Prevention and management of life-threatening complications during dental implant surgery: a clinical case series

Raid Sadda, DDS, MS, MFDRCSI ■ Aram R. Sadda, DDS, MS

Complications can occur during implant placement; thus, clinicians should be aware of all potential outcomes, and staff members should be fully prepared to respond in case of emergency. A thorough medical history, precise surgical technique, knowledge, and skill are essential to prevent complications. The most serious complications, which could threaten the patient's life, are airway obstruction, bleeding, aspiration of the implant or its parts, infection, cavernous sinus thrombosis, nerve injury, and mandibular fracture.

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The purpose of this case series is to discuss options for prevention and management of complications associated with surgical implant placement. Many of these complications can be resolved without serious problems. However, the most serious complications, which can be life-threatening, are airway obstruction, bleeding, aspiration of the implant or its parts, infection, cavernous sinus thrombosis, nerve injury, and mandibular fracture.

The 4 cases presented in this article were chosen on the basis of the following criteria. First, each case had the potential to threaten the patient's life, either intraoperatively or postoperatively. Selection criteria were based on the severity and urgency of the situation, with an emphasis on hemorrhage, airway obstruction, and cavernous sinus thrombosis (CST). Second, all patients were classified as ASA I according to the American Society of Anesthesiologists system and were otherwise healthy, with no morbidities that would contraindicate implant placement.[1] Third, there were no mortalities as a result of the complications.

Management options for each of these cases, including existing techniques as well as new methods for prevention and management, are described.

Case reports

Case 1

A 62-year-old man was referred to the Department of Oral and Maxillofacial Surgery for stage 2 implant surgery. The patient denied having any significant medical history, and the results of the physical examination were within normal limits. Surgery was performed under local anesthesia (2% lidocaine with 1:100,000 epinephrine).

During the procedure, the implant screwdriver was lost inside the patient's mouth, but he was unsure if he swallowed or aspirated it. The patient was immediately referred to the hospital, where a chest radiograph revealed the screwdriver in the lung (Fig 1). The patient was admitted to the hospital. Under general anesthesia, an attempt was made to remove the screwdriver with a bronchoscope. However, the procedure failed, and open chest surgery was performed. A few days after surgical removal of the screwdriver, the patient was discharged from the hospital and scheduled for regular follow-up visits. No postoperative complications developed.

This patient was unable to determine if he swallowed or aspirated the implant screwdriver. Extreme caution should be taken by clinicians when handling implants and their components inside the mouth. If the implant or its

Fig 1. Case 1. Chest radiograph showing aspiration of a screwdriver in the chest.

Fig 2. Case 2. Insertion of the endotracheal tube. (Courtesy of Dr Ed Miller, Hartsdale, New York.)

Fig 3. Case 2. Computed tomographic scan showing the sublingual and submandibular hematoma.

Fig 4. Case 2. Panoramic radiograph showing 2 implants and the perforation of the lingual plate.

components move from the floor of the mouth to the larynx, acute airway obstruction can result, or the object can settle in the bronchus or lung. Management becomes a burden to the patient and surgeon, leading to further complications that require more extensive treatment.[2]

To avoid this outcome and the consequent complex management, gauze should be placed as an oropharyngeal screen before insertion of the implant or its components. Most implant components accommodate placement of a floss ligature to allow retrieval of the device. Although patients may not be able to identify an aspirated implant component, the operator can use the ligature to retrieve it.

If the patient aspirates an implant or a component, he or she should be referred to the hospital immediately for chest and abdominal radiography to verify ingestion or aspiration and to localize the object. If the components are aspirated, they should be removed within 24 hours; otherwise, bronchoscopy will be more difficult, leading to further chest complications, such as infection. If bronchoscopy is unsuccessful, open chest surgery is necessary to remove the device.

Case 2

A 35-year-old woman was referred to the Department of Oral and Maxillofacial Surgery with a complaint of difficulty breathing. The patient denied having any significant medical history. Physical examination of the floor of the mouth revealed marked erythema and enlargement. The intraoral examination showed signs of a large sublingual hematoma extending to the submandibular region and moderate-to-severe airway obstruction.

The patient was transferred immediately to the hospital intensive care unit. Under sedation, an endotracheal tube was inserted to prevent airway compromise (Fig 2). A computed tomographic (CT) scan revealed a severe sublingual and submandibular hematoma (Fig 3). A panoramic radiograph confirmed perforation of the lingual plate of the left mandible at the site of implant surgery (Fig 4). Monitors were used to record the patient's vital signs, and intravenous antibiotics were administered. Under general anesthesia, an extraoral incision was made, and the hematoma was evacuated through the insertion of multiple drains. The patient tolerated the procedure well. She was discharged from the hospital a few days later and

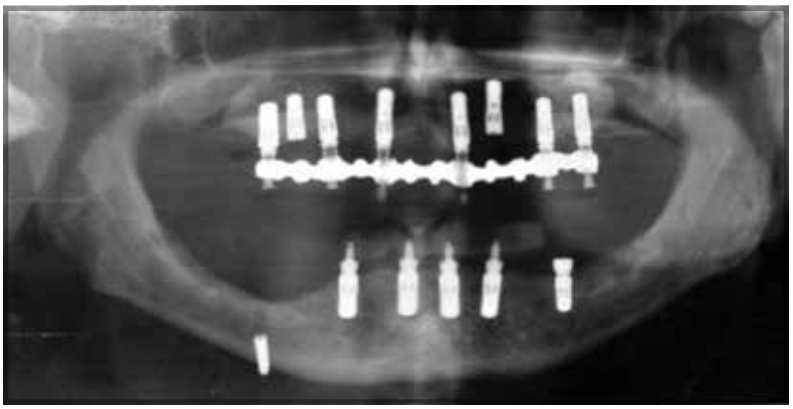

Fig 5. Case 4. Panoramic radiograph showing the implant in the submandibular space.

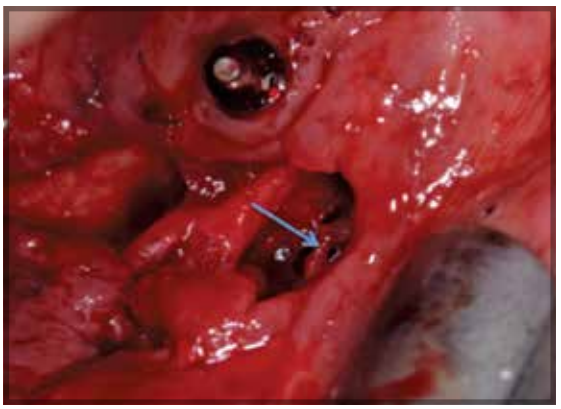

Fig 6. Case 4. Localization of the mental nerve (arrow).

attended regular follow-up visits for further evaluation. No postoperative complications occurred.

The arterial blood supply to the floor of the mouth is formed by anastomosis of the facial and lingual arteries. Intraosseous hemorrhage is not a serious event and can be controlled by compressing the area with a directional indicator, an abutment, or the implant itself.[3] Injury to the blood vessels may occur after surgical manipulation or tearing of the lingual periosteum, and such injuries can lead to severe airway obstruction that requires endotracheal intubation or emergency tracheotomy.[4]

Applying a pressure pack, hemostatic agents, cauterization, digital compression, or ligation of the bleeding vessel can control hemorrhage of ruptured maxillofacial blood vessels. The clinician should avoid making an incision over the hematoma because it may lead to further bleeding. Exploration of the external carotid artery to ligate the lingual or facial artery is contraindicated because of the collateral anastomosis; injury to this area can jeopardize the patient's life.[5] The surgeon must identify and ligate the bleeding artery and then transfer the patient to the hospital without delay to secure the airway.[6]

To prevent life-threatening hemorrhage, it is necessary to expose the lingual plate during surgery or palpate for any perforation of the bone through the soft tissue. If a perforation with severe bleeding is observed during surgery, redirection or removal of the implant is necessary, along with bimanual compression at the site of perforation. If possible, a cone beam CT (CBCT) scan with surgical stent should be used for treatment planning in patients with a narrow mandibular ridge because the correct angle of implant insertion can be calculated, leading to a more predictable outcome. However, implants can be placed without the use of a CBCT scan if the surgeon can visualize the surgical field by reflecting a lingual mucoperiosteal flap.

Case 3

A 38-year-old woman was referred to the Department of Oral and Maxillofacial Surgery for stage 1 surgical placement of a dental implant to replace a missing maxillary right first molar. The patient denied having any significant medical history, and the results of the physical examination were within normal limits.

A panoramic radiograph revealed a distance of 8 mm from the floor of the maxillary sinus to the alveolar crest, indicating the need for a bone graft procedure. Through a crestal approach, a Summers osteotome was used to elevate the maxillary floor for placement of a bone graft and an implant with a length of 10 mm. The procedure was successful, and there were no complications during surgery. No antibiotics were prescribed.

Three days later, the patient returned with a complaint of discomfort and heaviness in the right side of her face. An examination of the mouth showed no swelling or dehiscence of the wound, and a panoramic radiograph revealed a normal sinus. Antibiotics and analgesics were prescribed. Two days later, the patient returned with a unilateral severe headache, erythema of the eye, proptosis, and swelling of the eyelid. The patient was admitted to the hospital and diagnosed with a CST due to infection.

Cavernous sinus thrombosis is an unusual complication that rarely results from an infected tooth or an implant. It is a life-threatening infection that requires aggressive medical and surgical care. However, CST may develop as a consequence of a superiorly spreading odontogenic infection via a hematogenous route. Bacteria from a contaminated implant may travel from the maxilla to the cavernous sinus in 2 ways: posteriorly through the pterygoid plexus and emissary veins or anteriorly via the angular vein and inferior or superior ophthalmic veins.

The clinical signs and symptoms include some or all of the following: redness and swelling of the eyelids, ophthalmoplegia, skin hemorrhage of the nose and eyelid, burning and tingling sensation of the forehead, proptosis, fever, restlessness, and severe headache. A CST is difficult to diagnose from plain film imaging and physical signs. One limitation in diagnosis is the lack of immediate symptoms associated with the infection. In this case, the patient did not have a CST initially but was at great risk of developing one. All follow-up complaints from patients should be taken seriously, and a thorough examination and imaging studies should be performed immediately. Diagnosis depends on the symptoms and clinical signs as well as on careful imaging analysis by experts. Immediate management of a CST requires intravenous antibiotic treatment to prevent the spread of infection.

The greatest obstacle to preventing CST is the lack of a sterile

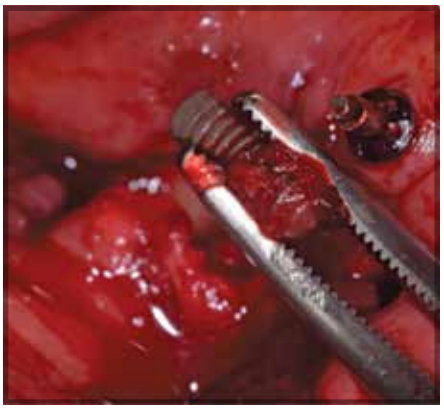

Fig 7. Case 4. Removal of the implant.

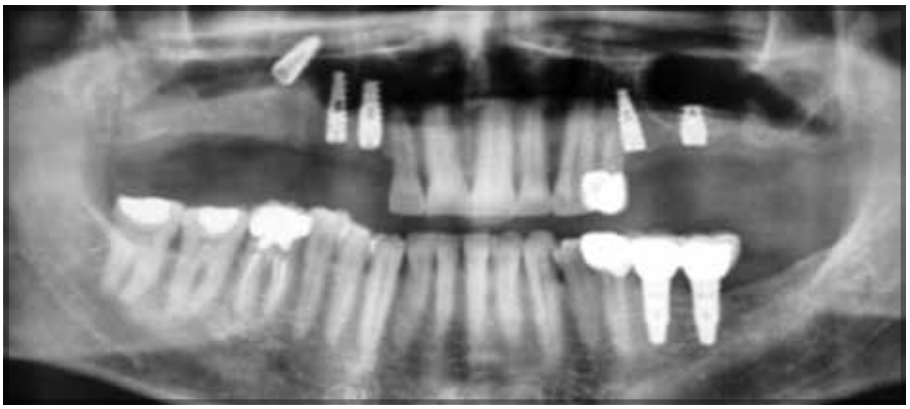

Fig 8. Displacement of the implant into the maxillary sinus during surgery.

field. The oral cavity is not sterile, and, as a result, it is difficult to prevent contamination of the implant and instruments during surgery. The implant and all surgical instruments should be kept sterile until the implant is inserted in the bone. Doing so will greatly minimize the risk of contamination and subsequent development of CST due to infection.

Case 4

A 62-year-old man was referred to the Department of Oral and Maxillofacial Surgery for removal of an implant from the right submandibular space. The implant was displaced to the right posterior atrophic mandible during insertion (Fig 5). The patient denied having any significant medical history, and the results of the physical examination were within normal limits.

Under local anesthesia, a mucoperiosteal flap was raised to localize and protect the mental nerve (Fig 6). The implant was palpated intraorally and extraorally, pushed upward, and then removed with a hemostat (Fig 7). At the 1-week follow-up visit, the patient reported no paresthesia of the lip or tongue, and there was no hemorrhage or airway obstruction.

Direct trauma to the nerve or injury to the blood vessels in the submandibular area could cause paresthesia, severe bleeding, and possible airway obstruction. The major reason for repositioning the inferior alveolar nerve is to prevent injury during implant placement in an edentulous posterior atrophic mandible. In addition, the utmost care should be taken to avoid displacing the implant into the soft tissue or submandibular space. Injury to the lingual artery results in sublingual hematoma and severe airway obstruction. Overpenetration occurs when the lingual or buccal plates are thin, causing the implant to escape the bone marrow and settle in the soft tissue. Immediate removal of the implant is indicated because of potentially fatal outcomes from submandibular space infection and airway obstruction.

When the mandibular width is in question for implant placement, proper radiographic evaluation should take place before surgery. In addition to a panoramic radiograph, a CBCT scan is a great tool for measuring the buccolingual width of the mandible prior to surgery. The appropriate implant size and positioning angle can be calculated, and a surgical stent can be created to guide the operator in proper placement.

Other life-threatening complications

Displacement of the implant into the sinus

A dental implant can easily be displaced into the maxillary sinus in the posterior maxilla during insertion (Fig 8). Immediate implant insertion should be performed only if the residual bone is stable and deep enough to ensure primary stability.[7] When the bone volume and quality are inadequate to support an implant of sufficient length, a bone augmentation procedure of the posterior maxilla should be performed. A wider implant also improves stability and helps to prevent perforation of the maxillary sinus.

A displaced implant in the maxillary sinus can travel farther into the deeper craniofacial cavities, causing an infection, tissue necrosis, and an adverse reaction to the foreign body, along with the risk of foreign body aspiration.[8] Cavernous sinus thrombosis, described in case 3, is the most serious, life-threatening complication.

Excessive force by the operator also can cause implant dislodgment into the maxillary sinus. If this occurs, the implant must be immediately retrieved surgically via an intraoral approach or endoscopically via a transnasal route to avoid inflammatory complications.[9]

Migration of the implant into the sinus

Migration of the implant into the maxillary sinus is uncommon, but it can result in life-threatening complications if it becomes displaced into the cranial cavities. The following mechanisms have been proposed to explain why an implant migrates into the maxillary sinus: changes in intrasinal and intranasal pressure; autoimmune reaction to the implant, causing destruction of the bone around the implant and compromising osseointegration; and resorption produced by an incorrect distribution of occlusal forces.[10]

An implant that has migrated into the maxillary sinus must be immediately removed surgically by means of a Caldwell-Luc or crestal approach or endoscopically via a transnasal approach. The immediate complications are similar to those resulting from surgical displacement of the implant; however, the migration scenario poses a greater risk because the complication will not be detected until the patient is reexamined. This interval allows enough time for the implant to migrate into critical structures.

The migrating implant may exit the sinus and travel into the ostium, leading to the possibility of aspiration; if that occurs, thoracic and abdominal radiographs should be obtained. If the implant has been aspirated, immediate removal is indicated, as described in case 1.

Migration of the implant rarely occurs; thus, prevention strategies are limited. Although clinical findings might suggest shorter reevaluation intervals, determining the indications for them is difficult.

Fatal air embolism during implant surgery

For an air embolism to occur, there must be an open vessel, a gradient between extravascular and intravascular pressure, and a source of air.[10] Bone is vascular, and injection of an anesthetic agent into the periodontal ligament resembles a direct intravenous injection. The intraosseous venous plexus in the mandible gives rise to large veins in the interdental septum. The septal veins drain into the inferior alveolar vein and eventually into the pterygoid plexus. Alternatively, they can drain into the facial vein and, ultimately, the internal jugular vein.

The risk of developing an air embolism increases when the pressure of the extravascular air is greater than the intravascular venous pressure. Implant surgery requires the handpiece to be attached to an implant motor and not to an air compressor. Davies & Campbell reported that 3 patients experienced cardiac arrest during oral surgery and subsequently died.[10] Patients who collapse as a result of an air embolism lose consciousness, rapidly develop cyanosis, lose their pulse, and quickly develop dilating pupils. These complications could be attributed to the handpiece's having delivered a lethal volume of air at the time of surgery. To prevent this complication, the surgeon should not use a pressurized handpiece to drill into the bone or a pressurized air-water syringe to clear debris from the bone or the tooth canals.

Conclusion

Although life-threatening complications are uncommon, dental implant placement is not free of risks. The cases described in this article illustrate some of the complications that can occur. The clinician should be aware of all potential outcomes and ensure that staff members are fully prepared for an emergency. Taking a proper medical history, using a precise surgical technique, and demonstrating the requisite knowledge and skills are essential to prevent complications. Moreover, prompt recognition and proper management of a developing problem are essential to prevent life-threatening outcomes. The patient should be informed of any possible adverse outcomes before implant placement. With the patient's cooperation and assistance of the dental team, such complications will be reduced to a minimum.

Author information

Dr R. Sadda is an associate professor, Department of Oral and Maxillofacial Surgery, New York University College of Dentistry, New York, New York. Dr A.R. Sadda is a resident, Department of Oral and Maxillofacial Surgery, University of Rochester, Strong Memorial Hospital, Rochester, New York.

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