peri-implant disease. The review identified 138 acceptable articles out of 1,113 published articles on this topic. In this meta-analysis the definition of the entities was as follows: Peri-implant mucositis is inflammation of the tissues surrounding the implant; peri-implantitis implies the additional involvement of the supporting bone such as the case in marginal bone loss. Both have been related to the presence of bacterial invasion.

Diagnosing peri-implant disease is not different from diagnosing periodontal diseases. Bleeding on probing (BOP) was shown to have a 100% positive predictive value for progression of peri-implant disease and therefore is considered a valuable parameter for diagnosis. Furthermore, Luterbacher [19] found that the presence of specific bacteria along with BOP enhanced the prognosis of disease progression. The bacteria that were cultured were Aggregatibacter actinomycetemcomitans, Prevotella intermedia, Porphyromonas gingivalis, and Treponema denticola. Recent research has also been centered around salivary biomarkers, and although promising at present there is no correlation between biomarkers and disease severity or progression.

Because of the length of time that it takes for peri-implant diseases to develop, large, prospective, longitudinal studies are required to determine risk factors. Unfortunately, there are very few reports in the literature, and most are retrospective, cross-sectional studies. The latter have been used in several literature reviews to determine risk factors. In one such study, [20] the presence of periodontal disease, smoking history, diabetes, genetic traits, poor oral hygiene, alcohol consumption, and implant surface were examined as possible risk indicators. The author found that there was substantial evidence that poor oral hygiene, history of periodontitis, and cigarette smoking were associated with peri-implant disease.

There was limited evidence that diabetes and alcohol consumption are associated with higher risks for peri-implant disease. There was conflicting and limited evidence for any conclusions regarding genetic traits and implant surface.

Once peri-implant disease is diagnosed, the clinician must decide how to treat the problem. Surgical or nonsurgical therapy can be considered. Renvert et al. [21] reviewed the literature to evaluate nonsurgical treatment of peri-implant mucositis and peri-implantitis. First and foremost, they found that the literature was significantly lacking. Twenty-four studies were included in the review out of a possible 437 articles that were identified and included human and animal studies.

The review evaluated mechanical therapy alone, mechanical therapy with adjunctive chlorhexidine rinse, and mechanical therapy with adjunctive systemic antimicrobials. They concluded that in the case of peri-implant mucositis, mechanical nonsurgical therapy can be effective, and the use of antimicrobial mouth rinses enhanced the mechanical therapy outcomes. In peri-implantitis cases, nonsurgical therapy was not found to be effective, and adjunctive antimicrobial application had limited benefit. Adjunctive systemic antimicrobial therapy was shown to reduce BOP and probing depths.

Surgical therapy for peri-implant disease has been reported in the literature, but the study designs are less than optimal. Additionally, there are multiple variables involved in surgical treatment of peri-implantitis. Variables include surgical approach, implant surface decontamination procedures and substances, presence and type of bone grafting, presence and type of antimicrobials, and presence and type of membranes. Because of this large variability, one cannot unequivocally advocate for a particular treatment.

SUMMARY

Implant complications can, for the most part, be avoided by diligent patient evaluation, multidisciplinary treatment planning, and a thorough understanding of and respect for the anatomy, physiology and clinical contributions of implant integration and wound healing. Nonetheless, complications do occur. If clinicians can anticipate or prepare for problems ahead of time, then more likely they will be able to manage such complications most appropriately. A thorough discussion of such possible complications and risks associated with implant rehabilitation is of utmost importance when treating patients in order to minimize the liability and its legal ramifications.

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