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Clinical complications with implant prosthesis: A review

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Abstract

Dental Implants have changed the face of dentistry over the last 25 years. As with most treatment procedures in dentistry today, dental implants not only involve scientific discovery, research and understanding, but also application in clinical practice. As the implants are so successful in the field of dentistry there are also various complications associated to it. These complications are divided into two sections. The first section focuses on oral soft tissue complications and the second segment addresses hard tissue dilemmas. The complications may occur at any stage but the purpose of this review is to describe the complications in implantology during prosthetic phase that may be encountered during the construction of fixed implant retained prosthesis.

Keywords: Clinical, complications, implant prosthesis

Introduction

The goal of modern dentistry is to restore normal contour, function, comfort, esthetics, speech and health, regardless of atrophy, disease or injury of the stomatognathic system. Throughout history, humans have attempted to replace missing or diseased tissue with natural or synthetic substances. A dental implant is actually a replacement for the root or roots of a tooth. As the implants are so successful in the field of dentistry there are also various complications associated to it. These complications are divided into two sections. The first section focuses on oral soft tissue complications: hemorrhage, neurosensory disturbances, tissue emphysema, infections, wound dehiscence, aspiration or ingestion of surgical instruments, and postoperative pain. The second segment addresses hard tissue dilemmas: periapical implant pathosis and endodontic considerations, lack of primary implant stability, inadvertent penetration into the maxillary sinus or nasal fossa, sinus lift predicaments, and mandibular fracture [1].

Review of literature

In 1994 J. N. Walton and MacEntee M. I [2] evaluated both patient satisfaction and maintenance for several patients. Removable implant supported prosthesis (ISP) averaged almost three times as many adjustments per prosthesis and more than twice as many repairs. The most common adjustments were to the contour of both types of prosthesis, and the most frequent repairs involved the retentive clips with removable ISPs and the gold screws with fixed ISPs. In 2002 Tinsley D, Watson CJ and Preston AJ [3], discussed various complications that may be encountered during the restorative phase of the construction of fixed implant-retained prosthesis. The implant-retained fixed prosthesis has been advocated as an effective restoration offering significant benefits over conventional prosthetics. In the year 2006 Nedir R, Bischof M, Szmukler-Moncler S, Belser UC, Samson J [4] evaluated prosthetic complication that was performed on 236 patients treated with 528 implants in an 8-year private practice experience. He concluded that posterior fixed prosthesis had more complications than anterior ones, however, the difference was not significant.

In the year 2012 Sailer I, Muhlemann S, Zwahlen M, Hammerle C.H.F and Schneider D [5] assessed the 5-year survival rates and incidences of complications of cemented and screw

-retained implant reconstructions. The study concluded that both types of reconstructions influenced the clinical outcomes in different ways, none of the fixation methods was clearly advantageous over the other.

Discussion

The introduction of dental implants has expanded the armamentarium of dental practitioners in replacing missing teeth, however implant rehabilitation is no longer restricted to restoring function. Dental implants have become a multi-million dollar industry driven by bone augmentation, soft tissue management and aesthetic restorations. The implants have become an important therapeutic modality in the last decade, mainly after the works developed by Branemark [6]. Failures can be divided into biological failures (related to biological processes) and mechanical failures of the components (including fractures of implants, coatings, connecting screws and prostheses). An iatrogenic failure can be seen as one characterized by a stable and osseointegrated implant, but due to malpositioning, it is prevented from being used as part of the anchorage unit.

Prosthetic complications

1. Complications related to immediately loaded dental implants

A. Material failure

It should be recognized that there is a possibility of alveolar damage which may be magnified if tapered or wide platform implants are forced into dense bone without adequate osteotomy preparation. It is possible to over-torque implants so that the excessive pressure could lead to crestal bone necrosis and defect formation, inhibiting normal healing. Forcing implants into underprepared sites risks the biological

complications related to compromise healing or implant failure, as well as material failure of the implant.

B. Gingival recession, blunted papillas, incomplete regeneration

Good esthetic results and dimensionally stable tissues can be obtained when implants are immediately placed and restored in healed ridges. Immediate restorations may not be compatible with significant alveolar site development when bone and soft tissue grafting is needed. Sockets should be carefully evaluated and categorized. This can be done preoperatively using a CBCT to image the buccal plate or clinically using periapical radiographs and periodontal probing measurements.

C. Occlusal mismanagement

Complications with the provisional restoration can lead to implant failure. When single teeth or small segments are immediately restored, the provisional restorations are usually contoured and adjusted to avoid direct occlusal contact. The occlusion provided will be implant protected occlusion if the implant has no mobility, it should be monitored for an additional 1–2 months before final restoration. If it is mobile, splinting was performed within 2–4 weeks of implant placement and loading [10].

D. Inadequate support, improper design, loss of retention

In full-arch immediate loading cases, the provisional restoration must be designed to manage direct occlusal forces in addition to splinting implants and limiting mobility. If a provisional loosens from the supporting implants too early in the healing process or if the implant support and restoration are inadequately engineered, implant failure may occur.

Table 1: Prosthetic complication

1. Complications related to immediately loaded dental implants	2. Immediately loaded full-arch hybrid prosthesis	3. Overdentures	4. Occlusal Complications	5. Single unit prosthesis	6. Multiple Unit Prosthesis
A. Material failure B. Gingival recession, blunted papillas, incomplete regeneration C. Occlusal mismanagement D. Inadequate support, improper design, loss of retention. E. Incompletely seated prosthetic components F. Adjustment to the tissue-fitting surface of the prosthesis	A. Alveolar defects precluding optimal implant placement or primary stability B. Restorative complications relating to hybrid prosthesis (i) Provisional or component fracture (ii) Implant loss (iii) Retained impression or prosthetic materials (iv) Incompletely seated prosthetic components (v) Phonetics	A. Inadequate Crown Height Space (CHS) B. Poor Osseous Angulation (C-A) C. Non-ideal Implant Positioning D. Retention Loss Over Time E. O-Ring Failure F. Bar try in resulting in pain G. Gingival inflammation around bar H. Prosthesis with lack of soft tissue support in RP-5 I. Overdenture fractures J. Food impaction	A. Moment Loads B. Occlusal Height C. Not Utilizing Implant-Protected Occlusion D. Premature Occlusal Contacts E. Poor Emergence Profile F. Parafunctional Habits	A. Improper Crown Margin B. Abutment Not Seated C. Prostheses Fractures/Occlusal Material Fracture D. Abutment Will Not Tighten E. Improper Torqueing Technique F. Damaging Implant Body	A. Screw Tightening Sequence B. Screw Fracture

E. Incompletely seated prosthetic components

In flap surgery, it is possible for ledges of bone to prevent complete abutment seating. These instances could have been avoided by using implant manufacturer’s crestal bone milling tools to clear away spicules of bone that could interfere with abutment seating. The problems could have been discovered at the time of surgery by taking periapical radiographs immediately following abutment connection. Also, an

incompletely seated abutment could become a bacterial reservoir leading to crestal bone loss and may not distribute load to the underlying implant, contributing to overloading of other implants.

F. Adjustment to the tissue-fitting surface of the prosthesis

This complication is difficult to avoid. The thickness of the mucosa is difficult to assess on radiographs. As a result, the

amount of contact pressure between the soft tissue and prosthesis often needs to be adjusted. Prevention of this problem is difficult and informing the patient prior to treatment of the need for adjustments after prosthesis placement is necessary. It is important to resolve this issue in the provisional restoration prior to fabrication of the final restoration. Communication between the patient, restorative dentist, and the dental technician is important at this stage.

2. Immediately loaded full-arch hybrid prosthesis

A. Alveolar defects precluding optimal implant placement or primary stability

Typically, patients requiring full-arch hybrid restoration have significant bone loss manifesting either as generalized alveolar atrophy resulting in reduction in bone volume or as a specific alveolar defect, which might be associated with site-specific bone loss. It is essential to obtain 3D radiographic imaging and complete surgical planning for immediately loaded hybrid procedures. The available alveolar structures should be evaluated for bone volume, alveolar defects, relative bone density, and ability to obtain a favorable implant distribution to optimize the “supporting zone” for the proposed prosthesis.

B. Restorative complications relating to hybrid prosthesis

(i) Provisional or component fracture

Provisional restorations for hybrid cases are particularly important for the success of the procedure since the number of implants is reduced compared with cement- or screw-retained ceramic-metal design cases. The fewer the number of implants supporting the restoration, the stronger and stiffer the provisional material needs to be to resist functional stresses. Three months postoperatively, the provisional has to be removed and all components were retorqued to insure implant osseointegration and abutment tightness. Patient should be under regular follow up and checked for sequence of osseointegration to prevent abutment fracture.

(ii) Implant loss

It most often occurs within the first few months of healing. Late failures are most likely the result of peri-implantitis and have little or no relationship to the loading protocol. Most implant failures occurred in the distal implants, male patients, poor bone quality, opposing fixed dentitions. The occlusal design follows the principles of periodontal prosthesis developed for restoring periodontally compromised dentition. To mitigate lateral occlusal forces provisional restorations with flat plane occlusal guards are provided.

(iii) Retained impression or prosthetic materials

Prosthetic materials such as acrylics, impression materials, abrasives, dust, etc. to be inadvertently introduced under or left below flaps. There is also a possibility for air from a high-speed hand piece to be blown into tissue, creating soft tissue emphysema. The frequencies of these complications are unknown, but clinicians should be aware of the possibility of causing these problems. It should be checked that there should not be any remnant or residue of the impression material left in that area. The impression material should have high tear strength.

(iv) Incompletely seated prosthetic components

One common error that is made is failing to fully seat a prosthetic abutment on an implant which may occur because of several reasons. In flap surgery, it is possible for ledges of

bone to prevent complete abutment seating. Once a misfit has been discovered, it should be corrected immediately as the large gap between the implant and abutment could become a bacterial reservoir leading to crestal bone loss.

(v) Phonetics

It has been a concern that significant immediate changes to the teeth and supporting structures would create phonetic difficulties or deteriorated speech. Patients who receive complete dentures develop distortions in articulation. These problems were not associated with vowels, but with consonants and more frequently with /s/, /t/, /d/, and /z/ sounds. It should be clear that patients should be aware that there is a risk of phonetic complaints in the long term, and that they should anticipate an adaptation period of 3–6 months following treatment.

3. Overdentures

A. Inadequate crown height space (CHS)

When sufficient CHS is lacking, the prosthesis fabricated over it is more prone to component fatigue and fracture and has more complications in comparison to porcelain-to-metal fixed prostheses. The lowest possible profile attachment should be used in situations of reduced CHS to fit within the contours of the restoration, provide greater bulk of acrylic resin to decrease fracture, and allow proper denture tooth position without the need to weaken the retention and strength of the resin base.

B. Poor osseous angulation (C-A)

If the clinician is unaware of this angulation, the implants may perforate the lingual plate and irritate the tissues of the floor of the mouth. If the implants are within the confines of the bone, they may enter the crest of the ridge at the floor of the mouth and make it almost impossible to restore. Removal of the implants followed by bone grafting, placement of new implants in a more ideal position. Surgical cover screws are placed in the implants, thus “sleeping” the implants followed by fabrication of a conventional prosthesis.

C. Non-ideal implant positioning

Usually, the greatest available bone height in an edentulous mandible is located in the anterior region between the mental foraminae. Non-ideal implant positioning leads to many complications, which include hard and soft tissue complications, prosthesis dissatisfaction or fracture, and questionable long-term implant health. To prevent this, when placing implants, regardless of the treatment option being executed, all five implant sites should be ideally located at the time of treatment planning and surgery.

D. Retention loss over time

The main complication over time with dental implant attachments is the loss of retention. Depending on the situation, this is highly variable and dependent on many factors. Factors that predispose to loss of retention and wear include mastication wear and insertion – removal wear. Implant parallelism is one of the important factor which reduces the chances of loss of retention. There should be less axial and paraxial forces.

E. O-ring failure

O-rings typically fail in their application because of the combined adverse effects of stress and environmental elements (i.e., friction, heat, and swelling). Such

environmental factors may be compounded by incorrect O-ring size, improper laboratory technique, installation damage during final component assembly, and failure to properly maintain or lubricate the O-ring. The clinical solution for extrusion and nibbing problem is to use a harder O-ring material or install a properly sized O-ring.

F. Bar try in resulting in pain

In certain clinical situations, during try in of the bar, the patient may experience pain which may originate from different area. It may be due to several reasons which are non-passive prosthesis, incorrect placement of bar where there is deep sulcular tissue present which intern lead to bar not seating fully, loose abutment, poor bone – implant interface, impingement on tissue. To prevent this always tighten abutments prior to try in, making sure no tissue collapse is present that would impede placement. The bar should be tried in proper sequence.

G. Gingival inflammation around bar

When a bar is fabricated and placed too close to the tissue, gingival hyperplasia may result. This will lead to a chronic inflammatory complication that may be painful and result in bleeding with possible bone loss which is mainly caused by direct contact of bar causing compression of mucosa. To prevent this complication, a minimum of 1 to 2 mm gap is needed between the bar and the soft tissue. This will allow for self-cleansing of the area along with decreasing the possibility of tissue inflammation and discomfort.

H. Prosthesis with lack of soft tissue support in removable prosthesis (RP-5)

The clinician must understand the inherent difference between RP-4 and RP-5. Because RP-5 is soft tissue supported, it is mandatory the prosthesis have adequate flange support mainly in primary stress bearing areas. If support is inadequate it will result in oversteering of implants leading to increase morbidity and bone loss. For maxillary prosthesis horizontal plate should have ideal primary stress bearing coverage and it should be a full coverage prosthesis. For mandibular prosthesis the buccal shelf should have adequate coverage.

I. Overdenture fractures

The reason may be excessive occlusal force and thin acrylic base. Ideal occlusion and even distribution of forces is mandatory. The denture base may be strengthened with the use of acrylic or meshwork. For an overdenture, always make sure there is sufficient room for attachment or bar with adequate acrylic thickness.

J. Food impaction

A common complaint of mandibular overdentures is food impaction. Because the flange of the prosthesis do not extend to the floor of the mouth in the rest position, opening allow for food accumulation under the prosthesis. Highly polished borders of the prosthesis should be completed because less food will tend to accumulate. The flange of prosthesis should extend to the floor of the mouth during rest position.

4. Occlusal complications

A. Moment loads

Moment loads induce microrotations and stress concentrations at the crest of the alveolar ridge at the implant-tissue interface, which lead inevitably to crestal bone loss. Three clinical moment arms exist in implant dentistry: (1) occlusal

height, (2) cantilever length, and (3) occlusal width. Minimization of each of these moment arms is necessary to prevent unretained restorations, fracture of components, crestal bone loss, and complete implant system failure.

B. Occlusal height

The occlusal height serves as the moment arm for force components directed along the facio-lingual axis working or balancing occlusal contacts, tongue thrusts, or in passive loading by cheek and oral musculature, as well as force components directed along the mesiodistal axis.

C. Not utilizing implant-protected occlusion

A proper occlusal scheme is a primary requisite for long-term implant prosthetic survival, especially when parafunction or a marginal foundation is present. A poor occlusal scheme increases the magnitude of loads and intensifies mechanical stresses (and strain) to the implant system. A primary goal of an occlusal scheme is to maintain the occlusal load that has been transferred to the implant system within the physiologic and biomechanical limits of each patient.

D. Premature occlusal contacts

The surface area of a premature contact is small, the magnitude of stress in the bone increases proportionately (i.e., $S = F/A$). All of the occlusal force is applied to one region rather than being shared by several abutments and teeth. In addition, because the premature contact is most often on an inclined plane, the horizontal component of the load increases the shear crestal stresses and the overall amount of stress to the entire implant system. The elimination of premature contacts is more critical than in natural teeth because of the lack of proprioception and the implant's inability to move and dissipate the forces.

E. Poor emergence profile

The "emergence profile" concept was first introduced in 1977 by Stein *et al.* to describe tooth and crown contours from the soft tissue to the contact area interproximally. When a restoration is fabricated with an unnatural contour, esthetics and soft tissue health will be compromised. Implants should be placed approximately 2.0 mm from a natural tooth, 3.0 mm between implants, and in the ideal buccal and lingual orientation with respect to the incisal edge and occlusal table.

F. Parafunctional habits

When an implant reconstruction is considered in a bruxing patient, a patient with significant occlusal force, or an irregular plane of occlusion, occlusal analysis is warranted. Premature and posterior contacts during mandibular excursions increase stress conditions. Education and informed consent of the patient are helpful to gain cooperation in eliminating or reducing the noxious effects. An occlusal guard can be a useful diagnostic tool to evaluate the influence of occlusal disharmony and parafunction.

5. Single unit prosthesis

A. Improper crown margin

Often clinicians use the prefabricated abutments with a built-in flare. This is most likely 1 mm above the implant body connection, which is often near the crest of the bone, resulting in a deep subgingival margin. Implant abutments are a common indication for minimum abutment margin reduction because they are usually smaller in diameter than a prepared natural tooth for a crown. The subgingival margin for teeth or

implants should not proceed further than 1.5 mm below the free gingival margin even in the interproximal region. It is important to note that the implant abutment flare is often 1 mm above the implant body connection, which is often at the crest of the bone.

B. Abutment not seated

If an abutment is not fully seated within the implant, the preload placed on the screw will be insufficient. This will lead to an increased possibility of screw loosening and prosthesis mobility. An opening or microgap will lead to bacterial accumulation, which will result in soft tissue infection and irritation. When placing the abutment, insert the abutment into the implant until it is fully seated. When the implant is significantly subgingival, this may be difficult to determine. A radiograph should always be taken to confirm complete seating.

C. Prostheses fractures/occlusal material fracture

Occlusal material fracture is more common with implants than natural teeth because of the lack of periodontal stress relief with implants and a resultant higher impact force to the occlusal material. Porcelain, acrylic, and composite fractures may occur under excessive loads or even with a lesser load of longer duration, angulation, or frequency. A common treatment that is most widely underutilized is the use of occlusal guards. It is highly recommended to treat all patients with an occlusal guard who exhibit symptoms of parafunction and prosthesis situations that are prone to fracture (implant prosthesis against implant prosthesis).

D. Abutment will not tighten

In some situations the abutment is tightened onto the implant; however, the abutment will move in a vertical direction. This is the direct result of the abutment screw not being fully seated, which may lead to screw loosening or component fracture. The most common cause of inadequate abutment tightness is debris inside the base of the implant. It is not uncommon for blood coagulants or excess debris to accumulate in the base of the implant. This can be easily prevented by irrigation with saline or 0.12% chlorhexidine with a small tuberculin syringe.

E. Improper torqueing technique

The use of a torque wrench improperly may lead to inadequate torque application, stripping of the hex screw head, and/or dulling of the hex driver. There are numerous errors when using a torque wrench. The first is not placing apical pressure on the top of the torque wrench. Secondly, the torque wrench can be a significant lever arm. Thus, the torque wrench should be used with short strokes. And lastly, the torque wrench should be replaced on a regular basis and maintained in a good working condition. Finger tighten the hex screw to approximately 10–15 N/cm. Place good apical pressure with your index finger when torqueing the abutment. Hold the torque wrench stable to minimize lateral forces. An abutment clamp may be used to apply counter torque, which is held against the rotation of the wrench to protect the bone interface from excess lateral stress.

F. Damaging implant body

Most implants today are fabricated from grade 5 titanium or Ti6Al4V. This metal does have the disadvantage of easily being altered or damaged. If an implant is traumatized with a handpiece and bur, or a sharp instrument, irreversible damage

may be done to the implant. When removing tissue or bone around an implant, care should be exercised to not damage the implant. Another common situation that may damage the implant is the removal of a fractured screw. To prevent damage to the implant, a tissue punch bur or profiling bur should be used.

6. Multiple unit prosthesis

A. Screw tightening sequence

When screw tightening a multi-unit fixed implant prostheses, a proper sequence and technique is crucial to obtain the correct torque. The torque should be applied incrementally amongst all screws so that not one screw is tightened fully. A non-ideal tightening sequence will lead to either an insufficient or excessive amount of torque placed onto a specific screw thread. When placing and torqueing abutment screws, more accurate torque values result under wet conditions vs. dry. Saline may be used to lubricate the screw prior to placement of preload to maximize the accuracy of the preload.

B. Screw fracture

The etiologic factor most likely to cause screw fractures is biomechanical stress to the implant system. The biomechanical stress leads to partially unretained restorations or fatigue, which is directly related to an increased amount of force. If an abutment screw is determined to be mobile, immediate treatment is recommended. The easiest method to remove a screw is to rotate the screw counter clockwise with a sharp explorer tip.

Success and Failure statistics

The longitudinal clinical studies have reported a success rate at 10 years ranging from 81% to 85%, for the maxilla and from 98% to 99% for the anterior mandible. Despite high success rates, failures do occur. Esposito *et al.* in 1998 reported the biologically related implant failures calculated on a sample of 2812 implants and found a failure rate of 7.7% over a 5 year period^[9].

Conclusion

Although serious complications are uncommon, dental implant placement is not free of complications, as complications may occur at any stage. The most common observed complications are inflammatory (10.2%), followed by prosthetic (2.7%) and operative (1.0%). Most of the implants (62%) associated with complications did not fail. One should be aware of the possible complications related to implant placement so that the patient can be properly informed. Prompt recognition of a developing problem and proper management are needed to minimize postoperative complications.

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