

CASE REPORT

Challenges and Complications in Endosseous Dental Implant: An Analysis with Case Illustrations

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ABSTRACT

The purpose of this article is to illustrate with case representation of complications that have been reported in conjunction with endosseous root-form implants. On review of previous volume on implant complication, the most common implant complications are peri-implantitis, hemorrhage, damage to vital structure, loss of implant, inability to rehabilitation, implant body and component fracture. Successful implant rehabilitation is followed by meticulous case preparation and surgical protocol. Case examination can summarize certain challenges that may compromise implant success. We had focused on clinical data over a period of 15 years, regarding management of challenges in implants and failure/complications in implant rehabilitation. The complications can be categorized into following two categories: (1) Surgical complications and (2) prosthetic complications.

Keywords: Complications, Bone quality and quantity, Implant anatomy.

How to cite this article: Srinath N, Akhila ND, Sunil C. Challenges and Complications in Endosseous Dental Implant: An Analysis with Case Illustrations. *Int J Oral Implantol Clin Res* 2014;5(2):63-71.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Major advances have occurred over the last four decades in the clinical use of dental implants making it simpler and reliable chairside procedure. However, implants sometimes results in a spectrum of complications leading to implant failure. Most common complication is the peri-implantitis, which is chronic inflammation usually causes osteolysis around the implant.¹ Many investigators have evaluated clinical features of implant associated complication listed as follows: implant loss, sensory disturbance, soft-tissue complications, loss of implant onto tissue spaces, improper angulated implant, dehiscence of peri-implant bone,

peri-implantitis, bone loss and implant fracture.²⁻⁵ In this article, implant complications over 15 years have been discussed. The purpose of this article is to provide data regarding the challenges in implant and types of complications that have been reported in conjunction with endosseous root-form implants associated with implant protocol and follow-up. Implant complications can be broadly categorized as: (1) Surgical complications and (2) prosthetic complications.

Case preparation for implant rehabilitation begins with clinical examination with radiographs and meticulous planning. Case examination becomes a key for successful implant prosthesis, as it reveals and warns the implantologist about the challenges (Tables 1 and 2) that could be encountered.

SURGICAL COMPLICATIONS

Many surgical complications have been identified in the implant literature, like hemorrhage,¹⁻⁴ neurosensory disturbance,¹⁻¹⁷ adjacent tooth devitalization/damage,¹⁸⁻²² mandibular fractures,^{1,13,23-29} life-threatening hemorrhage,³⁰⁻³⁴ air emboli,³⁵ implant displacement into the mandibular canal,³⁶ submandibular space, maxillary sinus, fracture of implant, fracture of implant hex, dehiscence of implant, screwdriver aspiration,³⁷ descending necrotizing mediastinitis,³⁸ intraocular hemorrhage³⁹ and singultus (hiccups).⁴⁰ Surgical complication can be classified depending on time of incidence as (Table 3).

PROSTHETIC COMPLICATIONS

Prosthetic complications (Table 4) are related to implant component and prosthetic component. Factors related to complications include length, number and angulation of implant, opposing dentition, parafunctional habits and masticatory forces and their duration. As per back volumes' review, a large number of mechanical complications have been reported and they include overdenture loss of retention/adjustment (30%); resin veneer fracture of fixed partial dentures (22%); the need for overdenture relines (19%); overdenture clip/attachment fracture (17%); porcelain veneer fracture of fixed partial dentures (14%); overdenture fracture (12%); opposing prosthesis fracture (12%); acrylic resin base fracture (7%); prosthesis screw loosening (7%); abutment screw loosening (6%); prosthesis screw fractures (4%); metal framework fractures (3%); abutment screw fractures (2%) and implant fractures (1%).⁴¹

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Table 4: Prosthetic complication in implantology

<i>Prosthetic complications related to implant component</i>	<i>Prosthetic complications related to prosthesis</i>
1. Inability to rehabilitate due to improper implant planning	1. Crown decentration
2. Fracture of implant body	2. Metal framework fractures
3. Fracture of implant collar	3. Veneer fracture
4. Fracture of internal hex	
5. Abutment screw fracture	
6. Screw loosening	
7. Failure of cantilever	

region, a thin labiolingual width of bone is encountered. In reduced labiolingual width, implant placed can get exposed over a period of time or even before stage II due to loss of labial cortex. In the case illustrated, the clinical picture shows the thinning out of mucosa and discoloration of mucosa as the implant is lying just beneath the mucosa due to complete resorption of labial cortex (Fig. 2A). On surgical exposure, the site we noticed that the entire implant is exposed, and partial exposure of the second one (Fig. 2B).

Adequate Vertical Height of Maxillary Alveolar Bone

In poor bone quantity and quality as in maxillary molar region, possible complication is the migration of implants into the maxillary sinus. In a scenario like maxillary posterior region reduction of bone height available for implant placement is due to two reasons, ridge resorption and sinus pneumatization. Implant placement in maxillary posterior region is critical, due to minimal vertical bone height and the type of bone, i.e. D3 type of bone. Type D3 bone has a thin cortical bone and more of cancellous bone, that leads to reduced primary stability.⁴⁴ Sinus perforation is the com-

mon complication due to inadequate bone height in posterior maxilla. With reference to the above-noted clinical conditions, implant placement may lead to, loss of implant into the maxillary sinus⁴⁵ (case 1, Fig. 3A; case 2, Figs 3B and C). The ideal way of management of such cases is by sinus lift and grafting procedures, thereby increasing the bone height for implant placement.

Adequate Vertical Height of Mandibular Alveolar Bone

Mandibular fractures secondary to implant placement occur when implant is placed in type 4 or 5 (Atwood's atrophic mandible). In an inadequate vertical bone available, as an attempt of utilizing available vertical height of bone an implant with longer length may be selected. Case illustrated here in a mandible with reduced vertical height (Fig. 4A), a long implant that extended till the lower border has led to fracture⁴⁷ of mandible and displacement of implant into submandibular space (Fig. 4B).

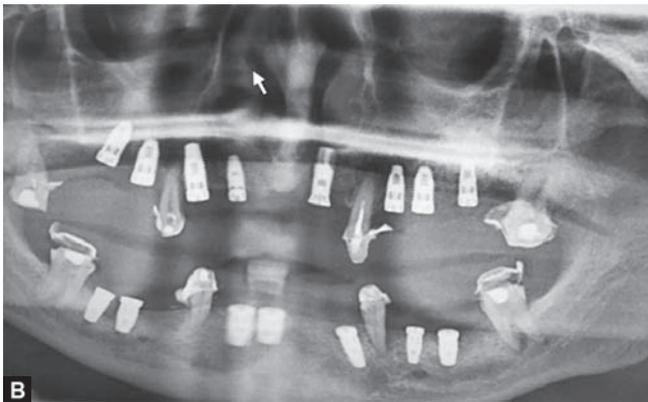
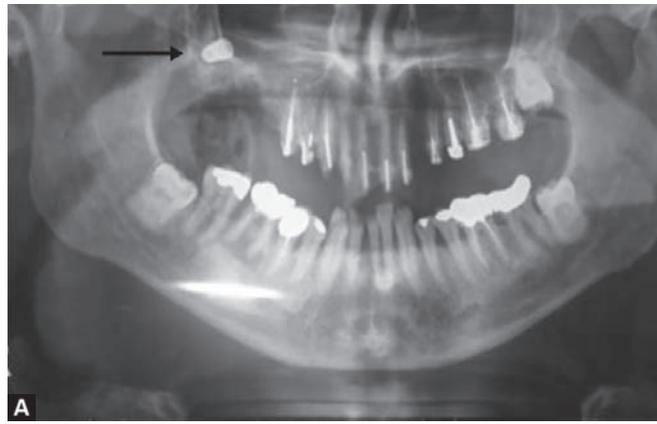
Inflammation

Peri-implantitis

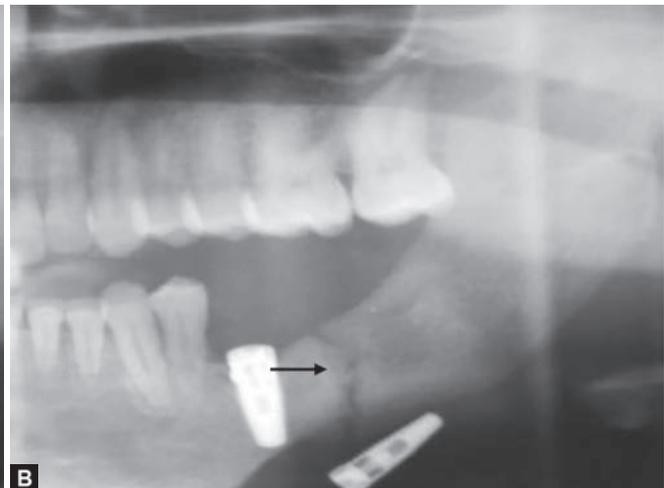
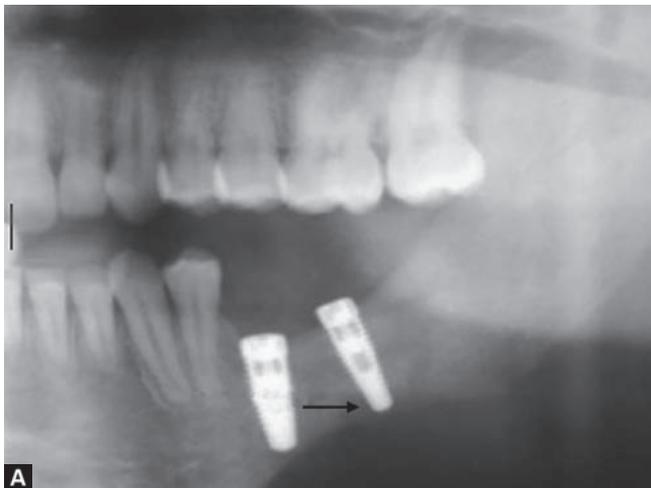
Peri-implantitis is defined as an inflammatory reaction with the loss of supporting bone in the tissues surrounding a functioning implant. According to the literature, peri-implant and its complications have been reported in three or more studies include fenestration/dehiscence, gingival inflammation/proliferation, and leads to gradual bone loss and finally implant failure.^{1,8,14,43} After successful implant rehabilitation, peri-implantitis⁴⁶ is one of the most common late postoperative complication leading to the failure of implant-supported prosthesis. Peri-implantitis is seen in compromised systemic conditions and plaque accumulation due to improper local maintenance of implant by the patient.



Figs 2A and B: (A) Clinical view and (B) surgical exposure—implant fenestration



Figs 3A to C: (A) Displacement of implant into maxillary sinus, (B) immediate postoperative and (C) postoperative



Figs 4A and B: (A) Immediate postoperative and (B) postoperative with fracture of mandible and displacement of implant

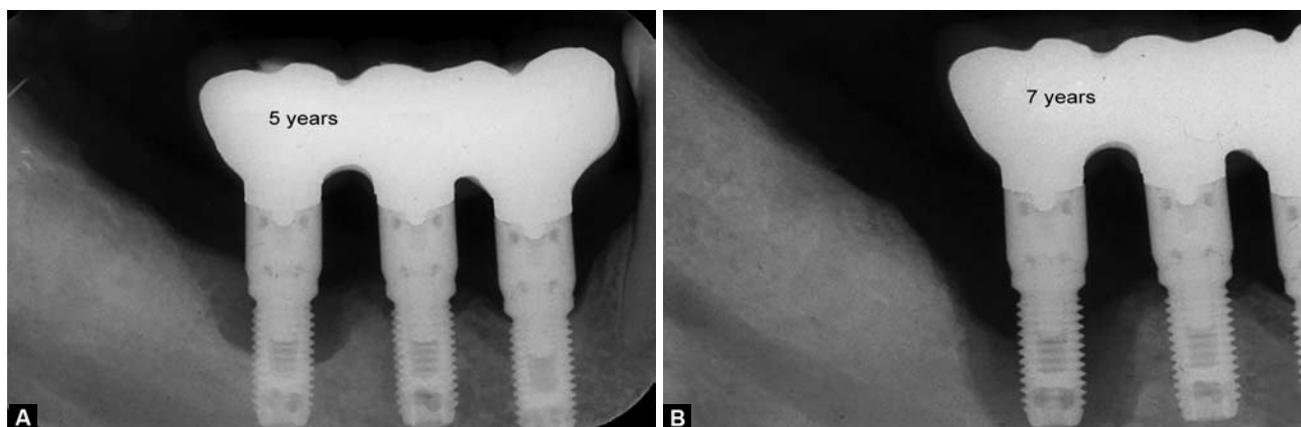
Peri-implantitis can also be seen in one of the multiple implants place, the reason being hypothetical as excessive masticatory forces and bone loss (Figs 5A and B).

A case of peri-implantitis (Fig. 6A) shows ideal features of peri-implantitis, like swollen, inflamed, reddened gingiva with loss of stippling. On surgical exposure, a bone loss of 9 mm approximately was noted on graduated periodontal probe examination (Fig. 6B). The case was managed by debridement and bone grafting. After a period of 6 to 7 months, adequate amount of bone around the implant (Fig. 6C) showing a successful graft procedure.

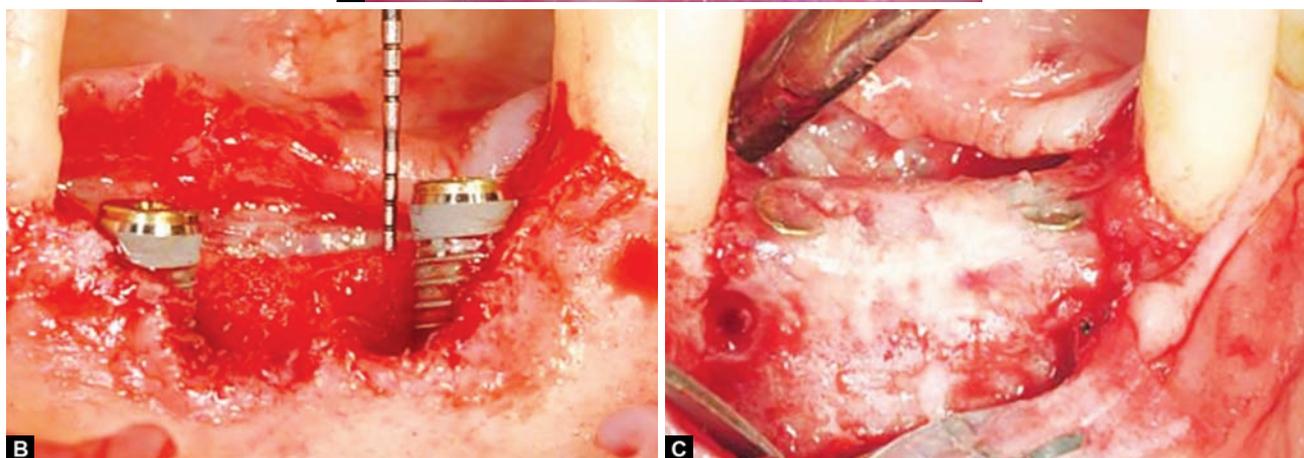
Fracture of Implant Components

Fracture of Implant Body

One of the basic criteria for prosthetic tooth rehabilitation is the crown-root ratio. As a rule of thumb crown-root ratio ideal 1:2, minimum 1:1 and optimum 2:3, altered ratio leads to failure of prosthesis. Implant fracture is noted with a lower incidence in edentulous jaws (0.2%) and more frequent occurrence in partially edentulous jaws (1.5%).⁴² Crown root ratio found to be more which lead to implant body fracture (Fig. 7A).^{11,18,42} Large crown length over a shorter



Figs 5A and B: (A) Five years postoperative and (B) seven years postoperative



Figs 6A to C: (A) Clinical appearance of gingiva, (B) surgical exposure and (C) after bone graft placement

implant acts as vertical cantilever, and leads to an imbalance in masticatory force distribution and failure of implant. The fracture implants had to be retrieved (Fig. 7B) and replaced.

Fracture of Implant Component

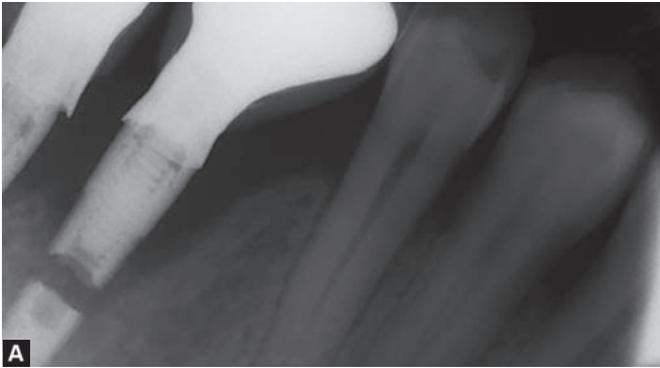
First implant design was given by Per-Ingvar Brånemark; over a period of time, we see various modifications. The implant-abutment attachment component, i.e. implant platform is modified as internal from an external hex. The internal hex modification of the attachment seems to weaken

the attachment component of implant. In the case radiograph illustrated, an implant with internal hex platform was used that has lead to fracture of the internal-hex component (Figs 8A and B) and implant failure.

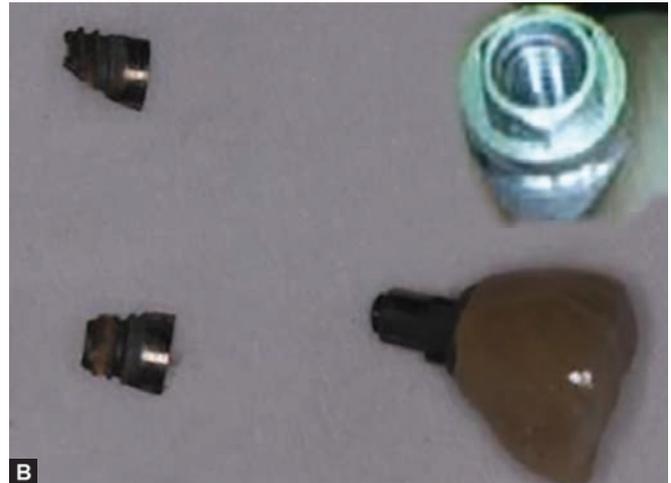
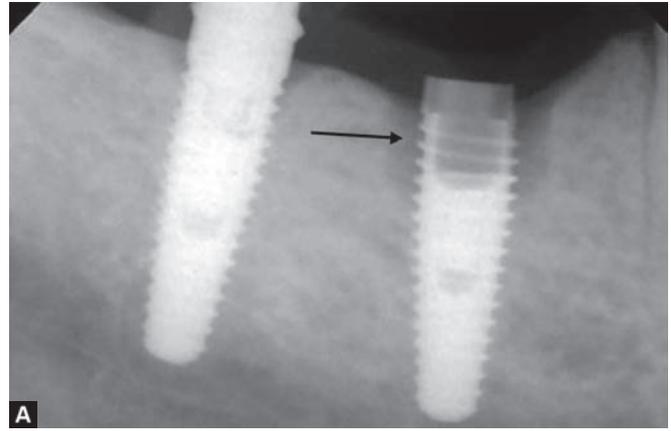
Angulation of Implant Placement-related

Improper Orientation

Successful functional oral rehabilitation depends of functional adaptation of the prosthesis to masticatory forces.



Figs 7A and B: (A) Radiograph showing fractured implant and (B) implant retrieved



Figs 8A and B: (A) Radiograph showing altered radiopacity at the implant collar and (B) retrieved implant and fractured implant collar

Implant placement should be done, in consideration of orientation^{47,48} of the tooth replaced by the implant, direction of masticatory force and also the orientation of adjacent tooth. The radiograph (Fig. 9) shows an improper angulation of implant orientation, such condition not only compromises the implant but also the adjacent tooth. Control of orientation is easily managed by a prefabricated surgical stent. Occasionally, incorrect positioning or lack of relative parallelism in the placing of the implants causes damage to an adjacent tooth.

DISCUSSION

Implant treatment is regarded as a safe technique with high rates of success. Nevertheless, it has complication in every surgical procedure. Complications that can occur and must be known in order to prevent and manage the same. A detailed case evaluation must be conducted systematically during the preoperative stage based on clinical history, thorough investigations and, if necessary, consulting other specialists, dentists or physicians.

The challenges that occur in implantology are a consequence of an inadequate quality or/and quantity of bone, an

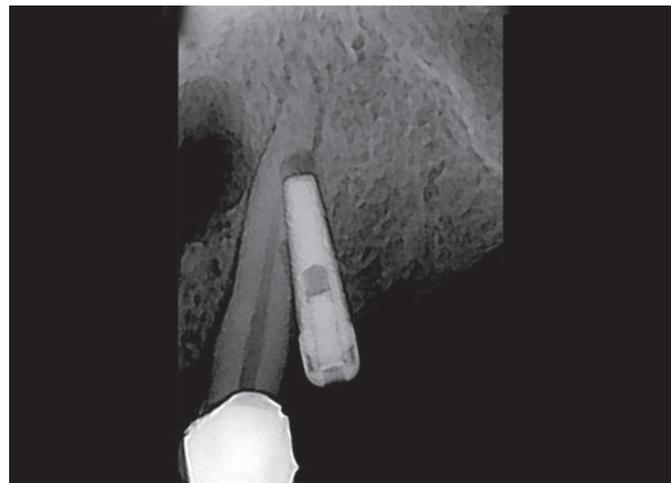


Fig. 9: Improperly oriented impinging the adjacent tooth root

erroneous surgical technique, improper prosthetic design, infections, lack of oral hygiene deleterious habits, patient cooperation and systemic diseases that are poorly controlled.

There are various classifications in the implant volumes⁴⁴ and publications,⁴⁶ here complications in implantology are classified as follows:

- Surgical complications and
- Prosthetic complications

As illustrated above, adequate bone quality and quantity plays a key role in implant success. Inadequate bone quantity being a major challenge, alveolar bone augmentation procedures plays a major role in implant dentistry. Among ridge augmentation procedures, augmentation with bonegraft, distraction and ridge split techniques are popularly used in implant practice. The bone graft used can either be an autologous or allogenic with autologous having more success. In preparing alveolar ridge for implant placement, the size of graft used is typically limited by the availability of space at the recipient site that allows for proper gingival coverage and water tight closure of surgical site. As a process of uptake and healing the bonegraft may lose some of its bulk, leaving insufficient ridge for implant placement. A slow resorbing bone like cortical bone serves better for both maintaining the graft as a scaffold and primary stability of implant. Bone augmentation with alloplastic material or combination of graft are frequently used to achieve adequate bone bulk. Membrane technique and molecular approach are the advances in augmentation techniques.⁴⁹

Hemorrhage is a most common emergency situation. This can be avoided by a preoperative radiological examination that should include regular computerized tomography to appreciate the particular anatomy of each mandible. The onset of this complication is easily determined by clinical signs and symptoms. Hemorrhage is commonly encountered in sinus lift procedures, osteotomy closer to the inferior alveolar canal. The reason being claimed as high vascularity of the sinus lining, damage to the vascular anastomosis namely, the posterior superior alveolar artery and rarely damage to the infraorbital artery.⁴⁶

Malposition or an overangulation of implant placement, leads to an obstacle for carrying out the prosthetic restoration, while it also would deteriorate long-term implant viability. One of the key for success is to study the axis of those teeth adjacent and/or the edentulous space to be rehabilitated with implants. The malposition of an implant may lead to damage or loss of radicular surface or the root apex and a subsequent postoperative pulpitis, or periodontitis, sometimes also involves the nonintegration of the implant because of the inflammation. Other causes for implant failure due to malpositioning are, proximity of implant to the tooth, shorter distance between tooth and implant, shorter time lapse between the endodontic procedure and the implant placement.^{46,47} Osseous dehiscences and bone fenestrations can go unnoticed in those cases in immediate implant prosthesis, inadequate buccolingual width or a transmucosal flapless surgery⁵⁰ when compared to conventional implant placement. This risk can be prevented by a correct exploration of the alveolus and assessment of implant orientation before inserting the implant.

Mandibular fracture, during implant placement, is associated with atrophic mandibles. The central area of the mandible has a greater risk for this complication because its poor vascularity.⁵¹ The bone in this area is usually sclerotic and undergoes severe resorption as a consequence of a large period of edentulous and also as a result of the pressure exerted by the prosthesis, which makes the same incapable of tolerating force transmitted during implant protocol.⁴⁶

Neurosensory impairment may occur at any time during implant surgery, i.e. flap elevation and retraction, during osteotomy preparation, bone augmentation, implant placement, suturing or any soft-tissue swelling after surgery incidence of (0-44%).⁵² One of the most severe local complications is the damage of the osseous roof of the mandibular canal, which is caused by incorrect surgical procedure, incorrect reading of the X-ray or tomography.⁴⁶

The choice of a screw-retained vs a cement-retained crown is a complex and comprehensive decision involving many points of consideration. Cement-retained implant-borne restorations has several advantages, including the elimination of unesthetic screw access holes and greater resistance to porcelain fracture. Soft-tissue surrounding screw-retained implant crowns were found to be healthier than soft-tissue surrounding cemented restorations. Custom abutments can now be designed with supragingival margins that allow for easy and complete cement removal. In implantology, reduced stress to the bone and implant is a desired feature. This is obtained through a passive fit of the prosthesis on the implant abutments to attain for a screw-retained implant restoration with more than one implant.⁵³

Fracture of prosthetic retaining screws is more common than implant fracture and it is normally due to metal fatigue following an overload of materials.⁴⁶ An implant fracture seems to be an infrequent complication that could be ascribed to different reasons: defects in the implant design or materials used in their construction, a nonpassive union between the implant and the prosthesis or by mechanical overload, specially cantilevers in fixed prostheses, occlusal overload or/and parafunctional habits.⁴⁸

CONCLUSION

All the above-listed complications are outcomes of improper execution of procedures. The vast majority of complications in implant surgery can be prevented by correct selection of case and treating, compromised and challenging cases in an appropriate way to achieve successful implant rehabilitation. Knowledge of the risks, trying to avoid them with the necessary information helps in designing a specific plan for every patient. Detailed case evaluation and treatment planning are desirable for a successful implant-supported prosthesis.

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