



## COMPLICATIONS AND SOLUTION SUGGESTIONS BEFORE AND AFTER TREATMENT IN DENTAL IMPLANTOLOGY

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### Reviewing the literature

#### ABSTRACT

Dental implants have revolutionized the field of restorative dentistry, providing patients with a reliable and aesthetically pleasing solution for missing teeth. However, the success of dental implant therapy is contingent upon the meticulous planning, precise execution, and comprehensive post-operative care. Despite advancements in implant technology and surgical techniques, complications can arise, jeopardizing the overall outcome of the treatment. Various complications associated with dental implants, encompassing both early and late post-operative issues have been reported. Early complications, such as infection, implant malposition, and nerve injuries, are often related to the surgical phase, whereas late complications, including peri-implantitis, implant fracture, and prosthesis-related problems, manifest in the long-term post-operative period. Moreover, this review delves into the etiological factors, clinical manifestations, diagnostic approaches, and management strategies for each complication. Additionally, the article explores recent developments in implant surface modifications, biomaterials, and surgical techniques aimed at minimizing these complications. A thorough understanding of these complications is crucial for dental practitioners to enhance patient outcomes, improve the longevity of dental implants, and ensure patient satisfaction.

**Keywords:** Dental implant, complication, surgery.

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### **A. SUCCESS AND FAILURE IN DENTAL IMPLANT**

In order for a dental implant to be considered successful, it must meet functional properties such as chewing and speaking, psychological properties such as the absence of pain and discomfort and satisfactory aesthetic results, and physiological properties such as ensuring osteointegration and not causing pathology in the tissues. The success criteria were that the implant was not mobile when tested, that no radiolucency residue was seen in the peri-implant, that the bone loss was less than 0.2 mm after one year, and that the patient did not have conditions such as pain, infection, paresthesia, neuropathy and violation of the mandibular canal (1-4).

The success of the implant procedure depends on various factors such as the material having the necessary properties, the immune competence of the person and the healing capacity of the tissues, the adequacy of the method applied, the experience of the team, the error-free treatment planning and the care the patient will take (1,2,5).

Prosthetic material, presence of cantilever extensions in fixed prostheses, type of retentive elements supporting the overdenture prosthesis, cemented or screw-retained fixed prostheses, bruxism, angled abutments, crown-implant ratio, length of the superstructure, number of implants supporting the fixed prosthesis, good settling capacity of the bone region of the host. Deterioration and damage to the bone-implant interface also affect the risk of success in implant surgery (3-6).

### **B. REASONS FOR THE INCREASE OF COMPLICATIONS**

The main reasons for the increase in dental implant complications are the increase in the number of implant models and indications, inexperienced surgical and prosthetic practices, high success rates reported in the literature, ignorance about complications and solutions, and inappropriate indications. In addition, the increase in the number of physicians applying implants and the number of cases, physicians turning to riskier jobs, the inadequacy of the training provided in faculties, and the uncertainty of the qualifications of sponsored or private courses are among the factors that cause the increase (1,2,7).

In order to reduce these complications, physicians should receive accurate and comprehensive training, gain experience with practical applications, evaluate systemic diseases carefully and ask consultation from specialists when necessary. And also case-specific design

and planning, correct implant selection and following appropriate surgical principles, regular check-ups in the postoperative period and proper patient care need to be done to prevent complications (6-9).

## **C. COMPLICATIONS AND SOLUTION SUGGESTIONS IN IMPLANTOLOGY**

### **a. SURGICAL COMPLICATIONS**

#### **i. Intraoperative Complications**

##### **1. Anesthesia Complications**

In implantology, situations other than the anesthetic given to the patient causing anesthesia in the area innervated by the relevant nerve during or after anesthesia are considered complications. These complications can be listed as follows: Systemic complications such as toxicity, allergic reactions, anaphylactic reactions, idiosyncrasy, local complications, tissue reactions and infections caused by contamination of the anesthetic substance; complications related to the way anesthesia is administered, such as failure to provide anesthesia, prolonged anesthesia, edema, hematoma, trismus, syringe breakage, neurological symptoms and infection (1,2,10).

Precautions that can be taken against these complications are as follows: Making the right choice of anesthesia, checking that the storage conditions and expiration date of the anesthetic substance are appropriate, having extensive knowledge about the effects of the anesthetic substance, making sure that the correct solution is drawn when injecting the anesthetic substance into the syringe, and during anesthesia to prevent hematoma formation. aspiration, performing topical anesthesia beforehand in order not to cause pain during anesthesia, making sure that the anesthetic substance is at body temperature, applying the anesthetic substance injection slowly, not using each syringe more than once and not dipping it repeatedly, not neglecting to get bone contact from the syringe, and having extensive knowledge about anatomical structures (1,2,10-12).

In case of a toxic dose of local anesthetic, especially in children or weak patients, the procedure should be stopped immediately. Due to the possibility of increased cerebral blood pressure as adrenaline release continues, the patient should be placed in a semi-sitting position and the supine position should be avoided. In these cases, blood pressure and oxygen saturation should be monitored. If there is an increase in respiratory rate or depth, oxygen should not be given. If local anesthetics cause an allergic reaction, hydrocortisone, diphenyl hydramine or, in severe cases, adrenaline are administered (10-12).

In cases where trismus develops, treatment should be postponed and the patient should be asked to open and close the mouth frequently and make lateral movements (for example, chew gum). It is desirable to chew gum as it will help lateral movements. In severe trismus cases, antibiotics and muscle relaxants should be given, warm salt water gargling should be recommended, and drainage should be performed in the presence of infection. In cases of chronic trismus, the jaw should be opened and lateral movements should be performed under local and general anesthesia (10-12).

## **2. Incision and Flap Errors**

In implant surgery, errors in incision and flap design can lead to avascularization of the tissue and scar formation, extending the incision line from the corners can lead to hemorrhages, expansion of the operation area, irregular openings and folding at the flap corners due to tearing during retraction, primary closure of the wound edges without releasing the flap can lead to dehiscence and lacerations, collar openings and periimplantitis (1,2,13).

Things to do to prevent complications caused by incision and flap errors are as follows: The operation area should have a clear view, it should be free of residues such as tissue and blood, if there is tissue residue, it should be dissected, electrocautery or laser should be used in areas where vascular structures are dense, along the base of the flap in cases where the flap needs to be shifted. The flap should be released by making an incision, soft tissue free flaps and graft applications should be used, the incision should be made with a single-direction incision by taking as much hard tissue support as possible and angling the scalpel only with the movement of the wrist, and the tissues should be carefully dissected from the full or half-layer bone surface with a blunt instrument (1,2,6,13).

## **3. Implant Angling and Positioning Errors**

In implant surgery, insufficient bone volume, physician error or lack of planning, or sudden movements of the patient during the operation may lead to errors in implant positioning. This may cause the following complications: If the implant is placed too deep, bone resorption, nerve damage, sinus perforation and loss of soft tissue height; if the implant is placed mesiodistally, it prevents damage to adjacent teeth, bone resorption and formation of gingival papilla; if the implant is placed palatally or buccally, gingival recession, bone fenestration and aesthetic problems in the buccal region; aesthetic problems such as inability to create a crown of sufficient height or exposure of the abutment if it is placed at insufficient depth; if less than 2 mm is left between the adjacent teeth, devitalization may occur in the neighboring teeth. With

incorrect angulation of the implant, damage to the surrounding anatomical formations, functional problems and aesthetic problems with the implant may occur (15-17).

Recommendations to prevent these complications are as follows: First of all, detailed evaluation and planning should be done with accurate radiological imaging before the operation, if there is tissue loss in the area where the implant will be placed, it should be augmented first, a distance of 1.5-2 mm should be left between the implant and the tooth, and a distance of 3 mm should be left between the implant and the implant. To prevent this, a parallel pin or surgical stent should be used. In the presence of buccal dehiscence, the implant should be repositioned urgently and simultaneously grafted with a collagenous membrane and slowly resorbing bone particles. In case of an angulation error during the operation, a side-cutting drill should be used (15-17).

#### **4. Drill Fractures**

Drill or bur fractures can occur as a result of exceeding the tolerance level due to metal fatigue, rupture as a result of wear, weakening of the metal as a result of high heat or pressure or the use of chemicals during autoclaving, and excessive and adverse force applied by the dentist. If drill fractures occur, the following complications may occur: Fractures may escape to vital areas, damage to vessels, nerve damage, and jamming of the drill within the bone tissue.

The following precautions are recommended to prevent drill fractures: The technical specifications and application procedures specified by the manufacturer should be mastered and fully followed. If the drill gets stuck, the broken piece should be carefully removed from the socket to cause minimum damage to the bone. If the stabilization of the socket is not complete or damaged due to heating, the implant process should be postponed and it should be planned after bone reconstruction is achieved (17-19).

#### **5. Warming of the Alveolar Bone (socket)**

During implant surgery, the heating that occurs in the alveolar bone, that is, the socket, as a result of the drill rubbing against the bone, may cause osteolytic degeneration, necrosis and fibrosis in the bone. If inflammation develops in the area between the bone and the implant, the maturation of the bone tissue is not completed and a compact structure cannot be formed, which prevents osteointegration (20,21).

To prevent these complications, the following should be done: Sharp burs should be used, cooling should be applied, the use of dull drills should be avoided, the speed of use of the drill should not be high, and the application should be terminated when the drill jams. In

addition, it is necessary to avoid using excessive irrigation for the cooling process in order not to cause the operation to be inadequate as a result of decreased visibility of the surgical area (20,21).

## **6. Bleeding**

Although life-threatening bleeding cases during implant placement are rare, they are mostly caused by A. lingualis and A. facialis. Apart from that a. inferior, a. palatinum majus and palatinus may cause minor bleeding. Edema that develops in this area and on the tongue as a result of internal bleeding originating from the floor of the mouth may block the respiratory tract. These bleedings mostly occur due to overflow from the nasopalatine duct bone cortex or perforation of the maxillary sinus (15,22,23).

To prevent these complications, the following should be done: In order to prevent bleeding, the physician must first have knowledge of the anatomical structure of the region. In order to avoid bleeding, it is necessary to palpate the lingual surface of the mandible, determine a stop depth on the drill, and select a shorter implant. Additionally, the patient's history of anticoagulant use should be known (15,22,23).

Minor bleeding can be stopped with electrocautery, pressure application, or sutures. In case of life-threatening bleeding, the operation should be stopped and bimanual compression should be applied to prevent the rotary device and aspiration process from interfering with the coagulation process. In this application, one finger should be in the bleeding area and one finger should be outside the mouth. Additionally, the head should be elevated and it should be checked whether there is an increase or decrease in the amount of bleeding. In addition, hemostatic agents should be placed in the osteotomy area through or over the lingual periosteal tissue, pressure should be applied to the transverse 4th cervical vertebra in the neck, vasoconstriction should be applied, the artery should be sutured, and if bleeding does not stop or is observed after the operation, referral to the hospital should be made (2,15,22,23)).

## **7. Soft Tissue Injuries**

Heating of the handpiece during implant surgery may cause burns to the inner surfaces or corners of the lips. Soft tissue injuries may occur as a result of sudden movement of the patient, excessive force by the physician, or use of the wrong tool. Soft tissue injuries; It includes damage such as lambo swallows, injuries to the floor of the mouth, and cuts to the vestibule areas (5,13,20,21).

The following precautions are recommended against such injuries: Care should be taken during the application, full concentration of the physician and assistant personnel should be ensured, working with old rotary tools should be avoided, excessive force should not be applied. Additionally, in case of damage, appropriate medical treatment should be initiated by providing reconstruction and precautions should be taken against the development of infection (5,13).

## **8. Nerve Injury**

During implant surgery, during the removal of the flap, preparation of the implant slot, or placement of the implant, damage may occur to the mandibular nerve or to the branches of this nerve, N. alveolaris inferior, N. lingualis and N. mentalis. Nerve injury may be caused by poor design of the flap, traumatic flap, accidental intraneuronal injection, exposure of the mental nerve to traction force due to the translated flap, penetration of the osteotomy preparation, and compression of the implant body in the canal. These injuries can be seen in the form of paresthesia, such as partial or complete numbness of the lips, tongue or cheek, or paresthesia, such as a stinging, burning or tingling sensation, hypoesthesia, as a decrease or increase in sensation, dysesthesia, as a painful feeling, and anesthesia, as a complete loss of sensation. (24-26)

The following precautions can be taken against these complications: A good radiological evaluation should be made before the operation, in case of excessive resorption, the incision should be shifted from the crest to the lingual, a 2 millimeter safety margin should be left between the inferior canal and the implant, and immediately after the implant is placed, radiological examination should be done to evaluate whether there is a malposition. In addition, the areas where the Nervus mentalis passes should be carefully exposed and the implant should be avoided in this area. In case of nerve compression, the compressing implant should be pulled back a few turns or removed and a shorter implant should be placed. Mandibular nerve block or local infiltration can be performed to prevent compression of the inferior alveolar nerve. In order to reduce inflammation and its effects caused by pressure on neurons, clonazepam, carbamazepine or vitamin B complex options should be considered in addition to anti-inflammatories. It should be kept in mind that sensory delay may occur, and anti-inflammatory treatment should be continued in high doses for several weeks. If an unexpected situation occurs or if the nerve compression is severe or if there is paresthesia lasting for 16 weeks, which is an important finding indicating that the integrity of the nerve sheath has been disrupted, the patient must be referred to microsurgery (24-26).

## **9. Damage to the Adjacent Tooth**

During implant surgery, reasons such as incorrect positioning of the rotating bur axis, deterioration in tissue integrity and vascularity in the pulp as a result of trauma, incorrect preparation of the socket, incorrect positioning of the socket and incorrect angulation may cause damage and devitalization of the adjacent tooth. Additionally, sudden movements or posture changes by the patient may cause traumatic damage to adjacent teeth. As a result, endodontic treatment or tooth extraction may be required, and in advanced cases, bone tissue or implant loss may occur (1,2,27,28).

To prevent these complications, the following should be done: In order to avoid damage to the adjacent tooth, the roots and inclination of the teeth in the adjacent area should be determined, the distances between the areas to be prepared for the implant and the tooth roots should be measured, advanced imaging techniques should be applied, planning should be made precisely and simulation applications containing artificial intelligence should be used. The physician should also be careful about reverse torque force and binding of the drills (27,28).

## **10. Fractures in the Jaws**

Although jaw fractures are not common in implant surgery, they are an important clinical situation. Increased fragility of the maxilla or mandible is observed due to reasons such as advanced osteoporosis, osteomalacia, cortical differences in bone density and some bone diseases. In the presence of such a factor, the localization, direction and intensity of the force applied during the operation may lead to fracture. Fracture may occur during endosteal implantation, especially applied to the mandible that has been excessively resorbed due to osteoporosis and whose alveolar bone height is less than 7 mm and narrower than 6 mm. In addition, inappropriate implant diameter may lead to fractures (1,2,28,29).

To prevent these complications, the following should be done: In order to prevent jaw fractures, surgical planning should be done very precisely, computerized tomography method should be used, which can give clear information about the anatomy of the area to be implanted, measurements should be checked before opening the implant package, and the use of wide or aggressively threaded implants should be avoided in risky patients. Excessive force should not be applied during the operation, and care should be taken to ensure that the socket structure is not much smaller than the implant diameter. In case of fracture of the mandible, treatment takes a long time. Mandibular fracture must be restored. Immobilization should be provided in monocortical mini plates. In some cases, in the presence of severe atrophic fractures, fixation

can be achieved with two mini plates and microplates. Depending on the situation, the implant may need to be removed. In some cases, bone grafting may be required (1,2,28,29).

### **11. Dehiscences and Fenestrations**

Fenestrations, known as dehiscences, or bone windows, are buccal or oral bone defects that can occur in patients with insufficient bone width. These defects can be seen as a result of errors during implant site preparation or tapping, breakage of thinned sockets during milling, or tearing of the bone walls of the implant body threads. They are most commonly seen in the vestibule of the maxilla and the sublingual fossa. They can lead to infection, hemorrhage, support or implant loss (30-32).

To prevent these complications, the following should be done: surgical planning should be done carefully, alveolar bone slopes should be evaluated with precision, bone density should be examined meticulously, angulation errors should be avoided by checking the guide occlusal plane and angles, areas that may crack and fenestrate during drilling and implant placement should be manually checked and tried to be understood. In case of dehiscence or fenestration, implant placement should be canceled, intervention should be made if it is placed, and it should be known that the connective tissue that will form if left alone will prevent osteointegration. If implant placement cannot be canceled, treatment can be applied in the form of tissue guidance, membrane placement, use of the periosteum structure in the inner part of the flap as a membrane, or guided tissue regeneration using biomaterials and grafts (30-32).

### **12. Lack of Primary Stabilization**

Ensuring primary stability is one of the key factors for the success of the implant. After the implant is placed, there must be osteointegration between the bone and the implant through the advancement of soft tissue. However, factors such as incorrect preparation of the socket, use of the wrong drill, inadequate implant surface or form, lack of diameter compatibility between the socket and the implant, and low bone density in the area where the implant will be placed may cause primary stabilization to fail (33-35).

In order to prevent these complications, the following must be done: To prevent this complication, the implant surface must be sufficiently roughened, the appropriate bur must be selected, the bone density must be examined in detail beforehand, and the implant and socket diameters must be carefully evaluated. In cases where primary stabilization cannot be achieved, the implant should be removed and an implant with a larger diameter should be placed, and care should be taken to ensure that the implant diameter is 0.1-0.3 mm larger than the socket. In

cases where a larger implant cannot be placed, the operation should be postponed and the bone structure should be waited to regenerate with bone regeneration techniques or graft application (33-35).

### **13. Maxillary Sinus Perforation**

One of the important complications that may occur during implant surgery. In many cases, Schneider membrane perforation occurs during surgery. It has been suggested that perforation is related to the width of the angle formed by the mediolateral walls of the sinus. Sinus perforations are classified as being in the apical wall (class I), extending laterally and coronally (class II A), or being confined to the inside (class II B), and being in any other region of the sinus window (class III). It is controversial whether sinus perforation affects implant success. Maxillary sinus perforation may lead to some complications such as bleeding, sinusitis, and graft contamination (36,37)

To prevent these complications, the following should be done: To prevent sinus perforation or the complications it causes, the patient's history and general condition should be carefully evaluated, the height of the maxillary alveolar bone should be measured, the sinus floor septum should be investigated, and the size of the maxillary sinus should be examined. In order to prevent bleeding from complications caused by sinus perforation, it is necessary to clean the physician's field of vision with aspiration, to apply pressure, electrocautery, vasoconstrictor or suture if bleeding occurs, to gargle with chlorhexidine before the operation to prevent infection, and to pay attention to sterility. It should be known that infection develops in the presence of findings such as swelling, pain, fistula formation, discharge, and opening of the wound edges in the lateral region days after the operation. In these cases, surgical debridement is applied and antibiotics are given, and in advanced or stubborn cases, the implant, membrane and graft are removed (36,37).

### **14. Foreign Body Aspiration**

During implant surgery, foreign body aspiration may occur due to careless work, working in inappropriate conditions such as wet floors and insufficient lighting, intravenous sedation, sudden movements of the patient or insufficiency of swallowing reflex due to paralysis, Parkinson's disease and psychiatric disorders. For example, as a result of the doctor's

fingers getting wet in the mouth, some elements such as implants or screws may fall and escape into the oropharynx (38,39).

To prevent these complications, the following should be done: Precautions can be taken against aspiration, such as providing a mesh cover with gauze in the mouth or tying dental floss to the implant parts. If a piece falls into the mouth, the patient should be placed in the supine position and the inside of the mouth should be examined carefully. If the piece cannot be found, it should be referred to the hospital, the location of the foreign body should be determined by imaging methods, and it should be removed as soon as possible with flexible and rigid bronchoscopy or endoscopy if it has passed into the gastrointestinal tract (38,39).

## **ii. Postoperative Complications**

### **1. Early term**

#### **a. Hematoma and Ecchymosis**

During implant surgery, hematoma or ecchymosis may occur due to damage to the vessels and accumulation of blood leaking from the vessel within the tissue or under the skin. It is inevitable in some patients or operations (1,2,40).

In order to prevent these complications, the following should be done: The patient should be aware of coagulation disorders and anticoagulant use before the operation, the physician should avoid applying hard and excessive force against the tissues during the operation, care should be taken to ensure that the retractor pressure is not excessive, the presence of bleeding should be checked, the flap edges should be primarily sutured and blood should be removed. Leakage must be prevented. When bleeding is detected, in addition to the necessary measures to stop bleeding, the risk of hematoma formation can be reduced by compressing the spaces through which blood can pass, using flexible bandages, applying cold compresses and local vasoconstriction. If a hematoma has developed, a mini drain can be placed; treatment is not required in the presence of ecchymosis (1,2,28,40).

#### **b. Edema and Pain**

During implant surgery, localized edema may develop as a result of excess plasma (transudate) leaking into the interstitial spaces. In addition to trauma during surgery, the presence of microbial inflammation, medications and immunological factors can lead to edema. In cases where autogenous graft removal, open sinus lifting technique and hard tissue augmentation are performed, the risk of edema is higher and the edema may be larger in volume.

This edema can cause dysfunction, especially pain, limitation in mouth opening, difficulty in phonation and trismus (1,2,28,41)

To prevent these complications, the following should be done: In order to reduce the risk of edema, it is necessary to be careful during the operation, avoid causing trauma, complete the operation in the minimum time, apply a cold and flexible bandage after the operation, give corticosteroids and avoid edema-increasing movements (28,41).

#### **c. Infection**

After implant surgery, infection may develop, manifesting itself as pain, edema, exudate and regional temperature increase. In addition to inadequate oral hygiene and non-compliance with sterilization rules, contaminated gloves or body contact, a pre-existing infection in the socket, or a root remaining in the implanted area may lead to infection. Infections can lead to periimplantitis, sepsis, or complications requiring osteotomy or sequestrectomy (1,42).

To prevent these complications, the following should be done: In case of infection, the type of the agent and its resistance profile should be determined, if necessary, debridement, curettage and enucleative surgery should be performed, antibiotic treatment should be started and chlorhexidine should be used. In some cases, implant resection or explantation may be necessary (1,28,42).

#### **d. Incision Line Opening and Lacerations**

After implant placement, openings and lacerations may occur in the incision line within the first ten days after the flap is closed. Wound closure mostly occurs spontaneously and secondarily. However, wound opening may occur in cases such as infection, faulty suture, faulty design or tension in the flap, trauma due to the antagonist tooth, and the position of the healing head being too supracrestal. This can cause peri-implant bone loss (1,2,43).

To prevent these complications, the following should be taken: Precautions should be taken such as better cleaning of the area against opening the incision, turning the area into a cleanable opening rather than a partial opening, loosening and suturing the buccal flap a little more, and reducing tension. If separation has occurred, depending on the situation, healing can be supported by opening the way for the granulation tissue, or primary re-closure should be applied in the early period, and if a few days have passed, debridement and wound repair, and chlorhexidine and antibiotic treatment should be applied (1,2,43).

#### **e. Emphysema**

Emphysema is a rare condition that occurs when the air trapped under the flap moves under the soft tissue and muscle fascia into the space between the muscle fibers due to a sudden increase in intraoral pressure, such as the use of air-water spray to prevent thermal trauma during the preparation of the implant slot or sneezing after the operation. Swelling on one side of the face, extending to the neck and down, and a crackling sound on palpation are signs of emphysema.

To prevent emphysema, the use of high-speed tools should be avoided during the preparation of the socket, the wound site should be washed with hydrogen peroxide, and the cut edges should be approached meticulously during suturing. After the operation, sneezing should be avoided and nose blowing should be done gently. If emphysema develops, cold massage, saline solutions and radiation therapy can regress emphysema, and it usually resolves within 10 days (44,45).

#### **f. Covering Screw Complications**

If the wound edges are not properly sutured after the implant is placed, infection and/or inflammation may develop, which will negatively affect osteointegration and may expose and pull out the covering screw. Temporary dentures may also cause trauma and exposure of the cover screw. If the covering screws are exposed, it may cause insufficient control of inflammation and plaque. On the contrary, tissue proliferation between the implant body and the implant body due to the cover screws being buried too much or placed loosely can also be seen as a complication (1,46,47).

To prevent these complications, the following should be done: If there is insufficient plaque control when the cover screw is exposed, the gingival positioning should be re-positioned by removing the granulation tissue and the screw should be closed surgically. If there is not enough gingival mucosa, a gingival graft should be applied, or if there is not enough tissue, a flap procedure should be applied. In case the cover screw is buried, the overlying bone tissue must be eroded to provide a healing opening. If tissue proliferation develops, excess tissue should be removed (46,47)

## **2. Late Term**

### **a. Peri-implant mucositis and periimplantitis**

In peri-implant mucositis, inflammation may develop in the peri-implant due to poor oral hygiene or an incorrectly applied or angled implant. It manifests itself with redness and swelling like gingivitis. In addition, if there is bone destruction, periimplantitis is mentioned.

Inflammation can progress to the alveolar bone. In case of pocket presence in periimplantitis, anaerobic colonization may occur. These situations can lead to osteointegration. Genetic factors, diabetes, alcohol use and characteristics of the implant surface affect the risk of developing both conditions. Peri-implanter probing is diagnosed by evaluating bleeding, suppuration and percussion during probing (28,48,49).

In case of periimplant mucositis, mechanical cleaning should be performed, tartar should be cleaned with curettes, antiseptic agents such as chlorhexidine should be applied, any occlusal problems should be corrected and oral hygiene should be taken into consideration. The first thing to do in peri-implantitis is to remove the granulation tissue on the implant surface. Laser and ultrasonic devices can be used in the treatment of periimplantitis. Metronidazole or ornidazole are effective antibiotics. If there is no bleeding upon probing and the pocket depth is less than 3-4 mm, mechanical cleaning alone may be sufficient. Depending on the size of the lesion, osteoplasty or ostectomy may be performed. It may be necessary to abrade the implant surface or apply a graft or membrane to the area. If bone loss is severe or osteointegration is severely impaired, the implant should be removed (48,49).

#### **b. Gingival Hyperplasia**

Gingival hyperplasia, characterized by inflammation and proliferation around the implant, can be observed. It is caused by some factors such as incorrectly placed implants, incompatibility of prostheses with the gums, inadequate oral hygiene, some medications, cementation errors and loose or broken abutment (49,50).

To prevent these complications, the following should be done: In the treatment of gingival hyperplasia, tartar and bacterial dental plaque should be removed by mechanical cleaning, chlorhexidine should be used, occlusal incompatibilities should be eliminated, excess tissues should be removed by surgery, and the pocket should be eliminated by gum or flap operation (49,50).

#### **c. Periapical Lesion**

Pre-existing residual bone infections, sinus infections, accidental cutting and devitalization of the neurovascular bundle of adjacent teeth, presence of foreign bodies such as root fragments or overflow filling, contamination on the surface while placing the implant, non-compliance with sterilization rules, excessive heat application while placing the implant, and apical bone debris. Etiological factors such as implant abandonment may lead to infections around the implant, and these infections can occur in two ways, symptomatic or asymptomatic.

Periapical implant lesions can result from contamination with the microbial flora of adjacent teeth, surgical errors, and other factors. While active lesions require treatment, inactive lesions can be followed carefully. While minor infections can be treated with conservative surgery, major infections may require radical surgery (1,2,28).

To prevent these complications, the following should be done: To prevent periapical implant lesions, preoperative evaluation, minimally invasive surgery, appropriate hygiene measures and cleaning of microbial foci are important. To reduce the risk of retrograde peri-implantitis, it is recommended not to place the implant in the infected area and to use careful surgical techniques (1,2,28).

#### **d. Progressive Marginal Bone Loss**

After implant placement, collet failure may occur due to reasons such as incorrect placement technique in the early period, use of the implant that applies high pressure to the socket area, sharp bone ends being left and the implant not being fully adapted to the socket during placement, and peri-implantitis in the late period, inadequate cleaning, implant fractures and use of components with insufficient rigidity. Bone destruction can be seen in these areas.

To prevent these complications, the following should be done: Regardless of the extent of destruction, patients should be carefully monitored. If greater than expected destruction is seen on the radiograph during follow-up, it should be evaluated in terms of occlusal trauma, infection, mechanical complication of the prosthesis, or implant fracture. In the presence of inflammation, inflammation should be removed, precautions against infection should be taken, and soft and hard tissue reconstructions and regenerations should be performed when areas of bone destruction are observed (1,2,7,15).

#### **e. Chronic Maxillary Sinusitis**

Displacement of the dental implant into the maxillary sinus may occur as an intraoperative or postoperative complication in the event of incomplete osseointegration of the implant or lack of graft bone maturation. In this case, the displaced implant may distort the anatomy around the maxillary sinus, inhibiting mucociliary function in the sinus membrane and causing symptoms of sinusitis (1,2,15,42,49).

To prevent these complications, the following should be done: Minimally invasive surgical techniques and conservative intraoral surgery are preferred to prevent these complications. While immediate removal of the implant is an important principle, the risk of sinus infection may increase if delayed. Antibiotics, nonsteroidal anti-inflammatory drugs and decongestants can be used to prevent this condition (15,42,49).

**f. Fracture of the Implant**

Factors such as incorrect surgical techniques, faulty prostheses, loosening of connections with prosthetic components, or excessive load due to metal fatigue and parafunction may, although rare, lead to implant fracture. These fractures occur due to biomechanical overload. Bone resorption can weaken the implant, causing increased stress. Factors associated with implant fracture include loosening of prosthetic connections, mechanical overloads, parafunction, and implant design. Fractures usually occur in the molar and premolar regions. Small diameter implants tend to break more easily. The implant can be removed and replaced with a wider and longer implant, but in cases of advanced bone loss, bone grafting or bone augmentation may be necessary first (1,2,15,28,47).

**g. Fistula and Suppuration**

In implant surgery, in cases where good plaque control is generally not performed or in the presence of mobility between the implant body and the superstructure connection, fistula or suppuration may develop as a result of inflammation resulting from the entry of microorganisms through the micro opening between the soft tissue and this mobile area. In these cases, drainage should be provided, antibiotic treatment should be given, and attention to oral hygiene should be recommended (28,42,49,50).

**b. PROSTHETIC AND MECHANICAL COMPLICATIONS AND SOLUTION SUGGESTIONS**

While prostheses become more stable thanks to osseointegrated implants, three main complications generally occur: Implant loss due to deterioration of osseointegration, soft tissue problems and mechanical problems. These complications mostly occur due to measurement and cementation errors, overloading, loosening of implant components, abutment or attachment fracture, and loss of retention (1,2,15,28).

In case of implant or prosthesis breakage, missing parts must be removed. Screw loosening can be resolved with gold alloy support nails. Cantilevers should be designed appropriately, appropriate occlusal load should be provided, broken abutment should be removed and replaced with a new one, and the negative part should be activated in magnetic

systems to reduce retention loss (1,2,15,28).

### **c. AESTHETIC AND PHONETIC COMPLICATIONS AND SOLUTION SUGGESTIONS**

Aesthetic and phonetic complications are related to problems such as bone level in the implanted area, incompatible gum line, and the appearance of the abutment or implant. To prevent aesthetic complications, adequate horizontal and vertical bone amount should be checked during the treatment planning phase. Prosthetic adaptation should be postponed to prevent gingival recession, and if soft tissue manipulations are difficult, the missing soft tissue can be camouflaged with pink porcelain. Soft tissue replantation with connective tissue or free gingival graft may be performed to treat these complications. Additionally, bone regeneration or block grafting can be applied (1,2,15,28).

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