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TREATMENT

Surgical complications in dentistry

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Abstract

Surgical complications during or after dentoalveolar surgery are prevalent. These unforeseen events can occur after and due to the surgical dental procedure. The surgical complications can be effectively managed using several preventive and treatment approaches following a thorough evaluation.

Keywords Oral surgery procedures · Wound infection · Dry socket · Postoperative complications · Foreign body aspiration

Quick reference/description

Surgical complications during or after dentoalveolar surgery are prevalent. These unforeseen events can occur after and due to the surgical dental procedure. The surgical complications can be effectively managed using several preventive and treatment approaches following a thorough evaluation.

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Overview

Treatment modalities	Indications	Application
Review of medical, dental and medication history	Preoperative evaluation to prevent surgical complications and patient preparation To improve treatment compliance To avoid wrong-site surgery To identify risk factors associated with development of complications	Identification of a compromised patient and begin suitable adjunctive therapy
Clinical and oral examination	Preoperative evaluation of the patient's general condition, teeth and the selected surgical site To avoid wrong-site surgery To exclude or diagnose: Tooth or root fracture following extraction Displaced tooth, root fragment or broken instrument Maxillary sinus exposure or oro-antral fistula Aspiration or ingestion of foreign objects Postoperative infection Identification of: Source of bleeding Etiology of swelling Altered sensation or neurodeficit	Recognition of the risk factors that can lead to potential surgical complications Identification of certain patient conditions that can cause difficulty in performing the surgery
Radiographic examination	Preoperative evaluation of the teeth and the selected surgical site To avoid wrong-site surgery To prevent, exclude or diagnose: Tooth, root or jaw fracture following extraction Displaced tooth, root fragment or broken instrument Aspiration or ingestion of foreign objects Oro-antral fistula	To be aware of the risk of potential surgical complications like fractures, maxillary sinus exposure, etc For identifying the location of displaced, aspirated or ingested tooth, root fragments or broken instruments
Patient Referral	To prevent potential surgical complications if the clinician is not confident to perform the surgery In case of surgical complications like displaced, aspirated or ingested tooth or root fragments and broken instruments, and nerve damage	Referral of patients to a suitable specialist can prevent potential complications and enhance patient comfort
Use of proper instruments	To prevent breakage, displacement, aspiration or ingestion of instruments	Instruments should be available, sterilized and carefully examined prior to the procedure to prevent complications

Treatment modalities	Indications	Application
Use of long needles	To prevent breakage of needles during delivery of anesthesia Easy retrieval of the needle in case breakage occurs	All dental local anesthetic procedures can be administered using a long needle and can prevent the issue of uncoverable broken needles
Sedation with nitrous oxide or preoperative oral sedation	Inadequate anesthesia In case of anxious patients or patients with perception issues	Additional sedation can effectively overcome the concern of inadequate anesthesia
Nerve block	Inadequate anesthesia in case of local infection	Nerve blocks can prevent inadequate anesthesia that can occur with local infiltration technique
Use of a posterior pharyngeal curtain/screen/retractor	To prevent: Displacement of tooth and root fragments or broken instrument Aspiration or ingestion of foreign objects	The displaced, fractured or broken tooth fragments or instruments can be caught on pharyngeal screens or retractors and prevent their displacement, aspiration or ingestion
Tooth stabilization	Stabilization of fractured bone segment in case of maxillary tuberosity fracture during tooth extraction of maxillary third molar	The tooth is not extracted and is stabilized in place as it can act as a barrier between the maxillary sinus membrane and oral mucosa
Supporting adjacent structures	To prevent fracture of the alveolar bone	Identifies the potential of alveolar bone fracture and necessitate consideration of an alternative extraction technique
Placement of graft or barrier membrane	For restoration of the site of a small fracture of the alveolar bone	Maintenance of critical alveolar dimensions if an implant restoration is planned
Bronchoscopy	Visualization or removal of aspirated foreign objects	Useful for preventing or managing associated potential respiratory complications
Endoscopic removal	Removal of ingested foreign objects	Useful for preventing or managing associated potential gastrointestinal complications
Application of manual pressure	Control of intraoperative and postoperative bleeding	Plugging of the bleeding source and blood clot stabilization
Placement of resorbable coagulant materials in the socket		Stop localized bleeding, form a scaffold for the developing blood clot and its stabilization
Burnishing of osseous structures		Heat cauterization of bony bleeding sites
Ligation of artery with sutures		Sealing of the bleeding artery
Use of epinephrine		Epinephrine causes vasoconstriction that is effective in controlling bleeding
Use of soft tissue lasers Cauterization of tissue	Control of intraoperative and postoperative bleeding from the soft tissue	Control of bleeding via cauterization of the capillaries and small vessels

Treatment modalities	Indications	Application
Flap procedures	Closure of maxillary sinus exposure or oro-antral fistula	Usually preferred in large perforations (> 5 mm) that require an air–watertight closure to prevent further complications
Meticulous postoperative instructions	To prevent postoperative surgical complications	
Prescription of analgesics	Control of postoperative pain and dry socket-associated pain	Analgesics have a significant placebo effect along with its analgesic effect and are effective in alleviating pain
Cold/ice and warm compresses	Control of postoperative swelling	To control the factors of inflammation and minimize the swelling
Neurological assessment and possible nerve repair	Management of nerve damage, altered sensation and neurodeficit	Some cases of nerve damage or neurodeficit do not require treatment, and the altered sensation normalizes over time In cases of no improvement in altered sensation over time, permanent deficit can be suspected
Removal of the source of infection and/or drainage	Management of postoperative infection	To promote healing and recovery from the infection
Antibiotic therapy		To reduce the microbial load to promote healing, particularly in immunocompromised patients
Obtundant 'dry socket' dressing	Management of pain due to occurrence of dry socket	To keep the patient comfortable till the site heals by secondary intention with pain reduction
Use of chlorhexidine rinse	To prevent: Infection in case of maxillary sinus exposure or oro-antral fistula Soft tissue trauma and laceration Dry socket Removal of food or residual clot debris in case of dry socket	Antimicrobial properties of chlorhexidine reduce the risk of postoperative infections
Use of nasal decongestants	Following maxillary sinus exposure or oro-antral fistula	Promote sinus drainage
Attempts to re-establish contact with patients lost to follow-up	For follow-up care in case of a biopsy or dry socket dressing left in place	Effective from documentation perspective

Materials/instruments

- Long anesthetic needles
- Nitrous oxide
- Bone grafting material
- Barrier membrane

- Gelfoam® (Absorbable gelatin sponge)
- Antibiotics
- Nasal decongestants
- 0.12% chlorhexidine rinse
- Gauze
- Dental floss
- Saline
- Curette
- Ball burnisher
- Surgicel®
- Oxycel®
- Bovine purified collagen
- Epinephrine
- Electrocautery
- Analgesics
- Compresses
- Tea bag
- Soft tissue laser unit
- Silver nitrate
- Hemodent®
- 'Dry socket' dressing

Procedure

Surgical complications are unanticipated events that can occur due to a surgical procedure. Any dentoalveolar surgical procedure can lead to surgical complications. The complications can develop during or after the procedure has been completed and should be effectively managed for an uneventful recovery. A meticulous evaluation is necessary to implement the various preventive and treatment modalities available for the management of surgical complications. Surgical complications can be managed preoperatively, intraoperatively or postoperatively depending on the time of development of the events.

Review of the medical, dental and medication history

The aim of a thorough preoperative anamnesis of an individual's medical, dental and medication experiences is to identify a compromised patient and initiate suitable adjunct therapy. Medically compromised individuals are increasingly associated with the development of postoperative complications. The various issues that should be identified while obtaining a patient history include:

- Past and present illnesses
- Current medications
- Allergies

- Tobacco use
- Possible requirement of premedication prior to dental treatment
- Chief complaint of the patient
- Past dental conditions and treatment

Various systemic diseases like cardiovascular diseases, hypertension, hypotension, bleeding or clotting disorders and respiratory disorders can affect an individual's treatment. Certain medications or herbal supplements can contribute to prolonged bleeding. Special conditions like pregnancy, HIV/AIDS infection, active tuberculosis or hepatitis carriers can alter the treatment plan. Reviewing the patient's history and records is also important to prevent wrong-site surgery. In case of postoperative complications like excessive bleeding, an assessment of the medical history for current use of medications that can prolong bleeding is essential.

Clinical and oral examination

A complete clinical and oral examination should be performed to identify an individual's overall condition including the patient's capacity to adequately open the mouth to gain access to the suspect teeth, the patient's mental and emotional status and attitude, and the level of cooperation. A preoperative clinical and oral examination prevents wrong-site surgery by confirming the patient and the involved teeth prior to surgery.

Continuous intraoperative and postoperative monitoring of vital signs is essential as transient hypertension can be induced by pain and anxiety. Intraoral jewellery should be removed prior to any dental procedure. Preoperative oral examination can identify the risk factors associated with potential surgical complications and aid in their prevention or effective management following procurement of informed consent.

Following extraction of a tooth, a thorough examination should be carried out to ensure that the entire root is extracted. Tooth fractures, bone fracture, displacement of tooth, root or broken instruments, maxillary sinus exposure and aspiration or ingestion of foreign objects are potential surgical complications. In case of suspicion of the aforementioned complications, a meticulous clinical and oral examination should be performed as follows:

– First, remove everything from the oral cavity.
– Spread out the posterior pharyngeal curtain/screen and its inspection.
– Complete oral examination using an appropriate light and suction, particularly below the tongue.
– Careful palpation of the alveolar ridge in the region of extraction.

Dental procedure aspiration is the second most common cause of foreign body aspiration in the lung. Aspiration can lead to respiratory compromise or complete airway blockage, while ingestion can cause bowel obstruction, abscesses, fistula or

perforation. In case of aspiration or ingestion of foreign objects, the patient should be monitored and inspected closely for any clinical signs and symptoms.

Careful observation is also required to recognize the source of bleeding in case of excessive intraoperative bleeding by evacuating the saliva, visible blood and blood clots. In case of an inordinate amount of swelling, careful examination should be performed to ensure that the swelling is due to surgical trauma edema. A diligent clinical examination is essential to diagnose the source of postoperative infection or dry socket. Intraoral examination in oro-antral fistula cases commonly exhibits a mucosal perforation at the extraction site. Air leakage with or without purulent discharge can be observed following a Valsalva maneuver performed by the patient.

Radiographic examination

The region of the involved teeth should be sufficiently radiographed before the dental procedure. It is beneficial to visualize the roots of the involved teeth, any restorations, and adjacent teeth. Preoperative radiographic evaluation facilitates the determination of risk factors that can lead to potential surgical complications like tooth, root and jaw fractures, maxillary sinus exposure and nerve damage. The risk of jaw fracture increases when a large radiolucency is present in association with the involved tooth on a radiograph. It also helps to avoid wrong-site surgery.

In case of tooth, root or jaw fracture, displaced tooth or root fragments or broken instruments or aspirated or ingested foreign objects, a radiographic examination is of paramount importance to determine the location of the fracture, tooth or root fragment and displaced, aspirated or ingested foreign objects. If displaced foreign bodies are not detected on a clinical examination, obtaining a dental radiograph is prudent. Initially, a panoramic radiograph can aid in locating the missing tooth/fragment. Additional films are needed for accurate object localization in various dimensions.

Following aspiration or ingestion of foreign objects, radiographic examination of the thorax and abdomen by lateral and postero-anterior views is essential to determine aspiration or ingestion in a stable patient. The patient should be adequately informed and reassured. In case of an oro-antral communication, discontinuity of the maxillary sinus floor can be confirmed on a dental radiograph.

Patient referral

The patients should be referred to a specialist if the dental treatment required is beyond the scope of the clinician's competency and comfort, and to prevent potential surgical complications. Patient referral to a specialist is essential in case of a risk of jaw fracture, nerve damage or maxillary sinus exposure for prevention. If these complications occur, the patients should be recommended to a specialist immediately for their effective management.

Immediate referral to a specialist is necessary in case of foreign body displacement into the inferior alveolar canal, lingual space, maxillary sinus or similar regions as the displaced fragments can shift into the deeper spaces of the head and neck, and can lead to life-threatening infections. In case of altered sensation due to

surgical nerve damage that does not improve within 2 weeks, referral to a specialist for advanced evaluation and possible nerve repair procedure is considered prudent.

Use of proper instruments

The instruments required for dental procedures should be examined for sharpness and wear or fragility to prevent complications like broken instruments that can be displaced, aspirated or ingested. The instruments should be sterilized and easily available prior to the procedure. Soft tissue laceration or puncture can be prevented using sharp instruments and performing vertical relaxing incisions.

Use of long needles

Long needles should be used to prevent complications associated with broken anesthetic needles as a long needle does not penetrate into the tissue to the hub while administering local anesthesia. In case of needle breakage, an adequate length of the long needle is available for the clinician to grasp the broken end of the needle with a hemostat for its removal. To prevent the complication of uncoverable broken needles, the use of short anesthetic needles should be avoided.

Sedation with nitrous oxide or preoperative oral sedation

The most prevalent anesthetic concern encountered by a clinician is inadequate anesthesia. It frequently occurs in the mandible and is commonly related to the technique of anesthesia due to anatomic variation, incorrect technique and inadequate time allowed for anesthetic effect. Inadequate anesthesia can also be subjective due to problems of patient perception. Additional nitrous oxide sedation or preoperative oral sedation is usually helpful in such cases.

Nerve block

The presence of infection in the area of local anesthesia administration can result in inadequate anesthesia due to altered local pH. A nerve block instead of local infiltration anesthesia can be used to overcome this concern if the site of nerve block is at an adequate distance from the infection site to avoid the effect of tissue pH. In such cases, local infiltration anesthesia can be administered using an anesthetic agent with a more favorable pKa like mepivacaine.

Use of a posterior pharyngeal curtain, screen or retractor

A posterior pharyngeal curtain or screen is used to prevent displacement, aspiration and ingestion of tooth and root fragments or broken instruments. There is an increased risk of aspiration or ingestion of foreign objects in:

- Young children under 2 years old
- Elderly, sedated, inebriated, mentally impaired or traumatized with loss of consciousness individuals
- Individuals with functional impairment of swallowing
- Denture wearers
- Patients under local anesthesia or seated in a supine or semi-recumbent position

In such cases, placement of a pharyngeal screen using a 4×4 inch piece of gauze posterior to the surgical site can prevent aspiration or ingestion by covering the oropharynx (Fig. 1). Additionally, the patient's position can be adjusted to a more upright position. In case of tooth or root fractures or broken instruments with a posterior pharyngeal curtain, the screen should be removed from the mouth, spread out and inspected for the broken fragments. Small instruments can also be fastened to a long length of floss that hangs out of the mouth to permit easy instrument retrieval.

Tooth stabilization

Perforation of the maxillary sinus is prevalent during extraction of maxillary posterior teeth. Maxillary tuberosity fracture can occur while extracting a third molar. In such cases, the planned tooth extraction is discontinued, and the fractured bone segment is stabilized by fixating the tooth to be extracted to the adjacent tooth using composite resin. To use this approach, alveolar bone fracture should be detected while the bone is still attached to the periosteum.

Supporting adjacent structures

Alveolar bone fractures can be mostly prevented by placing the thumb or fingers of the non-dominant hand along the alveolus of the tooth to be extracted while using elevators or forceps. It can also facilitate in determining the potential of alveolar fracture, thereby warranting consideration of an alternative technique of extraction.

Fig. 1 Pharyngeal curtain

Placement of a graft or barrier membrane

In case of alveolar bone fracture, its management depends on the restorative plan following tooth extraction. If an implant restoration is scheduled, placement of a bone grafting material or a barrier membrane should be considered for the maintenance of critical dimensions of the alveolar bone.

Bronchoscopy

In case of aspirated foreign objects like tooth or root fragments, broken instruments, dental prosthesis or impression material, an emergent bronchoscopy should be performed for visualization and retrieval of the foreign objects. Broken dental instruments should be pieced together to ensure retrieval of all lost components.

Endoscopic removal

Endoscopic removal is indicated in case of ingested foreign objects like tooth or root fragments, broken instruments, dental prosthesis or impression material (Fig. 2). An

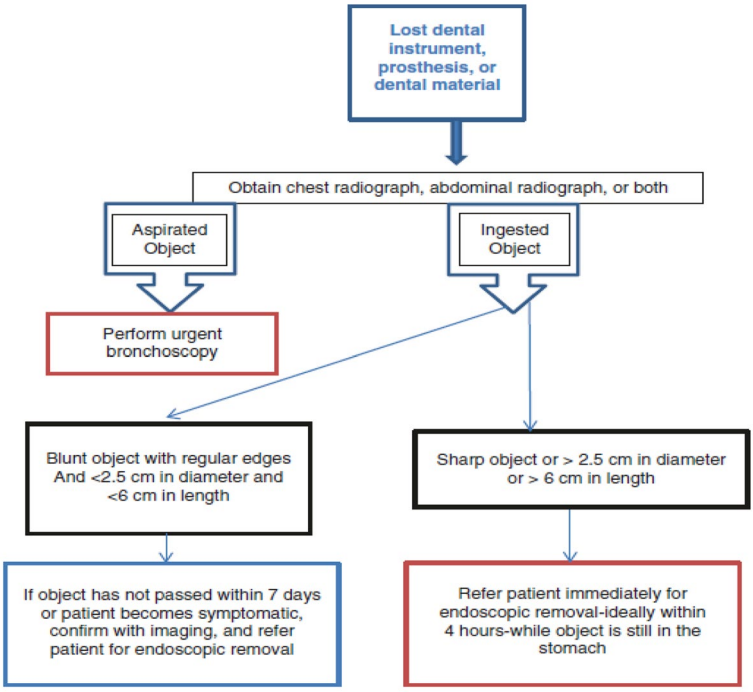

Fig. 2 Algorithm for the evaluation and treatment of aspirated or ingested objects. Adapted from Abusamaan M, Giannobile WV, Jhawar P, Guaratnam NT (2014). Swallowed and aspirated dental prostheses and instruments in clinical dental practice

emergent endoscopy is particularly performed in case of a sharp object, an object >2.5 cm in diameter or an object >6 cm in length. It is also performed if a blunt object with regular edges and size <2.5 cm in diameter or <6 cm in length has not passed within 7 days or the patient becomes symptomatic.

Application of manual pressure

Application of manual pressure is used to control intraoperative and postoperative bleeding by covering the bleeding source and stabilizing the blood clot. The patient is seated in an upright position and pressure is applied by placing 2×2 inch folded piece of gauze in the socket and instructing the patient to bite down on the gauze firmly for a minimum of 15 min. The socket is then re-examined for bleeding. The frequency of gauze pack changes should also be noted.

Alternatively, a 4×4 inch folded piece of gauze, saturated with saline, can be placed into the socket and held in place for a minimum of 5 min. If bleeding persists, the same technique can be repeated for a longer duration of time. Ensure proper placement of the pressure pack and maintenance of constant pressure. An excellent substitute for using a gauze piece is a wet tea bag. The tannic acid present in the tea can act as an astringent or coagulation agent.

Placement of resorbable coagulant materials

Resorbable coagulant materials can be placed in the socket to aid in coagulation if bleeding persists despite application of manual pressure. Various materials like Gelfoam® (absorbable gelatin sponge), Surgicel® (resorbable oxidized regenerated cellulose), Oxycel® (resorbable oxidized cellulose) or Hemodent® (buffered aluminum chloride epinephrine-free hemostatic liquid) in a resorbable carrier can be packed into the bleeding site and covered with sterile gauze to facilitate the coagulation process.

These coagulant materials control localized bleeding and aid in clot formation. In some cases, the Gelfoam® can be saturated with topical thrombin and placed in the socket to act as a framework for the developing blood clot. It is held in place by a resorbable suture and pressure application using gauze. For clot stabilization by facilitating platelet adhesion and aggregation, bovine purified collagen can also be used.

In case of small maxillary sinus perforations of less than 3 mm, no intervention is required. Moderately sized perforations of 3–5 mm can require minimal intervention like placement of a Gelfoam® plug that is maintained in place by a 'figure-8' suture to approximate the margins of the oral mucosa to act as a barrier between the oral cavity and the sinus.

Burnishing of osseous structures

Instruments like a ball burnisher or dental curette can be used to burnish the osseous structures in case of bleeding from the bone.

Ligation of artery with sutures

Resorbable sutures can be used to ligate a bleeding artery.

Use of epinephrine

In case of bleeding from the soft tissue, careful injection of local anesthesia containing epinephrine (vasoconstrictor) is recommended directly into the bleeding site. The bleeding may recur once the epinephrine has worn off.

Use of soft tissue lasers

Soft tissue lasers can also be used to control intraoperative and postoperative bleeding from the soft tissue by cauterization of the bleeding capillaries and small vessels.

Cauterization of tissue

Tissue cauterization, using electrocautery units or chemical agents like silver nitrate, can be performed for the management of intraoperative and postoperative bleeding. Adequate local anesthesia should be obtained before using electrocautery. Bone bleeding can also be controlled through heat cauterization using a heated instrument.

Post-extraction instructions

Postoperative instructions should be simple and easy to understand. These should be provided meticulously in verbal and written form.

Prescription of analgesics

Analgesics are usually prescribed for unanticipated high intensity of postoperative pain. Requirement of analgesics (A) in patients with postoperative pain is evaluated using a formula ($A = H + I + S$) that depends on:

- Medical history of the patient (H) that involves drug allergies, ongoing medications and organ function
- Patient's interpretation (I) of the pain stimulus
- Stimulus (S) of the procedure that involves the difficulty, duration and complexity of the procedure

A large amount of the effect of an analgesic is placebo in nature. The aforementioned formula provides an evidence-based method for prescribing analgesics

and is useful to avoid opioid abuse. Analgesics can also be prescribed for pain associated with dry socket along with anti-inflammatory medications.

Cold/ice and warm compresses

Postoperative swelling is a prevalent surgical complication. In case of postoperative swelling, the patients are advised to use cold/ice compresses for the initial 24–48 h to reduce the swelling. After 48 h, the use of warm compresses is advised to minimize the swelling.

Neurological assessment and nerve repair

Nerve damage can occur following any surgical procedure like flap elevation, biopsy, or surgical third molar removal etc. In case of neurodeficit or altered sensation post-surgery, a neurological evaluation should be performed. A thorough neurological examination should also be conducted following damage to the inferior alveolar nerve or the lingual nerve during third molar extraction. If the patient's condition does not improve after 2 weeks, a nerve repair procedure should be considered.

Removal of the source of infection or drainage

Postoperative infections can usually occur 3–4 days following any dental surgical procedure. The initial treatment includes removal of the source of the infection or drainage of the infection to promote healing.

Antibiotic therapy

In immunocompromised patients or in patients with widespread infection, antibiotic therapy should be considered for the management of postoperative infections. Prescription of antibiotics (A) in patients for postoperative infection should be based on the formula ($A = S + H + O$) that depends on:

- Presenting signs and symptoms of the patient (S)
- Patient's past and current medical history (H)
- Most-likely infection causing organism (O)

Broad spectrum antibiotics, like amoxicillin or amoxicillin and clavulanate potassium, are usually prescribed following surgical closure of moderate- or large-sized oro-antral communications.

Obtundant 'dry socket' dressing

Alveolar osteitis also known as dry socket is an acute inflammation of the bone surrounding an extracted tooth. In patients with dry socket, the characteristic symptom

is severe pain that increases or radiates. The aim of the treatment for alveolar osteitis includes enhancing the comfort of the patient till the extraction site heals by secondary intention and soft tissue covers the exposed bone.

Initially, the extraction site is cleaned to remove the residual clot and food debris. A 0.25 inch wide piece of gauze (length as required}, containing an obtundent medication like eugenol, is packed into the cleaned extraction socket. Several 'dry socket' dressings are commercially available. The frequency of dressing change is every 1–3 days for duration of 7–10 days. In apprehensive and sensitive patients, the treatment of dry socket can require local anesthesia.

Use of chlorhexidine rinse

Chlorhexidine 0.12% rinses pre- and postoperatively reduce the risk of development of postoperative infections and alveolar osteitis. Substantial irrigation with chlorhexidine and saline can be performed for improved visualization and patient comfort during flap elevation and to clean the sites of dry socket. Chlorhexidine mouth rinse is also prescribed in case of surgical closure of an oro-antral fistula as an adjunct to prevent postoperative infection.

Use of nasal decongestants

Nasal decongestants are commonly used following the closure of maxillary sinus exposure. These are often combined with the use of chlorhexidine mouth rinses and antibiotics.

Flap procedures

Various flap procedures are used for the closure of oro-antral communications and to retrieve displaced tooth fragments or broken instruments. An envelope flap can be elevated to retrieve foreign objects that get displaced into the alveolar plate.

An airtight or watertight closure is required for the surgical management of an oro-antral fistula. This type of closure warrants a flap procedure in case of large perforations of more than 5 mm in size. It is important to understand that the underlying bone defect is larger than the mucosal defect. Various flap procedures can be performed for oro-antral communication closure like:

- Buccal mucosal advancement flap
- Palatal rotational flap
- Buccal fat pad flap

Buccal mucosal advancement flap

A buccal mucosal advancement flap is the most prevalent method of oro-antral fistula closure. The flap is elevated by performing vertical relaxing incisions anteriorly and posteriorly that are connected by an alveolar crestal incision with inclusion of the

mucosal fistula opening. To permit stretching of the mucosa, the periosteum is scored in a horizontal manner. It is essential to remove the entire fistulous tract before closure. The free margin of the buccal flap is sutured to the palatal mucosa for achieving a proper seal. To ensure an appropriate closure, the patient is then advised to perform a light Valsalva maneuver.

Sinus precautions like avoiding blowing of the nose and avoiding the Valsalva maneuver, meticulous oral hygiene measures and close patient monitoring are required following surgical closure of maxillary sinus perforations.

Attempts to re-establish contact with patients lost to follow-up

Attempts should be made to re-establish contact with patients lost to follow-up particularly after surgical dental procedures. These attempts should be updated in the patient's records and are essential for documentation purposes.

Pitfalls and complications

- Frequent changing of gauze packs while applying manual pressure to control bleeding can cause aggravation by impairing the coagulation process.
- Rebound hemorrhage can occur with the use of epinephrine.
- Use of electrocautery for cauterizing tissue releases a noxious odor.
- Crushing of the alveolar walls to control bleeding from the bone can potentially lead to a larger bleeding site.
- Excessive/uncontrolled pressure on the extraction site in the posterior maxilla can lead to a sinus communication.
- Pressure or the use of chemical agents on the neurovascular bundle can cause nerve damage.

Further Reading

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