Review Article

Iatrogenic complications of implant surgery

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Implants have gained tremendous popularity in modern dental practice and their placement in the edentulous region for the prosthetic reconstruction has become routine. Four essential steps in the use of dental implants, are careful selection of the patient, correct choice of the implant, proper surgical technique and precise prosthetic replacement. The operator's knowledge and skills have a significant role in each of these steps and each step is as important as others. Neglect in any one can result in iatrogenically induced damage. This article describes some of the commonly occurring iatrogenically induced complications during implant surgery and provides some guidelines to prevent the same.

Key words: Implant, iatrogenic complications

INTRODUCTION

Ideally, specific diameter with maximum length of the implant has to placed for the tooth to be replaced in appropriate surgically prepared sites, that are surrounded by a minimum of one mm of bone of favorable quality.[1] The available implant systems vary in material, dimensions, geometries, surface properties and interface geometry. Implant failures can be biologic, mechanical, iatrogenic, or functional.[2] Iatrogenic complications largely arise during stage I surgery and occasionally during stage II surgery. Operator related causes are wrong indications, lack of experience or neglect during implant selection, surgery, inadequate equipment or staff and neglect during and after the follow up.

SELECTION OF PATIENT AND TREATMENT PLANNING

The success of any therapeutic treatment depends on careful selection of the patient, formation of a treatment plan and implementation of gentle and careful treatment procedure. If the operator strictly adheres to these principles, the operator- induced damage can be prevented to a large extent. The selection of patient and treatment planning is critical step in the prevention of iatrogenically induced damage during implant treatment. The patient's history should elicit smoking habits. A thorough medical and dental evaluation must be carried out. Medical evaluation helps to identify potential medical problems like uncontrolled diabetes, cardiac problems, radiation treatment, steroid therapy, psychological disorders, etc. that could prohibit a patient from receiving implant treatment, or influence the success of implant. If these problems are not ruled out at this stage, the outcome of the treatment may not be satisfactory. Dental evaluation should rule out parafunctional habits like bruxism, wherein the implant treatment is contraindicated. Careful attention should be paid to mounted diagnostic casts. They are examined for anatomical structures, vertical space, ridge width and maxillomandibular relations. Radiographic analysis is crucial for evaluation of vertical height of bone, ridge width, bone quality, vital structures and any bony defect or pathologies. The number of implants to be placed and their angulations should also be considered. The surgical template can be a useful aid in the orientation of the implant. The bone sites available for implant placement should not be compromised in quality and quantity. The anatomic limitation for the placement of implants is very important to prevent damage to the maxillary sinus, mental nerve and inferior alveolar nerve. It is important to develop a treatment planning in a partially edentulous patient, such that a minimum specified edentulous space exists between the adjacent tooth and fixture. There should be a minimum of one mm clearance between the apex of the fixture and the superior wall of the inferior alveolar canal. Cases planned with allograft and membranes are less predictable, compared to straight forward cases.

Asepsis

The implant surgery has to be performed in aseptic conditions. Any negligence in this can cause iatrogenically induced complications. All the surgical instruments and surgical handpiece should be autoclaved. The implant surgical kit has to be vacuum sterilized. The hand piece cord and suction tube must be covered with disposable plastic covers. The patient has to be covered with sterile cloth and instructed to keep the hands beneath the cloth. The patient should rinse with antimicrobial mouth wash before the start of the procedure. The surgeon and the assistants should wear mouth mask, surgical gloves and sterile gowns.

Surgical technique

A careful surgical technique is strongly associated with a successful implant outcome. Primary implant stability can reflect how well the site was prepared to receive the implant. The implant must snugly fit into the prepared bony site after the first surgical procedure. Thus, the primary rigid fixation is the responsibility of the implant surgeon, which is a key to the success of implants.

Hard tissue

The following causes have been attributed for the failure of implant to osseointegrate during Stage I surgery by Zarb and Schmitt[3]

- Excessive counter sinking, resulting in a non availability of superior cortical bone plate to stabilize the implant.
- Failure to maintain or use the equipment impeccably compromised drilling precision.
- Inadvertent drilling, excessive tapping and threads were destroyed.

Zarb *et al*[4] in their study, related any implants failure as determined at stage II surgery to one or both of the following factors

- Over-instrumentation of the bone site leading to inadequate immobilization of the implant during stage I surgery and
- Inadequate bone length to engage the mandible's inferior cortical plate when unfavorable bone quality was present and probably iatrogenic in nature.

Temperature related bone changes that attend the drilling necessary for implant placement have been investigated clinically and in a laboratory setting.[5,6] Tanaka *et al* showed that self tapping implants that are 0.8 mm larger than their prepared osteotomy sites, had successfully integrated.[7] In soft bone, the osteotomy site can be inadvertently oversized, resulting in a lack of an intimate fit.

It is critical that excessive heat generation during the drilling procedure be prevented. Gentle handling with following precautions is very important in the success of the surgical technique.

- The drilling bur should be used in a sequential manner, relevant to the implant employed.
- Burs with internal cooling system.
- Sharp burs.
- The drilling unit should provide high torque at slow cutting speed.
- Bone should not get heated beyond 43ºC to maintain its vitality. To prevent excessive heat generation, copious amount of sterile irrigation must be done.
- Drilling position and angulations should be as per the planning, to prevent perforation and damage to vital structures. Pilot hole drilling is most crucial.

Vital structures

During the surgery, vital structures like maxillary sinus, mental nerve and inferior alveolar nerves should not be encroached. The damage to nerves can cause numbness and tingling sensation. The encroachment into maxillary sinus can cause development of oroantral communication. Implants inserted close to the maxillary sinus provide a route for spread of infection from the mouth, following poor oral hygiene. When the maxillary dental implant is infected, sinusitis occurs easily due to spread of inflammation. Minoru *et al* reported two cases of maxillary sinusitis resulting from the improper placement of dental impants.[8] The perforation of the membranous lining of maxillary sinus occurs commonly during sinus lift operations. The floor of the mouth contains branches of submental and sublingual and mylohyoid arteries that may lead to life threatening complications. Damage to arteries, especially in the floor of the mouth has been reported in the literature, by many authors.[9-12] Most of the times, it can result in fatal hemorrhage. Mason *et al* Reported a case of fatal hemorrhage arising from dental implant placement in the mandible due to damage to sublingual artery.[13]

Studies by Bevitz *et al*[14] and Hofchneider *et al*[15] indicate that submental and sublingual arteries may course intimately to the lingual cortical plate, from the floor of the mouth. It should be stressed that the edentulous mandible is even shorter and perforations occur deeper in the floor of the mouth.The majority of reports of the floor of the mouth and sublingual hemorrhage have been iatrogenic in nature. Sharp instruments such as rotating dental disks and burs have slipped off mandibular teeth causing injury to the floor of the mouth and even laceration of the sublingual artery.[9-12] Niamtu J reported a case of near fatal airway obstruction after routine implant placement, secondary to sublingual bleeding and haemotoma.[16]

Those performing implant surgeries should be knowledgeable in the management of arterial hemorrhage and other medical emergencies. The damage to adja-

cent teeth must be prevented.

Soft tissue

The healing process with the implant is same as normal soft tissue. If there is a clean wound, it heals by primary intention. If the wound is open, it heals by secondary healing. Secondary healing is associated with granulation tissue formation which prolongs the healing period. Healing by secondary intention is undesirable for the implant fixation.

- A full thickness flap must be raised without causing any tear in the tissues. A single straight incision to full depth is most important for primary closure of the wound after Stage I surgery, which will facilitate wound healing without complications. After the first stage surgery, the fixture installation site is checked for properly sutured wound closure.If the wound appears open, infection can occur and inflammatory reactions can extend to underlying fixture sites. After healing occurs, the tissue may pull away or shrink exposing cover screws.
- The sutures should not cause any tension in the soft tissue. If the suturing is too tight due to odema, tissue may break open.
- The soft tissue should not be entrapped between the bone and the implant.
- Varying degrees of swelling and ecchymosis may be caused due to defective flap, long duration of surgery and healing of tissues.

Loading the implant

After the stage I surgery, it is required to maintain fixtures within the bone, without the occlusal loads onto the fixtures. If load is applied onto the fixture, primary stability is destroyed. During the healing period in the anterior region, a splinted restoration or a removable partial denture with soft lining material can be constructed. The posterior region can be left undisturbed till the osseointegration takes place.

CONCLUSION

Dental implant therapy for occlusal rehabilitation has recently become more popular. To be successful, the implant must be stable in the jaw bone after the healing period. Placement of implant is technique sensitive and depends on the application of Surgical and Prosthodontic principles. An absolute requirement is not to cause iatrogenically induced damage during implant placement, an awareness of possible risk involved, adequate training and knowledge of which patient's to refer to more specialized centers and which patient may cope with one's own clinical proficiency.

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