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Complications in Dental Implantology

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Abstract:- As the demand for dental implants continues to rise, driven by their distinct advantages over alternative restorative methods, a parallel increase in associated complications has become evident. This article aims to review these complications, enhancing the clinician's awareness regarding potential challenges during both the surgical and prosthetic phases and to contribute to the ideal case selection and treatment planning protocols.

I. INTRODUCTION

The rising popularity of implant dentistry for teeth replacement is largely credited to its capacity to promote bone health and prevent bone loss. Additionally, implants preserve neighbouring teeth's health and the patient's chewing efficiency as well. Despite high success rates, implant failures can occur, influenced not only by fixture placement and osseointegration but also by prosthesis quality.

To ensure a successful treatment procedure encompassing both surgical and prosthetic stages, clinicians must adeptly manage deviations from the anticipated process. This demands a comprehensive grasp of each case and the potential complications that may arise.

II. COMPLICATIONS

❖ *Case Selection*

Knowledge of contraindications in implant dentistry is the key in selecting an ideal case. This knowledge provides the dental surgeon to anticipate potential complications, advise the patient accordingly, and effectively address any issues that may occur.

A. Contraindications

➢ *Absolute Contraindications [1]*

- Myocardial infarction and CVA
- Immune suppression
- Bleeding problems
- Radiation therapy
- Drug abuse
- Psychiatric illness
- Intravenous bisphosphonate use.
- Uncontrolled diabetes
- Uncontrolled hypertension

➢ *Relative Contraindications*

- Age
- Smoking
- Hypothyroidism
- Osteoporosis

B. Parafunctional Habits

Despite providing a prosthesis with a passive fit in some cases (bruxism), instances of bone loss, implant fracture, and prosthesis fracture may still arise due to excessive forces.

C. Periodontally Compromised Patients

Patients with compromised periodontal conditions may lack the necessary bone structure for effective implant therapy. Even with bone grafting during implant placement, assessing outcomes remains challenging. Implant placement in periodontally compromised patients is essential, given the elevated risk of failure due to bone loss, peri-implantitis and lack of maintenance.

D. CBCT

The success of dental implants depends on primary stability, sufficient bone quality and quantity. However, this stability is compromised in certain bone types, leading to displacement risks. Cortical bone's role is crucial not just for stability but also as a scaffold for grafts. Implant placement in low bone height areas can cause displacement, e.g., maxillary sinus breaches. Understanding patient anatomy in 3D, aided by CBCT, is vital to prevent such issues.

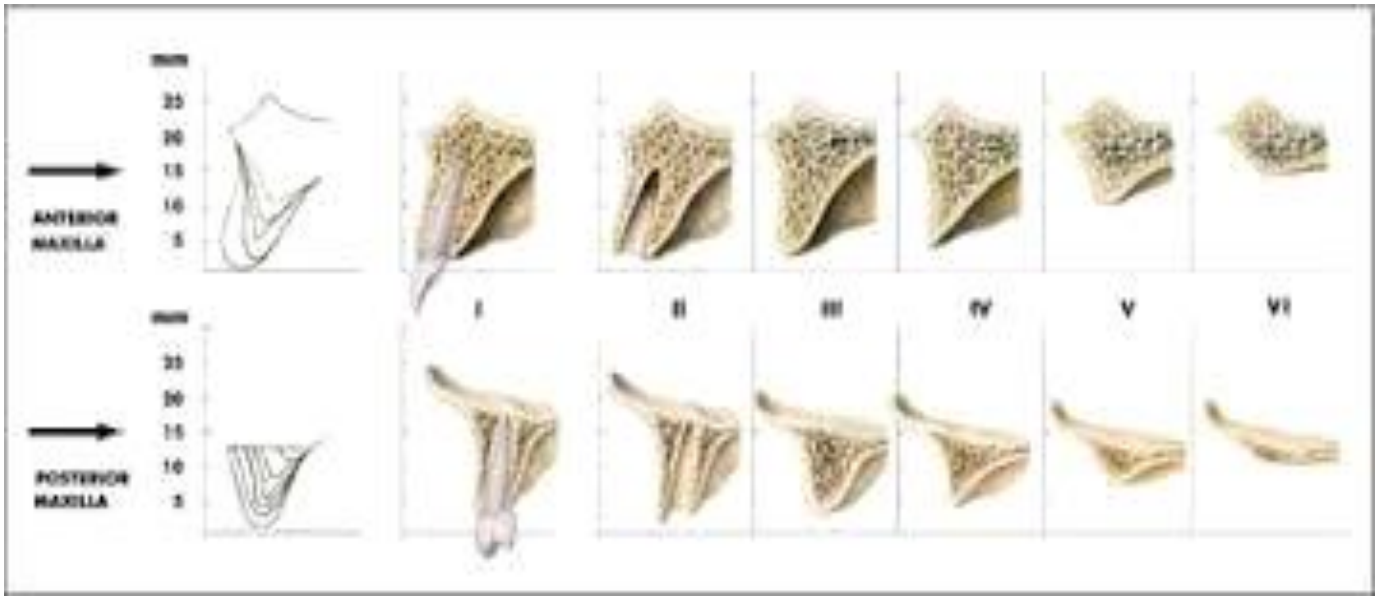

Fig 1 Picture Showing Bone Resorption Pattern in Maxilla

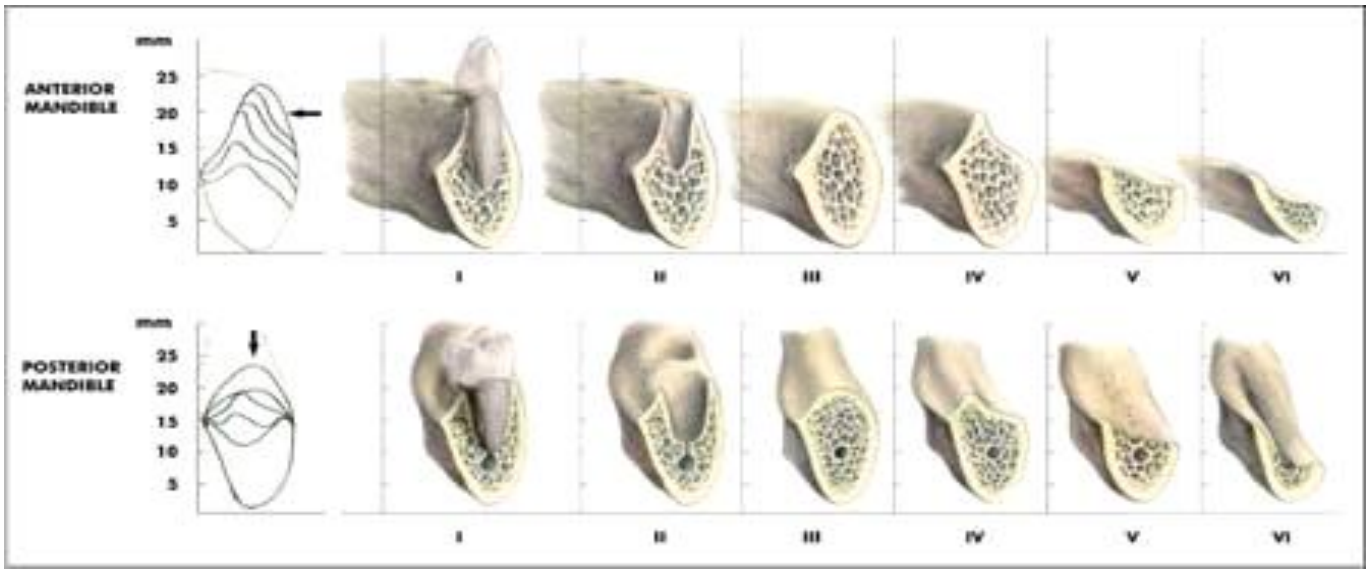

Fig 2 Picture Showing Bone Resorption Pattern in Mandible

E. Interocclusal Distance

Adequate interocclusal distance is required to determine the crown to root ratio which decides the fixture length. (crown to root ratio - Ideally - 1:2, minimum - 1:1, optimal - 2:3)

Furthermore, interarch space defines suitable prosthesis. Limited space restricts options, while excess causes esthetic and biomechanical issues.

For example:

The appropriate interocclusal distance needed for implant therapy is as outlined below:

For fixed screw-retained prostheses at the abutment level, an optimal space of 7.5 mm is recommended. [2]

In the case of fixed cement-retained prostheses, a vertical space of 7 to 8 mm is advised.

Therefore, it is crucial to carefully consider cases with an ideal interocclusal distance. This consideration plays a vital role in the selection of the appropriate prosthesis type and ensuring its long-term durability. [2]

III. SURGICAL COMPLICATIONS

A. Bleeding

Bleeding might occur due to following reasons

- Anemia
- Thrombocytopenia
- Hemostatic disorders
- Incision to highly vascularized areas
- Abscess and granulomas
- Trauma to vessels (inferior alveolar vessels, the palatal vessels, the incisive vessels, the lingual vessels etc.)

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Preventing bleeding resulting from anemia, hemostatic disorders, or the use of anticoagulation drugs can be achieved through a comprehensive pre-surgical assessment of the patient. However, when performing surgery in the mandibular anterior region, special attention must be given to avoid any inadvertent penetration into the lingual cortex. Such penetration could cause harm to the lingual artery, sublingual and submental arteries, potentially resulting in significant and uncontrollable bleeding.

B. Infection

While antibiotics are commonly prescribed, it's important not to assume that sterilization's role is insignificant. This is because surgical instruments and drills come into direct contact with blood, and without proper infection control, there's a risk of peri-implant infection, which can ultimately result in the failure of the implant.

➢ *Peri- Implant Infection*

Peri implant infection could be due to following reasons:

- Poor oral hygiene maintenance
- Surgery performed in non-sterile environments
- No keratinized mucosa
- Improper fit of the prosthesis leading to plaque accumulation
- When utilizing a cement-retained prosthesis, there is a potential concern regarding the presence of excessive cement.

There are two categories of infections that occur around the implant.

- Peri-implant mucositis - inflammation of mucosa around the implant without infecting the bone. [3]
  Signs - bleeding on probing, erythema, edema, and suppuration.
- Peri-implantitis - inflammation of mucosa infecting the surrounding bone. [3]

The cause of early periimplantitis lies in the failure to implant under aseptic conditions. On the other hand, late periimplantitis could stem from any of the above-mentioned causes of peri-implant infection.

Signs - bleeding, pus formation, minimum 2.5 mm loss of bone, attachment loss, vertical bone loss, swelling and hyperplasia of tissues around the implant and increased probing depth. [4]

Fig 3 Picture Showing Bleeding, Pocket and Loss of Bone Around the Implant Strongly Suggesting Periimplantitis

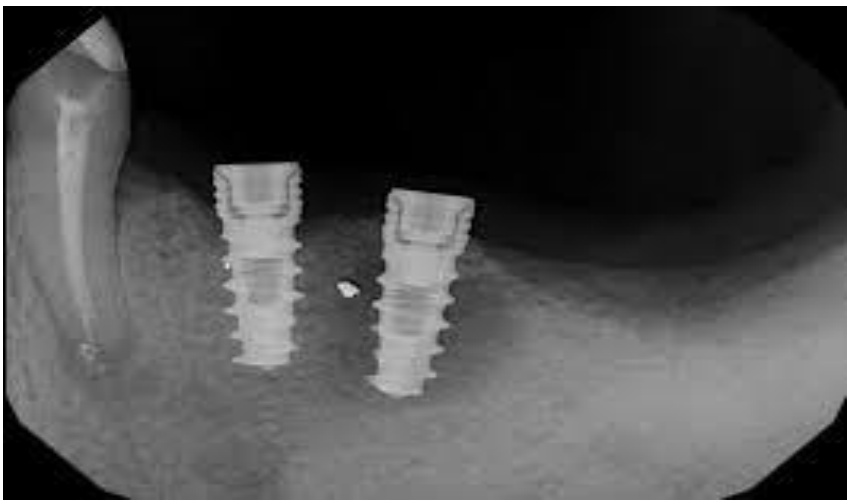

Fig 4 Picture Showing Crestal Bone Loss with Infection Around the Implant Indicating Periimplantitis.

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C. Nerve Damage

Nerves which are commonly damaged during dental implant surgery includes:

- IAN
- Mental nerves
- Lingual nerve
- Nasopalatine nerves
- Greater palatine nerves
- Incisive nerves and
- Infraorbital nerves

Most of the nerve injuries are due to inaccurate radiographic assessment. It is important to understand the nerve pathways and evaluate accessory pathways like anterior loop of mental nerve through CBCT scans to precisely estimate the drilling depth, implant position and size to avoid nerve damage. Nerve damage can manifest as partial resection, transection, degeneration, stretching, compression, or crushing. Moreover, nerve ischemia can occur because of peri-implantitis.

Nerve injury can also be due to indirect trauma, often induced by excessive bleeding (hematoma), alongside thermal and chemical injuries from accidental canal penetration. Among these, the lingual nerve holds the highest prevalence of nerve impairment instances, frequently caused by anaesthetic injections, as it is readily exposed to harm due to its shallow positioning from the mucosa.

Multiple factors contribute to nerve injury risk, like excessive bone heating, improper irrigation, crossing the safety zone during drilling (i.e., 2 mm from the nerve canal), implant intrusion upon the nerve, mechanical damage like pressure application, impaired visibility due to bleeding and laceration, chemical harm, or overly aggressive socket curettage.

➢ *Possible Signs and Symptoms Include –*

- Hypoesthesia - minor loss of sensation
- Dysesthesia - permanent and severe debilitating pain dysfunction
- Anaesthesia - type symptoms and neuroma formation
- Paresthesia - temporary loss of sensation

Following are a few images showing the role of CBCT in implant surgery.

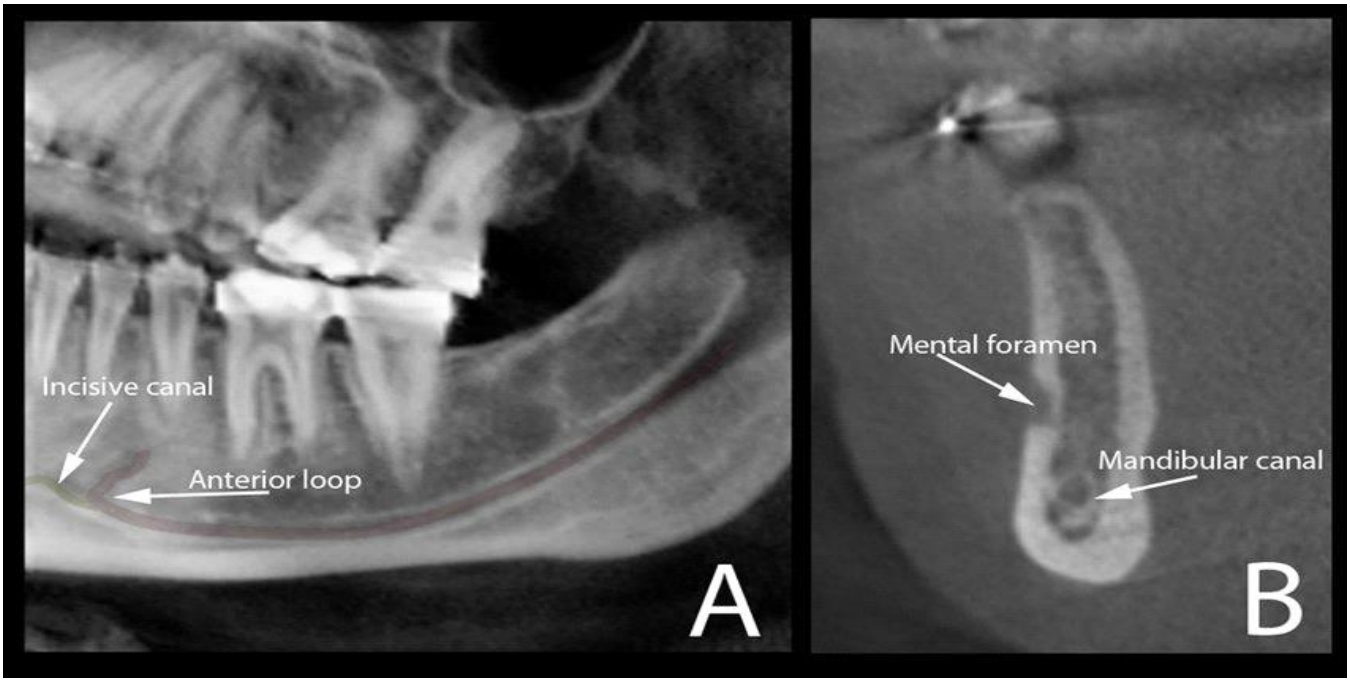

Fig 5 Picture Showing Mandibular Anatomical Features

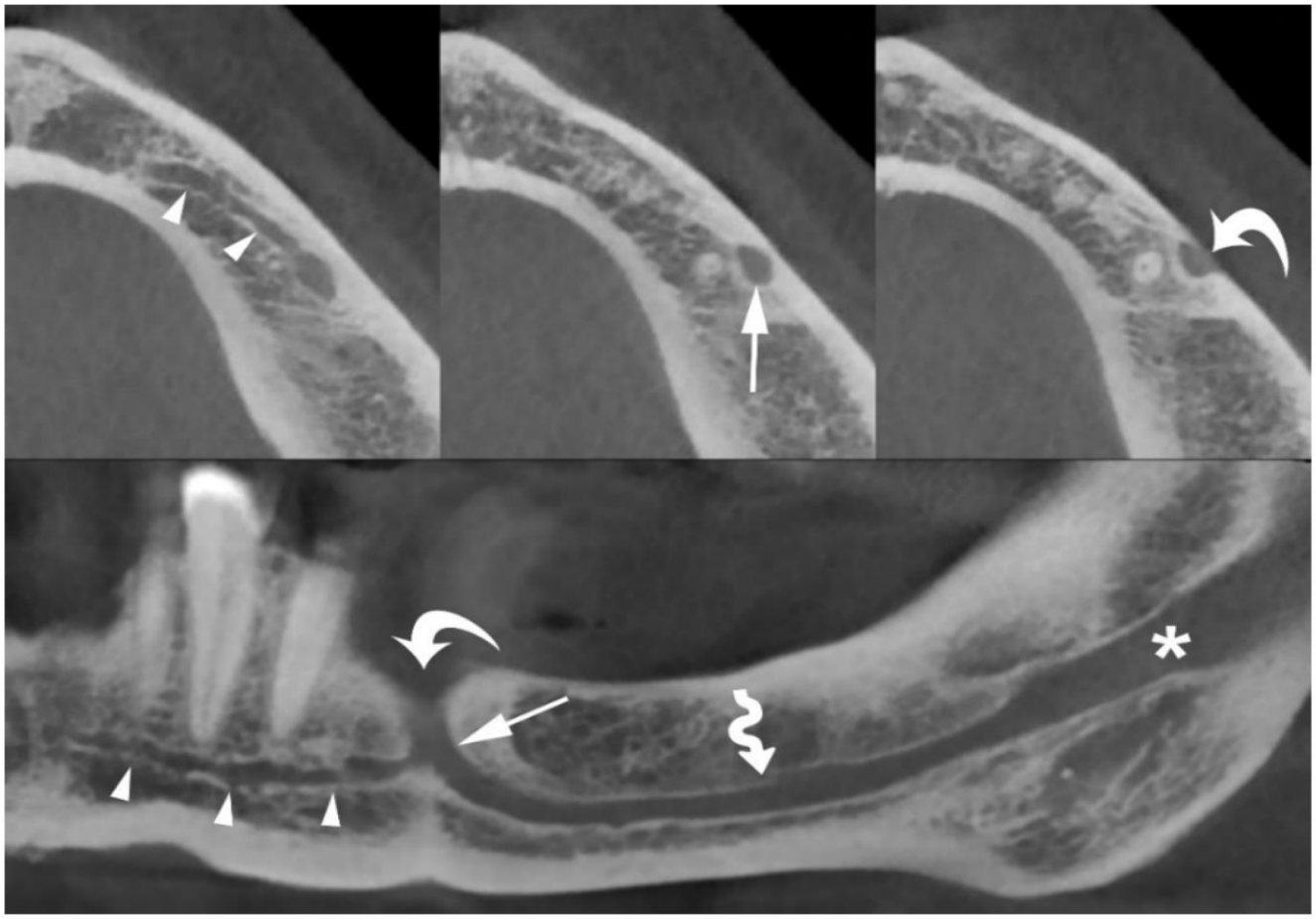

Fig 6 Picture Showing Mandibular Canal Course

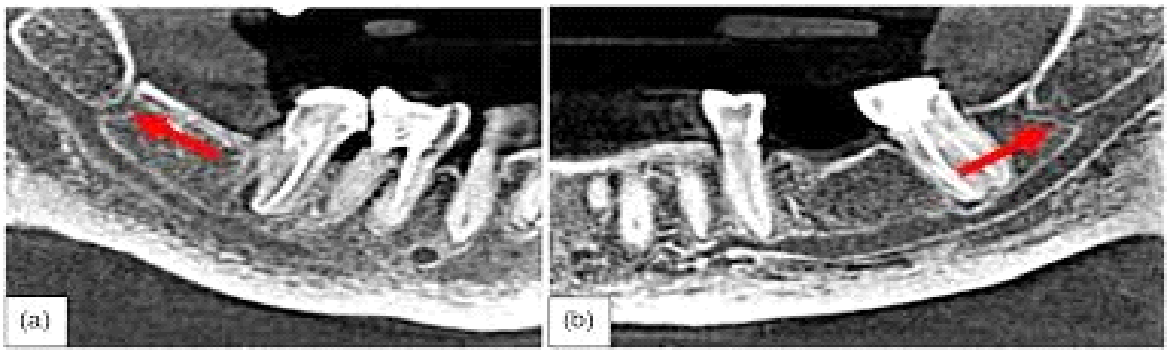

Fig 7 Picture Showing Anatomical Branching of Mandibular Canal

The provided images portray critical anatomical features such as the branching of the IAN. Failure to assess these radiographic details can result in inaccurate treatment strategizing, ultimately contributing to the unsuccessful outcome of implant procedures.

D. Bone Perforation

When bone width is insufficient, the risk of labial and lingual perforations increases. Notably, the mandibular canine region is particularly prone to lingual perforations. In cases where the bone has knife-edge morphology and falls under D3 or D4 bone types, which are rich in cancellous bone, there is a higher likelihood of drill slippage. This can lead to unintended trauma to adjacent structures such as nerves and blood vessels.

Placing implants in the posterior maxillary region with limited ridge height carries the potential risk of implant displacement into the sinus cavity. Negative pressure is a contributing factor to this displacement. Similarly, in the mandible, implant displacement into the mandibular space is a concern. Additionally, if an implant with excessive length is used in a mandible with low ridge height, there is a heightened risk of mandibular fracture. Proper assessment and understanding of bone dimensions and quality are crucial to mitigate these potential complications in dental implant procedures.

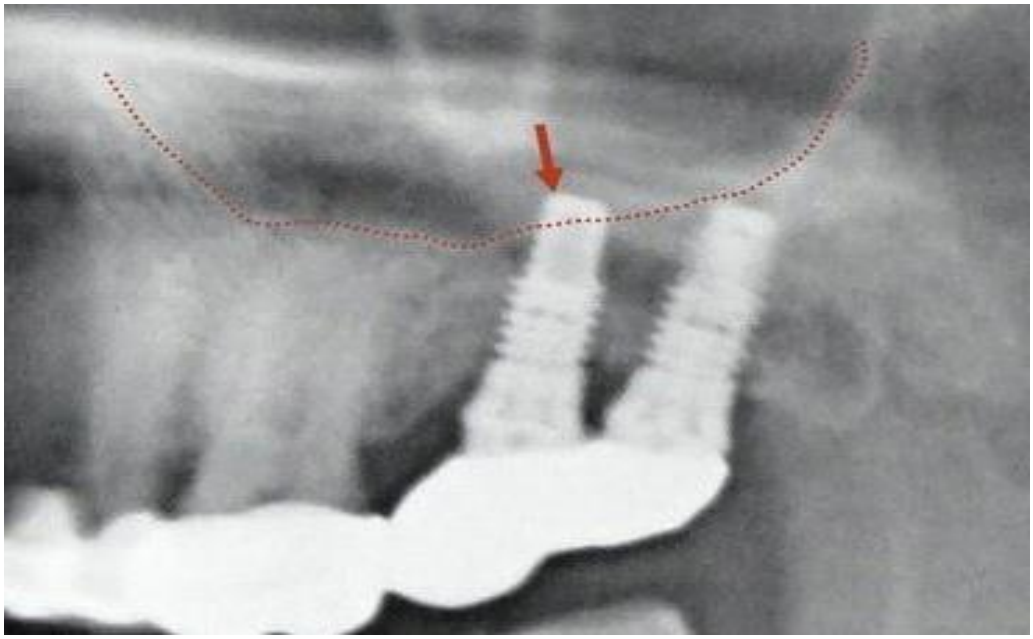

Fig 8 Picture showing Sinus Perforation

Fig 9 Picture Showing Labial Perforation

Fig 10 Picture Showing Implant Displacement into Maxillary Sinus

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E. Underdrilling and Overdrilling

Under drilling of osteotomy site results in failure of primary stability of the fixture leading to excessive drilling and overheating further complicating the surgery. Moreover, clinician can sometimes overtighten the implant to ensure primary stability which leads to implant fracture with bone loss surrounding it.

Over drilling of the osteotomy site leads to failure of primary stability of the fixture which further requires bone augmentation procedures.

IV. PROSTHETIC COMPLICATIONS

Screw loosening is a prevalent mechanical issue associated with implants, primarily attributed to the following factors:

Clamping and Separation Forces: The stability of implant components relies on clamping forces that hold them together, while separation forces attempt to disengage the implant and abutment. When clamping forces are insufficient compared to separation forces, screw loosening becomes likely.

Abutment Angulation: The alignment of implant abutments plays a role in screw loosening. Implants with angulated abutments endure heightened stress from non-axial loads, increasing the risk of screw loosening compared to those with straight abutments.

External Stresses: Various external factors amplify stresses on the implant system, including parafunctional habits, mastication forces, incorrect crown positioning, inadequate crown height spacing, suboptimal occlusal designs, and cantilevered prostheses. These factors elevate the load on the screw and implant, fostering screw loosening.

Fatigue Impact: The frequency of stress fatigue cycles is a determinant of screw loosening. Higher forces expedite screw loosening with fewer cycles, while lower forces require more cycles for the same effect. Instances of screw loosening often involve engagement in high-stress regions, further complicating the situation.

The following causes screw fracture / prosthesis fracture / abutment fracture:

- Consequence of screw loosening.
- Non-passive fit of the prosthesis
- Excessive parafunctional forces exceeding the material resistance.
- Long cantilevers

Among all, chipping of the ceramic is considered the most common technical complication. It is also caused due to improper occlusion or excessive loads which are naturally high for implant prosthesis than the tooth borne prosthesis.

Fig 11 Picture Showing Increase in Crown Height and Cantilever.

Such prosthesis can increase the intensity of the forces falling over the implant. Consequently, implant fracture, implant component fracture, screw loosening and fractures can be seen.

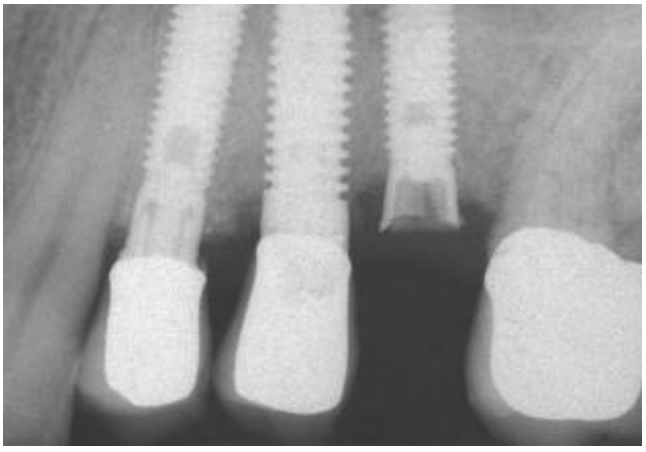

Fig 12 Picture Showing Implant Body Fracture and Abutment Fracture

V. CONCLUSION

This article highlights the essential role of proper radiographic evaluation in preventing complications and ensuring accurate treatment planning in implant procedure. Radiographic evaluation is crucial for identifying anatomical landmarks, assessing bone quality and quantity, determining optimal implant size and position, and more. Effective consideration of medical history, radiographic data, and treatment planning greatly assists clinicians in achieving successful prosthetically driven implant placement. While complete avoidance of complications is challenging, adherence to specific guidelines can significantly minimize their occurrence.

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