



WINSPERT

**ORAL SURGERY**

**H.O.T**

**HIGH-PRIORITY ORGANISED THEORY**

**NOTES**

By Dr. Jigyasa Sharma





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Thank you for your understanding and continued dedication.

Best regards,  
WINSPERT TEAM

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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

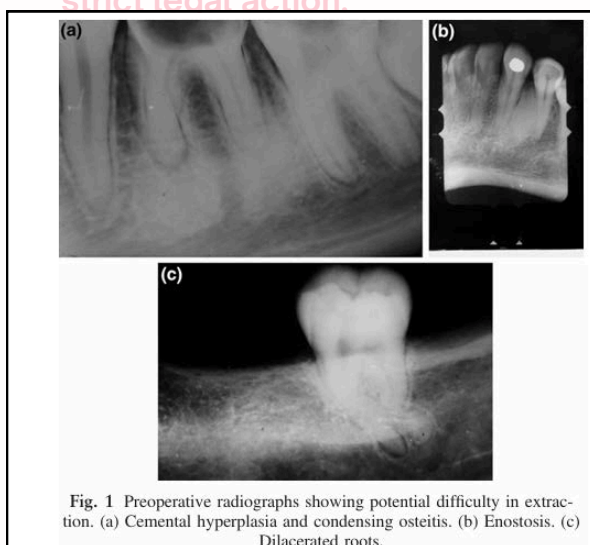
(Sources: Contemporary exodontia (ADJ), Dental extraction in a patient with undiagnosed Von Willebrand's Disease: a case report (ADJ), Principles of Exodontia Part 4 Dr. Hamid Hammad Enezei)

- Exodontia is a cardinal skill of all dentist and Patients expect extractions to be skillfully and painlessly accomplished every time.
- However, Extractions are not necessarily simple and can be challenging.
- All surgical procedure requires careful consideration of the harm and benefits which requires a full diagnostic process of history and examination and special tests.

**Table 1. Harm benefit analysis for surgical procedures – Exodontia**

	Benefit	Harm
Procedure performed		
Exodontia	control pain resolves problem	incomplete procedure dry socket damage
Procedure not performed		
No Extraction	saves tooth avoids procedure avoids complications	spreading infection later complications

- Pre extraction radiographs will confirm the diagnosis and indicate factors of potential difficulty. Pulpal sensibility and assessment of the periodontium can be invaluable additional pieces of information.



**Fig. 1** Preoperative radiographs showing potential difficulty in extraction. (a) Cemental hyperplasia and condensing osteitis. (b) Enostosis. (c) Dilacerated roots.

### Objective of Exodontia

- To remove the whole tooth whilst preserving the alveolus for future prosthetics or implants.

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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

Consideration of tooth for extraction should be done at:

### i. At the level of the individual tooth:

- The decision to extract tooth is straightforward in presence of gross decay, advanced periodontal disease and fracture.
- It is mandatory that a proper history and examination are undertaken to exclude referred pain from cramped masticatory muscles or sinus disease as causes of maxillary tooth pain.
- Trigeminal neuralgia also mimics tooth ache which should be carefully diagnosed.
- Dentists should not take out teeth on the insistence of patients in the absence of a clear-cut diagnosis.
- A surgeon who removed a normal body part because the patient demanded it would justifiably be sued.
- If the patient returns and demands another extraction or root filling because the pain is still there, they mandatorily need to be carefully reevaluated or referred for advice.

### ii. At patient's mouth

- Common indications for extraction of normal teeth, but at a mouth level, include orthodontic extractions where there is a tooth size/jaw size discrepancy or as part of a prosthodontic plan.

### iii. Overall patient's health

- Management of oncology patients does sometimes involve the extraction of compromised but individually savable teeth for patients undergoing head and neck radiotherapy or chemotherapy including intravenous antiresorptive agents.
- Only looking at individual tooth level is a common failing and should not be done.

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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Technique for extraction:

- After the decision to extract the tooth is made, the initial concern is pain control for the procedure.
- **Multiple choices are available for pain control:**
  - i. local anesthesia (LA)
  - ii. LA + oral sedation
  - iii. LA + IV sedation in rooms or in hospital or day stay general anesthetic (GA).
- A harm/benefit analysis needs to be applied to each and **most commonly local anesthesia** is the technique employed but this is not without complication.
- To facilitate the extraction of tooth without much damage to the alveolus, fine periostomes are used. Fine periostomes which are carefully inserted down the periodontal membrane to split it and gently expand the socket.

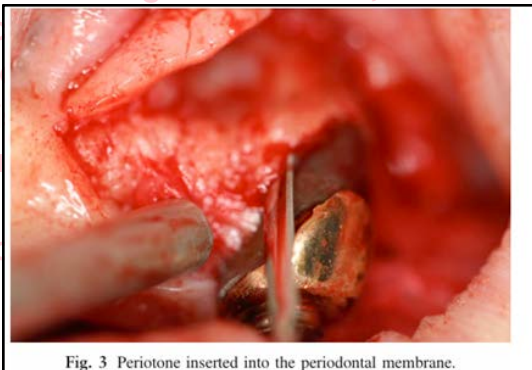


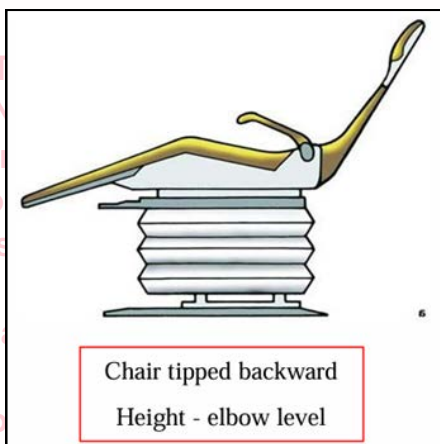
Fig. 3 Periostome inserted into the periodontal membrane.

### Position of Chair and dentist during extraction:

#### A) Chair position:

##### i. For maxillary teeth:

- The chair should be tipped backward so that when the patient opens his mouth the occlusal plane is at an angle of about 60 degrees to the floor.
- The height of the chair should be in such a way that patient's mouth is at or slightly below the operator's elbow level.



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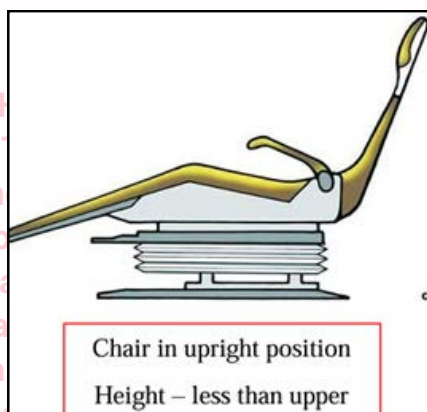
## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Position of Chair and dentist during extraction:

#### A) Chair position:

##### ii. For Mandibular teeth:

- The chair should be in more upright position so that when the patient opens his mouth, the occlusal plane is parallel to the floor.
- The height of the chair should be lower than for upper teeth which provide stable comfortable position.



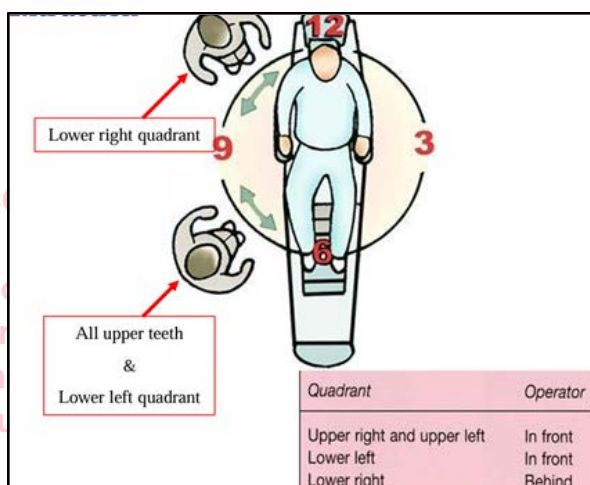
#### B) Position Of Dentist:

##### i. For maxillary teeth:

- For all maxillary teeth (left & right) the dentist should stand in front of the patient and to the right side during the extraction.

##### i. For mandibular teeth:

- For left quadrant, the dentist should stand in front of the patient to the right side. (For right-handed operator)
- For right quadrant, the dentist should stand behind the patient in the right side.



#### Note:

- 1 These positions are for a standing, right handed dentist, while for seated position or left handed dentist modifications required.
- 2 During extraction the left hand plays an important role in
  - A- Providing support and stability for the alveolar process and the jaw.
  - B- Provide tactile information to the surgeon regarding the progress of extraction.
  - C- Reflection of the soft tissues like lip, cheek, or tongue.

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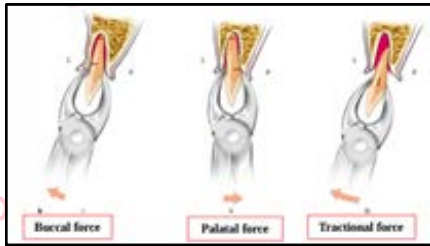
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# EXODONTIA - PROCEDURE, RISK AND COMPLICATION

## Movement of tooth:

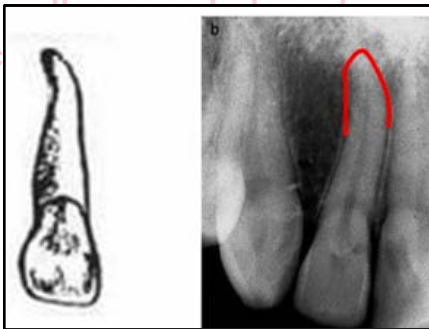
### 1. Maxillary Central Incisors:

- The initial movements are in a labial direction, and then palatal. Since the root is conical in shape, rotational forces are applied and the final extraction force is applied labially.



### 2. Maxillary lateral incisors:

- The same technique as for central incisors, the difference is that the extraction movements are labial and palatal only without rotational force because it has curvature of the root tip palato-distally.



### 3. Maxillary canine:

- The extraction technique is the same for lateral incisors with some degree of difficulty due to:
  - Their firm anchorage in alveolar bone.
  - The roots are long with frequent curvature of the root tip.
  - The labial surface of the root is covered by thin alveolar bone, so there is a risk of fracturing the alveolar process.

### 4. Maxillary premolar:

- For the **first premolar**, because it usually has two roots, buccal and palatal pressure should be gentle and slight. If movements are vigorous and abrupt, there is a risk of fracturing the root tips. Rotational motions are not allowed due to the tooth's anatomy.
- For the **second premolar** the extraction is easier, because the tooth mostly has one root.
- The final movement for both teeth is buccal.

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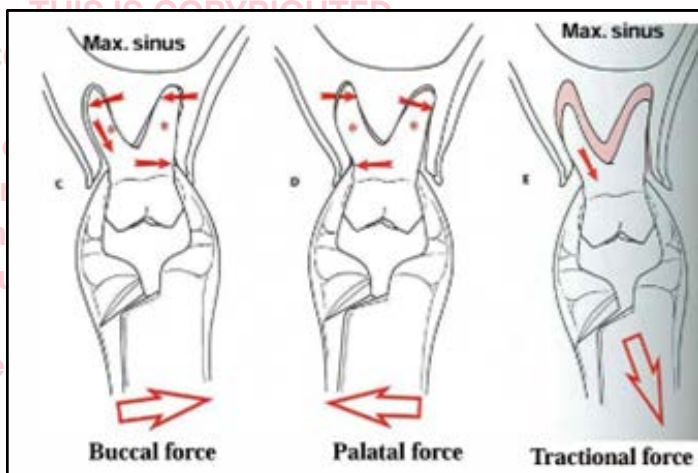


## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Movement of tooth:

#### 5. Maxillary First Molar:

- The maxillary first molar has three diverging roots, and the tooth is firmly anchored in the alveolar bone, therefore this tooth requires the application of strong force during its extraction, which may cause fracture of the crown or root tips.
- To avoid tooth fracture, initial movements must be gentle, with bucco palatal pressure and an increasing range of motion, especially buccally, where resistance is less. The final extraction movement is a buccal curved motion.



#### 6. Maxillary second molar:

- The same as for maxillary first molars because the teeth have similar anatomy, however, it is easier because of little divergence of the roots and quite often are fused together in a conical shape.

#### 7. Maxillary Third molars:

- If the third molar has erupted completely its extraction is accomplished by applying buccal pressure and very gentle palatal pressure. Root anatomy of the third molar may permit extraction using elevator only. The elevator is positioned in the mesio-buccal corner.

#### 8. Mandibular incisors and canines.:

- Extraction of mandibular incisors is easy, due to their morphology (narrow, single roots) and the thin labial alveolar bone surrounding the root.
- Mandibular canines are more difficult to extract compared to incisors, due to the long root and frequent curvature of the root tip.
- Pressure is applied labially and lingually, gradually increasing in intensity, only slight rotational force is permitted. The final extraction movement is outwards and downwards (to avoid damaging opposing teeth)

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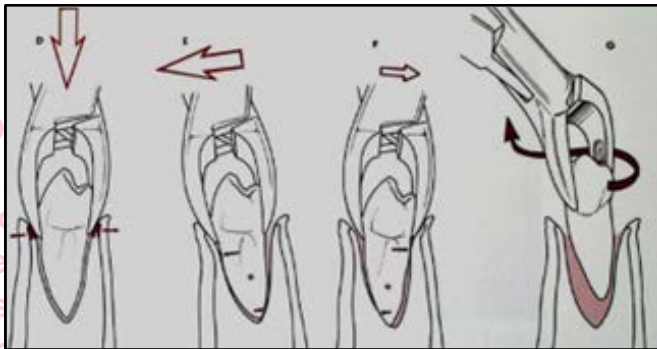
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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Movement of tooth:

#### 9. Mandibular Premolars:

- Premolar extraction is considered quite easy because their roots are straight and conical.
- Buccolingual force is applied for extraction of these teeth. Gentle rotational force may also be applied.
- The final extraction movement is outwards and downwards.

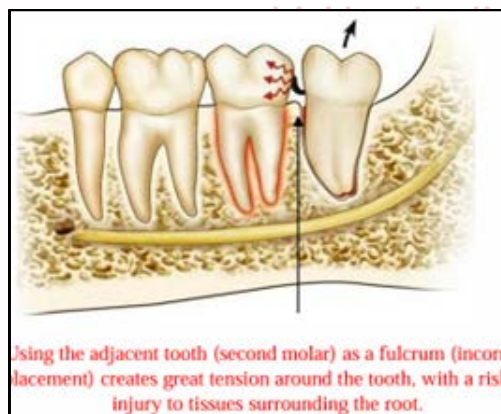
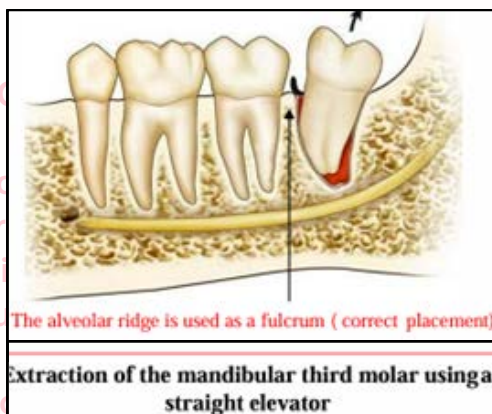


#### 10. Mandibular molars (First and second)

- The mandibular second molar has a morphology similar to that of the first molar, but its removal is more easily than the first molar, because its roots are smaller and less divergent.
- Initially the movements are gentle with buccal and lingual pressure. After the tooth is slightly mobilized, force is gradually increased and the final extraction movement is buccal (outward & downward).

#### 11. Mandibular Third molars:

- Buccolingual pressure is applied, but since the lingual alveolar bone is very thin compared to the buccal alveolar bone, therefore, the force that mobilizes the tooth must be more in the lingual direction.
- If the third molar has one root or if the roots converge, the extraction may be accomplished using the straight elevator alone.



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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Movement of tooth:

#### 12. Extraction of deciduous tooth:

- The forceps used to extract deciduous teeth are small and have narrow beaks.
- The extraction technique is similar to that used for permanent teeth and it is much easier, especially if their roots are resorbed.
- The beaks of the forceps must be positioned on the mesial or the distal area of the tooth and not the center (root bifurcation), underneath which is the permanent tooth to prevent damage to tooth bud.

### Complications of Exodontia:

- Complications are unforeseen and unexpected adverse sequelae from a surgical procedure.
  - A patient who bleeds after an extraction but has a known bleeding diathesis is not really a complication but a failure of planning.
  - Mandibular fracture after an attempt at elevator only extraction of the molar, in an elderly patient, with a grossly atrophic jaw, is a failure of planning and consent
1. The **most common complication** of exodontia is alveolar osteitis or **dry socket**. Here, common condition the blood clot undergoes fibrinolysis and the bony walls of the socket become exposed. This is a painful but self-limiting condition which resolves in 2–3 weeks. The incidence is 3–5% of extractions with risk factors being traumatic extraction, smoking, posterior teeth and mandible more than maxilla, but it is usually unpredictable.
  2. Penetration into or loss of tooth roots into the sinus must always be considered in the extraction of posterior maxillary teeth.
    - After extraction of such teeth check carefully that they are complete. Check for the presence of an oro-antral communication by holding the patient's nose and getting them to blow, listen for any passage of air or bubbles.
    - If the tooth is intact and the communication small, compress the socket and suture closed. Tell the patient not to blow their nose or create a negative pressure. Discuss fully with the patient the reason for this sometimes-distressing complication. If the communication is large, more than 4 mm or a piece of tooth is missing, promptly refer to an Oral and Maxillofacial Surgeon (OMS).
    - A two-layer mucoperiosteal flap with a buccal fat pad graft is useful for large communication.
  3. Tooth or root displacement, beyond the alveolus into the soft tissues, is usually a sign of excessive or misdirected force, don't ignore this as the probability of infection is high.
    - Promptly refer to an OMS for imaging to localize the tooth and retrieve it.

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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Complications of Exodontia:

4. If the tooth breaks or can't be removed and this should be considered as a failure of the decision-making process as much as a technique failure. Most experienced surgeons often start out an extraction as a surgical procedure, raising a mucoperiosteal flap and sectioning the tooth as this provides much greater control and is more swifter and less pressure is required.

5. If a root tip fractures:

- Firstly, consider leaving it there if it is vital, less than 5 mm and in proximity to a vital structure such as a nerve.
- If you can, remove it through a small bony window by maintaining alveolar bone height.

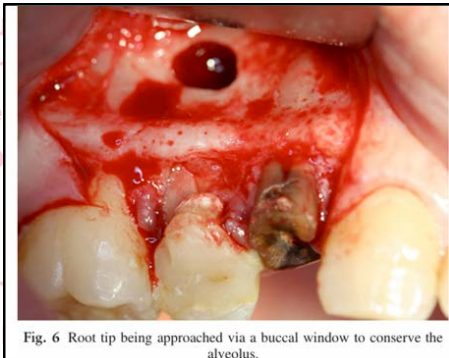


Fig. 6 Root tip being approached via a buccal window to conserve the alveolus.

6. Hemorrhage can be a challenging complication to manage. This is particularly relevant in patients with undiagnosed or underlying bleeding disorders.

- Bleeding disorders or coagulopathies can be classified as congenital or acquired.
- Congenital coagulopathies are typically related to genetic disorders, such as hemophilia and vonWillebrand Disease (vWD).
- Acquired conditions are often secondary to the use of anticoagulant/antiplatelet medications or systemic diseases.
- While acquired coagulopathies may be identified by taking a comprehensive medical history, congenital disorders often remain undetected in asymptomatic individuals.
- Von Willebrand Disease is the most common inherited bleeding disorder in humans.
- The importance of screening for bleeding disorders if any hemorrhagic activity occurs is well known.
- To control a hemorrhagic activity following can be done:
  - i. Direct pressure with non-resorbable gauze remains the gold standard in providing first aid to a bleeding wound.
  - ii. Skillful use of good lighting, magnification and high-volume suction can assist in visualization of the bleeding source.

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## EXODONTIA - PROCEDURE, RISK AND COMPLICATION

### Complications of Exodontia:

6. • To control a hemorrhagic activity following can be done:
  - iii. This allows for direct injection of adrenaline containing local anesthetic agents for their vasoconstrictive properties or the use of electro cautery if available
  - iv. Absorbable materials, such as porcine gelatin sponge and oxidized cellulose, may be used to initiate primary hemostasis and stabilize the blood clot.
  - v. These materials are generally safe for use in the oral cavity.
  - vi. Sutures may be used to achieve primary closure of the wound or hold non-resorbable gauze over the socket for a number of days to provide an additional tamponade effect.
  - vii. Bone wax is a traditional hemostatic agent, composed of a sterile mixture of beeswax and isopropyl palmitate. Its hemostatic effect is by acting as a physical barrier and creating a tamponade on bleeding bone. Although adverse effects are rare, bone wax is a foreign body and can be associated with granulomatous reaction and increased risk of infection.
  - viii. Surgicel (Ethicon) is a resorbable plant derived oxidized cellulose polymer that provides a scaffold for platelet adhesion and aggregation. It should be noted that surgicel can be neurotoxic and should not be placed directly over the neurovascular bundle.
  - xi. Floseal (Baxter ) is a gelatin-thrombin mixture sealant and effective adjunct to hemostasis for coagulopathic patients. It is frequently used in head and neck surgery.
  - x. Tranexamic acid is a useful antifibrinolytic agent. A 5% solution may be applied topically with gauze over a wound for five minutes or by rinsing in the mouth postoperatively for 2 min, four times daily.
  - xi. Tranexamic acid 4.8% mouthwash can be compounded by pharmacies. If this is not available, alternative solution can be prepared by crushing a 500 mg tablet and dispersing it in 10 mL of water immediately before administration.
  - xii. Ideally, a dental practice should have multiple hemostatic adjuncts available for use in case of emergency.
  - xiii. Patients with uncontrollable bleeding or symptoms inadequate end-organ perfusion, including altered mental status, dyspnea, palpitations or chest pain should be rapidly transferred to the local emergency department. Hospitals and Oral and Maxillofacial clinics will be able to provide definitive care.

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## ASA CLASSIFICATION

(Source- Statement on ASA Physical Status Classification System)

- The ASA Physical Status Classification System has been in use for over 60 years.
- The purpose of the system is to assess and communicate a patient's pre-anesthesia medical co-morbidities.
- The classification system alone does not predict the perioperative risks, but when used with other factors (like type of surgery, frailty, level of deconditioning), it can be helpful in predicting perioperative risks.
- Assigning a Physical Status classification level is a clinical decision based on multiple factors.
- While the Physical Status classification may initially be determined at various times during the preoperative assessment of the patient, the final assignment of Physical Status classification is made on the day of anesthesia care by the anesthesiologist after evaluating the patient.

### ASA CLASSIFICATION WITH EXAMPLES

#### 1. ASA I:

- A normal healthy patient.
- Examples:
  - a) For Adult Patients: Healthy, non-smoking, no or minimal alcohol use.
  - b) For pediatric patients: Healthy (no acute or chronic disease), normal BMI percentile for age.

#### 2. ASA II:

- A patient with mild systemic disease.
- Examples including but not limited to:
  - a) For Adult patients: Mild diseases only without substantive functional limitations. Like, *Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease.*
  - b) For pediatric patients:
    - **Asymptomatic** congenital cardiac disease,
    - **well controlled** dysrhythmias,
    - asthma **without** exacerbation,
    - **well controlled** epilepsy,
    - **non-insulin** dependent diabetes mellitus
    - **abnormal BMI percentile for age,**
    - mild/moderate OSA,
    - oncologic state **in remission,**
    - autism **with mild limitations**

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## ASA CLASSIFICATION

### 2. ASA II:

- Examples including but not limited to:

#### c) Obstetric patients:

- Normal pregnancy\*: **Although pregnancy is not a disease**, the parturient's physiologic state is significantly altered from when the woman is not pregnant, hence the assignment of **ASA 2 for a woman with uncomplicated pregnancy**.
- Well controlled gestational HTN
- Controlled preeclampsia without severe features
- Diet-controlled gestational DM.

### 3. ASA III:

- A patient with severe systemic disease.

- Examples including but not limited to:

#### a) For Adult patients:

- Substantive functional limitations,
- One or more moderate to severe diseases.
- Poorly controlled DM or HTN, COPD.
- morbid obesity (BMI  $\geq 40$ )
- active hepatitis
- alcohol dependence or abuse
- implanted pacemaker
- moderate reduction of ejection fraction
- ESRD undergoing regularly scheduled dialysis.
- History of (>3 months) of MI, CVA, TIA, or CAD/stents.

#### b) For pediatric patients:

- Uncorrected stable congenital cardiac abnormality
- asthma with exacerbation
- poorly controlled epilepsy
- insulin dependent diabetes mellitus
- morbid obesity
- Malnutrition
- severe OSA
- oncologic state,
- renal failure, muscular dystrophy, cystic fibrosis.
- history of organ transplantation,
- brain/spinal cord malformation,
- symptomatic hydrocephalus
- premature infant PCA <60 weeks
- autism with severe limitations
- metabolic disease
- difficult airway
- long term parenteral nutrition.
- Full term infants <6 weeks of age.

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## ASA CLASSIFICATION

### 3. ASA III:

- Examples including but not limited to:
  - c) **Obstetric patients:**
    - Preeclampsia with severe features
    - gestational DM with complications or high insulin requirements
    - A thrombophilic disease requiring anticoagulation.

### 4. ASA IV:

- A patient with severe systemic disease that is a constant threat to life.
- Examples, including but not limiting to:
  - a) **For Adult patients:**
    - Recent (<3 months) MI, CVA, TIA or CAD/stents
    - Ongoing cardiac ischemia or severe valve dysfunction
    - severe reduction of ejection fraction
    - shock, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
  - b) **For pediatric patients:**
    - Symptomatic congenital cardiac abnormality
    - congestive heart failure
    - active sequelae of prematurity
    - acute hypoxic-ischemic encephalopathy
      - shock
      - sepsis, disseminated intravascular coagulation,
      - automatic implantable cardioverter-defibrillator
      - ventilator dependence
      - Endocrinopathy
      - severe trauma
      - severe respiratory distress
      - advanced oncologic state
  - c) **Obstetric patients:**
    - Preeclampsia with severe features complicated by HELLP or other adverse event
    - peripartum cardiomyopathy with EF <40,
    - uncorrected/decompensated heart disease, acquired or congenital.

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## ASA CLASSIFICATION

### 5. ASA V:

- A moribund patient who is not expected to survive without the operation.
- Examples, including but not limiting to:
  - a) For Adult patients:
    - Ruptured abdominal/thoracic aneurysm
    - massive trauma
    - intracranial bleed with mass effect
    - ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction.

#### b) For pediatric patients:

- Massive trauma
- intracranial hemorrhage with mass effect
- patient requiring ECMO
- respiratory failure or arrest
- malignant hypertension
- decompensated congestive heart failure
- hepatic encephalopathy
- ischemic bowel or multiple organ/system dysfunction.

#### c) Obstetric patients:

- Uterine rupture.

### 6. ASA VI:

- A declared brain-dead patient whose organs are being removed for donor purposes.

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## THIRD MOLAR EXTRACTION AND COMPLICATION

Sources: Consent for third molar tooth extractions in Australia and New Zealand: a review of current practice (ADJ article), The extraction of first, second or third permanent molar teeth and its effect on the dentofacial complex (ADJ article), The contemporary management of third molars (ADJ article)

- The management of third molars requires a significant assessment and decision process both for the patient and the clinician.
- The third molar tooth (M3) is the last to appear and is the most variable tooth affected by morphology, eruption period and oligodontia/hypodontia.
- Wisdom teeth are the most likely to undergo impaction (incomplete eruption in the presence of a fully grown root), which occurs when there is inadequate space in the mouth, if there is an impediment by another tooth or if the tooth has developed in an abnormal position.
- The impacted tooth is generally trouble free and covered totally or partially by soft tissue, bone or a combination of the two.
- Third molars can be classified as: (as per recent literature)
  - a) Disease positive and disease negative and
  - b) Symptom positive and negative

**Table 1. Classification systems**

	Disease Positive	Disease Negative
Symptom Positive	S+/D+	S+/D-
Symptom Negative	S-/D+	S-/D-

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## THIRD MOLAR EXTRACTION AND COMPLICATION

- According to their symptom and disease status removal of third molars can be grouped as:

**Table 2. Indication for the removal of third molars grouped according to symptom and disease status**

Classification	Disease	Treatment
Symptom Positive & Disease Positive	<ul style="list-style-type: none"> <li>Unrestorable Caries</li> <li>Periapical Pathology</li> <li>Pericoronitis</li> <li>Odontogenic Infection</li> </ul>	
Symptom Negative & Disease Positive	<ul style="list-style-type: none"> <li>Periodontitis</li> <li>Pathology</li> <li>Food Trapping</li> <li>Root Resorption</li> </ul>	<p><b>Timeframe:</b> Treat immediately</p> <p><b>Treatment Options:</b></p> <ol style="list-style-type: none"> <li>1. Surgically Remove</li> <li>2. Coronectomy (only if necessary)</li> <li>3. Oral Hygiene Instruction</li> </ol>
Symptom Negative & Disease Negative	<ul style="list-style-type: none"> <li>In a fracture line</li> <li>Un-restorable / fractured</li> <li>Associated with orthognathic surgery</li> <li>Pre-orthodontics</li> <li>Prosthodontic inhibitor</li> <li>As part of a tumour resection</li> <li>To allow access and maintenance of adjacent teeth</li> </ul>	
	<ul style="list-style-type: none"> <li>Post orthodontics</li> <li>In conjunction with other oral surgery</li> <li>Elite athletes</li> <li>Military and scientific personnel</li> <li>Premedication assessments</li> <li>Pre geriatric assessments</li> <li>Persistent bacteraemia</li> <li>Mild periodontal disease</li> </ul>	<p><b>Timeframe:</b> Utilise the third molar decision matrix</p>

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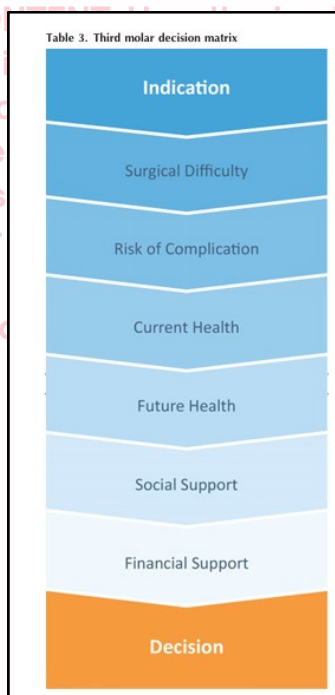
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## THIRD MOLAR EXTRACTION AND COMPLICATION

- The decision to **remove a symptom positive/disease positive** third molar is **straight forward**. This decision would only be modified by a significant patient contraindication.
- The decision to remove a symptom positive/disease negative tooth is generally received favorably by both the surgical community and patient's alike.
- Surgeons are often asked to assess and manage the symptom free third molar.
- There is now considerable evidence to support the removal of symptom free/disease positive third molars in young adults.
- The symptom/disease free third molar which are either not in line of occlusion is difficult and challenging for clinicians **and the decision matrix depends on the following:**



1. The decision matrix for the removal of the third molars should always begin with an indication.
2. **Indications** for removal of third molars are based on disease and symptoms status as summarized in above table.
3. Once an indication has been identified, the decision to proceed to surgery will be modified by the surgical difficulty along with the procedural risk of a permanent complication.
4. The patient's current health and future health will then modify the decision further. The final modifying factors include the patient's social support mechanisms and financial capacities.
5. The indications for removal where the patient is symptom free but disease positive are worth further examination.
6. There are also indications where the patient is both symptom negative and disease negative, **which is known as prophylactic removal of third molars.**

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## THIRD MOLAR EXTRACTION AND COMPLICATION

### Prophylactic removal of third molar:

(Source: *The contemporary management of third molars*)

- The prophylactic removal of third molars can be divided into six main groups:

#### A) Sports or military patients:

- Contact sports
- Peak performance patient

#### B) Reduced physical dexterity:

- Tremors
- Neuromuscular disease

#### C) Altered mental capacity:

- Dementia
- Cognitive development

#### D) Pre medication:

- Bisphosphonates
- Anti-coagulants

#### E) Pre Treatment:

- Radiotherapy
- Chemotherapy

#### F) Immunomodifier therapy:

- Bacteremia
- Tissue transfer patients

- Once the clinician has decided that there is an indication for the removal of a tooth, they must then **assess the surgical risk of the procedure**.
- A common system for examining and predicting the difficulty of removal of third molars is the WHARFE system which considers:
  - W**– Winter's lines
  - H**– Height of mandible
  - A**– Angulation
  - R**– Root form
  - F**– Size of follicular sac
  - E**– Exit pathway of tooth.
- This schematic allows for a more thorough examination of the tooth and its radiology prior to its removal.
- An **additional assessment** is whether the **surgeon is capable** of providing the surgery. If a **surgeon is incapable** of providing the procedure, they **should refer the patient** for assessment to someone who can perform the surgery, so that there is no bias in the decision pathway, especially when conservative management is recommended.

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## THIRD MOLAR EXTRACTION AND COMPLICATION

- **Post-surgery complications** remain a significant determining factor for patients and clinicians both.
- When the patient is disease or symptom positive, the benefits of surgery are seen to outweigh the risks and surgery ensues. When the patient is asymptomatic, the equation becomes more difficult.
- The relevance of post-surgery complication decreases with surgeon experience. The more experienced the surgeon, the less likely a significant complication. This would suggest that for patients considering prophylactic surgery for asymptomatic teeth, the surgeon's experience is a factor of importance.

### Advantages and indications of third molar extraction:

1. Impaction associated with dental caries (in tractable carious lesion).
2. Periodontal defects close to the preceding molar.
3. Pericoronitis.
4. Odontogenic cyst.
5. Dental tumors.
6. Prophylactic removal of impacted M3 is also indicated for root resorption, crowding of lower incisors and damage to the adjacent tooth.

### Disadvantages of third molar extraction:

1. Increase in probing depth on the distobuccal aspect of the second molars and a reduction in attachment level after surgical removal of impacted mandibular third molar.
2. No appreciable gain in alveolar bone height after removal of the impacted M3 of second molars with distal bone loss due to M3 impaction.
3. One of ten patients after surgical removal experience associated complications that include; intense pain, swelling, hemorrhage, infection, alveolar osteitis, hematoma, lockjaw, alveolar nerve injury, oroantral communication, incomplete root removal, delayed healing, infected subperiosteal hematoma and bony spicule.
4. Although rare, 5 in 1000 patients over 25 years of age experience mandibular angle fracture after M3 extraction.
5. Patients commonly experience anxiety with the removal of M3, which has a significant impact on the outcome of the surgery due to the disturbed emotional state of the patient.

Table 2. Indications, disadvantages and proposed timing for extraction of molar teeth

Tooth/condition	First molar	Second molar	Third molar
Indications	Caries, endodontic problems, hypomineralization	Caries, ectopically eruption, severely rotated, orthodontic treatment	Caries, periodontal defects, pericoronitis, odontogenic cyst, dental tumours
Disadvantages	Shifting of the dental midline, change in chewing habits, periodontal problems, temporomandibular joint problems	Drifting of the adjacent teeth, supraeruption of unopposed teeth, poor gingival contours, poor interproximal contacts, reduced inter-radicular bone, pseudopockets	One of 10 patients faced with intense pain, swelling, haemorrhage, alveolar osteitis, haematoma, lockjaw, alveolar nerve injury
Changes in other molar position	Help in mandibular third molar eruption	Relieve malocclusions, facilitate eruption of the third molars, faster eruption of third molars, maxillary first molars could have move distally	Relieve crowding of lower incisors

- The prophylactic M3 extraction at younger age has a more positive prognosis.

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## THIRD MOLAR EXTRACTION AND COMPLICATION

### Informed Consent for third molar extraction:

*(Source-Consent for third molar tooth extractions in Australia and New Zealand: a review of current practice (Article ADJ))*

- Informed consent is the legal requirement to educate a patient about a proposed medical treatment or procedures so that he or she can make informed decisions.
- It is one of the most important steps in the preoperative consultation, offering information on the treatment including a thorough explanation of the risks involved.
- It is also important in providing legal protection against complications and unforeseen circumstances that may arise during any medical treatment.
- Failure to gain valid consent can result in a claim for trespass, while failure to adequately disclose risk can be construed as negligence.
- There is no absolute guide about how much information to disclose as part of the consent process, but, according to contemporary Australian legislation, the doctor should provide what a reasonable patient would want to know and what that particular patient would want to know in light of their own values and interests.
- Consent must be given voluntarily by a competent patient who is adequately informed about the proposed treatment.
- For a patient to be competent, they must be able to understand the information provided to them and communicate their choice.
- Consent may be given in writing, verbally, or by implication.
- As per The National Health and Medical Research Council (NHMRC), the information that should be included in a informed consent includes:
  - a) The nature of the proposed treatment,
  - b) The risks and benefits,
  - c) Alternative treatment options,
  - d) The consequences of not proceeding, and
  - e) the person who will undertake the procedure.
- Risks to be disclosed include known risks that are common though slight, and rare though severe, as well as particular risks material to the patient.
- Information about a procedure can be written or given verbally.
- some of the potential complications of surgery include:
  - a) lingual and inferior alveolar nerve damage (temporary or permanent)
  - b) postoperative neuropathic pain;
  - c) alveolar osteitis; infection—not alveolar osteitis (general warning)
  - d) Excessive bleeding (general warning)
  - e) unexpected soft tissue injury (lip sores)
  - f) oroantral communication
  - g) bone fracture (general warning)

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## THIRD MOLAR EXTRACTION AND COMPLICATION

### Informed Consent for third molar extraction:

(Source-Consent for third molar tooth extractions in Australia and New Zealand: a review of current practice (Article ADJ))

- Written consent for invasive procedures is standard practice in most Australian hospitals.
- A survey revealed the following results for the risk and disclosure of risk and complication for third molar extraction
- Various complications

**Table 1. Vascular, infective and neurological complications of third molar tooth extractions. Number (%) of respondents who routinely include or do not include the risk in their written consent, and total number of responders**

	Yes	No	Total
Excessive bleeding (general warning)	50 (71)	20 (29)	70
Excessive bleeding (specific warning)	12 (18)	56 (82)	68
– requiring additional surgery			
Alveolar osteitis	36 (53)	32 (47)	68
Infection, not alveolar osteitis (general warning)	59 (84)	11 (16)	70
Infection, not alveolar osteitis (specific warning) – deep fascial space involvement	12 (18)	54 (82)	66
Temporary inferior alveolar nerve injury	67 (97)	2 (3)	69
Permanent inferior alveolar nerve injury	67 (97)	2 (3)	69
Temporary lingual nerve injury	63 (91)	6 (9)	69
Permanent lingual nerve injury	60 (88)	8 (12)	68
Temporary nerve injury other than inferior alveolar/lingual nerve injury (any warning, including buccal nerve injury, mylohyoid nerve injury)	8 (11)	62 (89)	70
Permanent nerve injury other than inferior alveolar/lingual nerve injury (any warning, including buccal nerve injury, mylohyoid nerve injury)	5 (7)	63 (93)	68

**Table 3. Complications of third molar tooth extractions related to adjacent structures. Number (%) of respondents who routinely include or do not include the risk in their written consent, and total number of responders**

	Yes	No	Total
Oroantral communication and/or fistula	49 (69)	22 (31)	71
Oronasal communication and/or fistula	10 (14)	59 (86)	69
Temporomandibular joint complications (any warning)	29 (41)	42 (59)	71
Aspiration or ingestion (any warning, including of tooth, tooth fragment, other material or instrument)	4 (6)	67 (94)	71
Subcutaneous and/or tissue space emphysema	1 (1)	69 (99)	70

**Table 2. Technical complications of third molar tooth extractions. Number (%) of respondents who routinely include or do not include the risk in their written consent, and total number of responders**

	Yes	No	Total
Damage to adjacent tooth/teeth	42 (59)	29 (41)	71
Bone fracture (general warning)	28 (39)	43 (61)	71
Bone fracture (specific warning)	11 (16)	59 (84)	70
– Fracture of the alveolus			
Bone fracture (specific warning)	13 (19)	57 (81)	70
– Maxillary tuberosity fracture			
Bone fracture (specific warning)	25 (35)	46 (65)	71
– Mandibular jaw fracture			
Displacement of teeth or roots (general warning)	34 (48)	37 (52)	71
Displacement of teeth or roots (specific warning) – into the maxillary sinus	35 (49)	36 (51)	71
Displacement of teeth or roots (specific warning) – into fascial spaces	5 (7)	65 (93)	70
Displacement of teeth or roots (specific warning) – into the inferior alveolar nerve canal	6 (9)	64 (91)	70
Incomplete tooth/root removal	35 (49)	36 (51)	71
Wound dehiscence	24 (34)	47 (66)	71
Periodontal defects	16 (23)	55 (77)	71
Unexpected soft tissue injury (any warning, including lip or tongue laceration)	11 (15)	60 (85)	71
Bony sequestra	19 (27)	52 (73)	71

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## THIRD MOLAR EXTRACTION AND COMPLICATION

- Consensus for the risk where disclosure is required as per Australian survey:

**Table 4. Consensus among surgeons that risk disclosure is required (≥80% routinely include that risk in their written consent) or that risk disclosure is not required (≥80% do not routinely include that risk)**

Consensus that risk disclosure is required	Consensus that risk disclosure is not required
Vascular, infective and neurological complications	
Infection, not alveolar osteitis (general warning)	Temporary nerve injury other than inferior alveolar/lingual nerve injury (any warning, including buccal nerve injury, mylohyoid nerve injury)
Temporary inferior alveolar nerve injury	Permanent nerve injury other than inferior alveolar/lingual nerve injury (any warning, including buccal nerve injury, mylohyoid nerve injury)
Permanent inferior alveolar nerve injury	Infection, not alveolar osteitis (specific warning) – deep fascial space involvement
Temporary lingual nerve injury	Excessive bleeding (specific warning) – requiring additional surgery
Permanent lingual nerve injury	
Technical complications	Bone fracture (specific warning) – fracture of the alveolus
	Bone fracture (specific warning) – maxillary tuberosity fracture
	Displacement of teeth or roots (specific warning) – into fascial spaces
	Displacement of teeth or roots (specific warning) – into the inferior alveolar nerve canal
	Unexpected soft tissue injury (any warning, including lip or tongue laceration)
Complications related to adjacent structures	
	Oronasal communication and/or fistula
	Aspiration or ingestion (any warning, including of tooth, tooth fragment, other material or instrument)
	Subcutaneous and/or tissue space emphysema

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## TMD'S AND SPLINT TYPES AND BRUXISM

Sources: TG, Temporomandibular Disorder: a practical guide for dental practitioners in diagnosis and management (ADJ article), Types of Occlusal Splint in Management of Temporomandibular Disorders TMD (Article), Management of temporomandibular joint disorders: A surgeon's perspective, Temporomandibular Disorders: Current Concepts and Controversies in Diagnosis and Management (Article)

- Temporomandibular disorder (TMD) is the most common reason for seeking dental care other than dental pain.
- Temporomandibular disorder (TMD) is a broad term encompassing pain and/or dysfunction of the masticatory musculature and the temporomandibular joints.
- TMD is a collective term for clinical problems involving masticatory muscles, Temporomandibular Joints (TMJ) and associated structures.
- TMD can be sub classified into disorders called:
  - a) Temporomandibular Joint (TMJ) disorders
  - b) Masticatory muscle disorders

### 1. Types of TMDs:

- The three most common temporomandibular disorders are:
  - a) **Myofascial pain & dysfunction:** It is primarily a muscle disorder resulting from oral parafunctional habits such as clenching or bruxism that is sometimes related to psychogenic disorders such as headache, fibromyalgia, chronic back pain and irritable bowel syndrome with stress, anxiety and depression being the key features.
  - b) **Internal derangement:** Internal derangement is used to describe a temporomandibular disorder where there is an abnormal position of the articular disc resulting in mechanical interference (i.e., clicking) and restriction of the normal range of mandibular activity (i.e., limited mouth opening) or even hypermobility that may result in jaw dislocation.
  - c) **Osteoarthritis:** Osteoarthritis is a localized degenerative disorder mainly affecting the articular cartilage of the mandibular condyle of the temporomandibular joint and is often seen in older individuals but can uncommonly present in younger patients.
- *Myofascial pain and dysfunction are the most prevalent.*

Table 1. The main temporomandibular disorders

- |   |   |
|---|---|
| 1 | Myofascial pain and dysfunction                   |
| a | Myositis  |
| b | Fibromyalgia                                      |
| c | Neuropathic pain                                  |
| d | Chronic pain syndrome                             |
| 2 | TMJ functional derangement                        |
| a | Internal derangement - disc displacement          |
| b | Hypermobility disorders – dislocation             |
| c | Hypomobility disorders – ankylosis, posttraumatic |
| 3 | TMJ degenerative/inflammatory joint disease       |
| a | Osteoarthritis/arthritis                          |
| b | Rheumatoid arthritis                              |
| c | Psoriatic arthritis                               |
| d | Juvenile arthritis                                |

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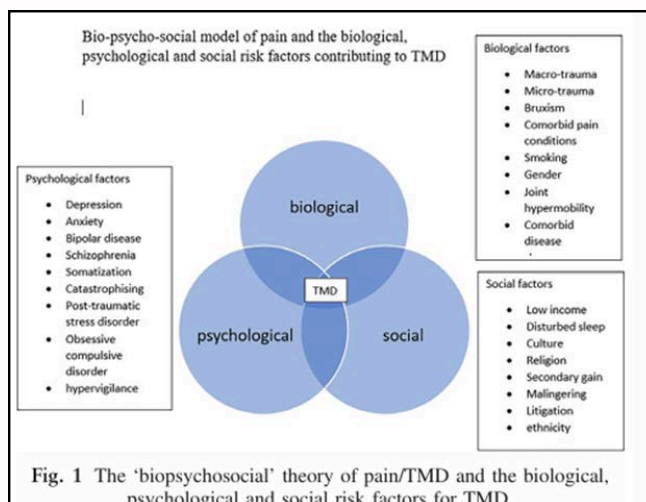
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## TMD'S AND SPLINT TYPES AND BRUXISM

### 2. Risk Factors for TMDs:

- a) TMD are a heterogeneous group of conditions that have a multifactorial etiology where a combination of predisposing, initiating and perpetuating factors are at play.
- b) They include:
  - Direct Trauma
  - Indirect Trauma (acceleration and deceleration injury)
  - Parafunctional habits (Tooth grinding and clenching)
  - Psychosocial issues like stress and anxiety have also shown to be contributing to TMDs.
  - Habits such as Lip biting, cheek biting, biting fingernails, chewing gum, smoking can perpetuate an existing temporomandibular disorder.
- c) Chronic TMDs are often associated with psychological disorders.
- d) Comorbid diseases which may specifically affect the TMJ include: rheumatoid arthritis, juvenile idiopathic arthritis, psoriatic arthritis, systemic lupus erythematosus, osteoarthritis and neoplasia.
- e) The incidence rate of TMD is only slightly greater in women than men, but up to four times as many women seek treatment in addition to having a greater overall pain sensitivity.



- f) TMD is also more likely to persist in women.
- g) Patients with TMD and chronic pain should be assessed for psychological factors such as depression or anxiety, catastrophizing, distress, fear avoidance beliefs and post-traumatic stress disorder (PTSD).
- h) **Bruxism and TMD can exist independently.** Bruxism may be a risk factor for some negative oral health consequences such as masticatory muscle pain, temporomandibular joint pain and extreme tooth wear.
- i) **Malocclusion is not a risk factor for TMD.**

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 3. Signs and symptoms of TMDs

- The most important feature is pain, followed by restricted or limited jaw movement, and joint noises during jaw movement.
- Pain is the most common presenting complaint and is by far the most difficult problem to evaluate.
- A history of limited mouth opening which may be intermittent or progressive is also a key feature of temporomandibular joint disorders.
- The patient should be evaluated for tenderness in those areas in head and neck accessible to palpation.
- Palpation is accomplished by placing the finger tips in the preauricular region, just in front of the tragus of the ear. The patient is then asked to open their mouth and the finger tip will fall into the depression left by the translating condyle.
- Pain specifically localized to the pre-auricular area is a good sign of actual joint pathology.
- Examination of the masticatory musculature may also be accomplished by digital palpation.
- Areas of tenderness, trigger points and pain referral patterns should be noted to visualize the extend of the pain in the head and neck.
- Joint sounds and their location during opening, closing and lateral excursions of the mandible may be either palpated or detected with a stethoscope placed over the pre-auricular area.
- Clicking is a reliable sign of internal derangement while grating/crepitus is a sign of advanced degenerative joint disease such as osteoarthritis.

**Table 15. Signs and symptoms of temporomandibular disorders**

<b>Common symptoms</b>	pain and restriction with mandibular function pain in and around the ears and masticatory muscles headache neck pain limited jaw opening joint sounds clenching of teeth (bruxism; see p.149)
<b>Uncommon symptoms</b>	reduced hearing changes in occlusion toothache altered sensation in the face (eg paraesthesia, a feeling of swelling)
<b>Signs</b>	tenderness of the temporomandibular joints and masticatory muscles during movement temporomandibular joint sounds (clicking, clunking or crepitus) during repetitive opening and closing of the mouth, as well as lateral and protrusive movements [NB1] deviation on opening of the jaw

NB1: Temporomandibular joint sounds are not an indication for treatment, unless associated with pain or dysfunction.

Image: TG

**Table 1. TMD signs and symptoms**

Common symptoms	Less common symptoms	Common signs
Facial pain	Reduced hearing or Feeling of blocked ears	Temporomandibular joint sounds
Restricted jaw movement	Tooth ache/sensitivity/ Tooth mobility	Restricted opening or jaw deviation upon opening masseteric hypertrophy
Headache	Sleep disturbance	Tenderness muscle of mastication
Pre-auricular pain	Paresthesia/swelling of face	Tenderness TMJ
Difficulty eating	Tinnitus	
Bruxing/ clenching	Occlusal disturbance	tenderness to percussion of teeth
Ear ache	Pain with swallowing	Bruxing/clenching
Joint sounds	Sharp pain in ear	
Neck/shoulder pain	Retro-orbital pain	

Image – source ADJ article on TMD

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 4. Investigations for TMDs:

- Investigations are required to not only eliminate the possibility of other pathological processes that may mimic temporomandibular disorder symptoms but also to see if there is pathology specifically related to the TMJ.
- Plain radiographs of the temporomandibular joint, such as high level orthopantomograms and transcranial projections, are useful as baseline investigations for detection of any gross pathological, degenerative or traumatic changes in the mandibular condyle.
- **Magnetic resonance imaging (MRI)** has increasingly been used in the investigation of the status of the articular disc to determine if there is internal derangement of the temporomandibular joint.

### 5. Diagnosis of TMD

- Accurate diagnosis of TMDs requires appropriate history, examination and imaging.
- Amalgamation of the presenting complaint, clinical history and findings from the examination will help the clinician arrive at a diagnosis.
- As TMD etiology is multifactorial, it is essential that clinicians should also consider employing the suggested questions while taking a detailed pain history and amalgamate these with the clinical findings and psychosocial factors to determine the risk.
- Those patients either presenting with an existing TMD or determined to be at risk of developing a TMD, should be treated as 'high risk' and managed with great care.
- Any dental procedure considered 'high risk' has the potential to trigger or exacerbate a TMD.
- Prior to commencing dental treatment it is critical that informed consent be obtained from the patient regarding the possibility of developing a TMD.

	Myalgia	Arthralgia	Intra-articular joint disorder	Degenerative joint disorder
Information from patient history	Pain in the masticatory musculature, modified jaw movement, function or parafunction	Pain in the masticatory structure, modified by jaw movement, function or parafunction	TMJ noise(s) present or TMJ noises present and jaw locks with limited opening	TMJ noises present
Clinical examination findings	Reported pain on palpation of the muscles of mastication, or pain reported with maximum mouth opening	Patient reported pain on palpation of TMJ or patient reported pain upon maximum unassisted or assisted opening, right, left, lateral or protrusive movements	Clicking, popping, or snapping noise present with either opening and closing or opening and closing and lateral or protrusive movements	Crepitus (crackling sounds) present in TMJ during maximum active opening, passive opening, right lateral, left lateral or protrusive movements

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 5. Diagnosis of TMD

- The following questions are a guide for clinicians to help gain an understanding of the pain history and to formulate a diagnosis.

- (1) Reason for presenting
- (2) Were there any triggers when the pain first started? (What do you think triggered the pain?)
- (3) History of trauma? (to elicit Macro-trauma (e.g. physical injury) versus micro-trauma (e.g. para-function such as gum chewing)
- (4) Describe the pain in your own words
- (5) When did the pain first start?
- (6) Is the pain there all the time? Is the pain episodic or continuous?
- (7) If there are episodes, how often do the episodes last?
- (8) If there are episodes, how frequently do they occur?
- (9) Is there a pattern to when the pain occurs? (i.e. every morning, during the day)
- (10) Can you rate the pain on a scale out of 10? How is the pain NOW, when it's very bad, and when it's manageable?
- (11) What causes the pain to start? What makes the pain worse? What makes the pain better?
- (12) Can you point to the area of pain?
- (13) Do you have pain elsewhere in your body?
- (14) Are you aware of tooth grinding or clenching? Is this during the day or night or both?
- (15) Do you have any joint noises?
- (16) Do you have an earache or ear noises?
- (17) Do you have other symptoms (for example nausea or vomiting, blocked nose or stuffiness?)
- (18) Do you have headaches? If so, duration, timing, location and frequency of headaches.
- (19) Do you avoid any foods because of facial pain?
- (20) Have you lost weight because of the pain?
- (21) Does this pain prevent you from doing any normal activities?
- (22) Do you have trouble sleeping?
- (23) Do you have airway problems or sleep apnoea?
- (24) Previous treatment for facial pain?
- (25) Have you been experiencing significant stress or anxiety recently?
- (26) Have you experienced significant stressful life events or changes in your family situation, routine or employment?

### 6. Differential Diagnosis if TMDs:

Table 3. Differential diagnosis of temporomandibular disorders (TMD).

Neuropathic Pain
Trigeminal neuralgia
Glossopharyngeal neuralgia
Postherpetic neuralgia
Traumatic neuralgia
Burning mouth syndrome
Atypical odontalgia
Atypical facial pain
Odontogenic Pain
Dental caries
Periodontal disease
Dental abscess
Dental sensitivity
Cracked tooth syndrome
Pericoronitis
Intracranial Pain
Tumours
Aneurysms
Bleeding
Infection
Pain from Other Adjacent Structures
Ear
Nose
Throat
Eyes
Sinus
Salivary glands
Lymph nodes
Vasculature
Cervical region
Headaches not Attributed to TMD
Migraine
Cluster headache
Tension-type headache
Temporal arteritis
Referred Pain
Psychogenic Pain

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 7. Management of TMDs:

- The aim of management is to control the patients' symptoms rather than achieve a cure.
- Treatment goals should be tailored to specific diagnosis, and includes:
  - a) Reducing pain
  - b) Adverse loading
  - c) Restoring mandibular function.
  - d) Resuming normal daily activities
- Once a diagnosis of TMD has been established, the dental practitioner needs to recognize whether management falls within their scope or a referral to a specialist is indicated.
- Identification of the 'high risk' patients is paramount, especially in the dental setting, as subjecting a 'high risk' patient to a 'high risk' procedure such as an extended dental visit, could precipitate or aggravate an underlying or undiagnosed TMD.
- It is essential that prior to commencing any dental procedure, the predisposing risks for TMD are discussed with the patient and documented in the clinical record.
- The recommended pathways for management of patients according to the patient risk and procedure risk are:

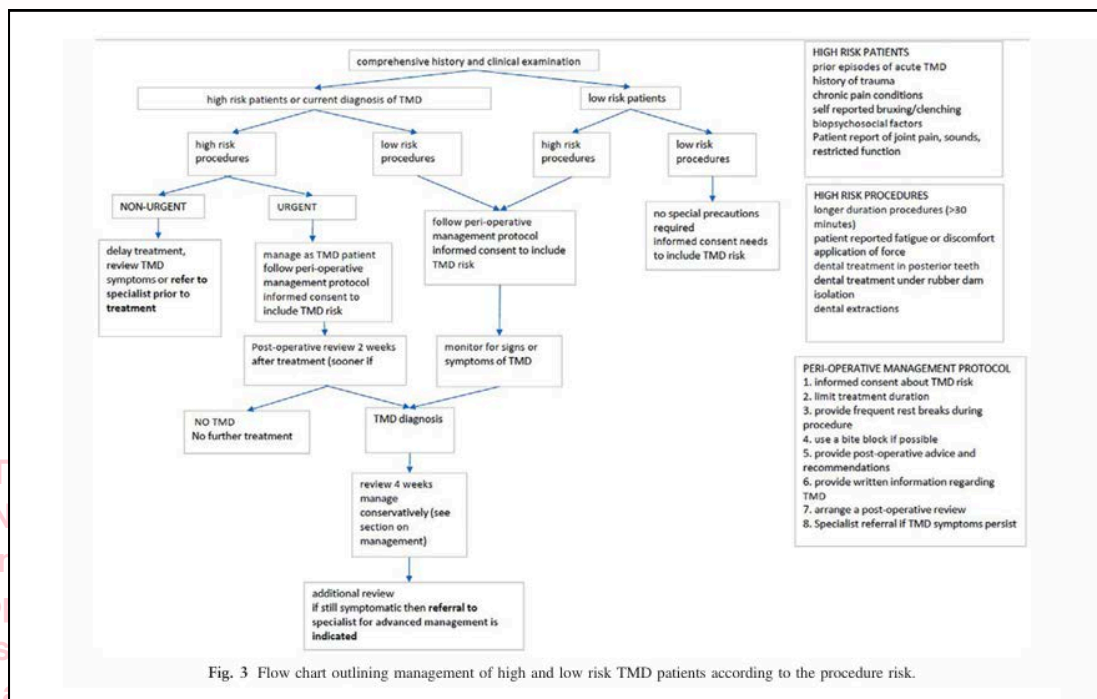


Fig. 3 Flow chart outlining management of high and low risk TMD patients according to the procedure risk.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### Management strategies:

Management strategies are conservative and can include:

- patient education and reassurance
- jaw rest, using strategies such as dietary modification to minimise chewing (eg eating only soft foods)
- avoidance of extreme jaw movements (eg yawning, chewing gum, singing)
- massage and application of warm packs to the temporomandibular joints and cheeks several times per day. Cold packs can be useful in the presence of redness and swelling
- behavioural modification (eg identifying and managing sources of stress, which may be facilitated by individual or group counselling)
- regular treatment (gentle muscle stretching and massaging) by a physiotherapist familiar in the management of temporomandibular disorders
- use of custom-made full-coverage intraoral occlusal splints\* to reduce joint loading, muscle activity and pain—splints are generally worn at night and protect teeth from the effects of bruxism. They should constitute only one part of a broader management approach
- short-term use of drugs—discourage patients from relying on drugs alone (particularly drugs of dependence) to treat the symptoms of temporomandibular disorders because of their chronic nature. Analgesics, muscle relaxants, anxiolytics, anticonvulsants, corticosteroids and antidepressants have been used with variable success.

Image: TG

Table 2. TMD management strategies

- 1 Explanation and reassurance
  - a TMD is not life-threatening
  - b TMD is not a Cancer
  - c TMD can become a chronic condition
  - d TMD can be managed
- 2 Education and self care
  - a Soft diet
  - b Jaw rest (especially during long dental appointments)
  - c Avoid extreme jaw movements (i.e yawning)
  - d Topical heat (e.g. wheat packs)
  - e Protect face and jaws from cold weather
  - f Avoid stress and anxiety
- 3 Medications
  - a Antiinflammatories
  - b Anxiolytics
  - c Muscle relaxants
  - d Antidepressants
- 4 Jaw physiotherapy
  - a Massage and stretching
  - b Dry needling
  - c TENS – transcutaneous electrical nerve stimulation
  - d Pulsed ultrasound therapy
- 5 Occlusal appliance therapy
- 6 Behavioural therapy
  - a Lifestyle counselling
  - b Relaxation therapy
  - c Hypnosis
  - d Biofeedback
- 7 Psychotherapy
- 8 Other
  - a Acupuncture
  - b Botox injections
  - c Chiropractic manipulation
- 9 TMJ surgery
  - a Closed procedures
    - i TMJ arthrocentesis
    - j TMJ arthroscopy
  - b Open procedures
    - i TMJ arthrotomy/arthroplasty
    - ii TMJ joint replacements.

Image: Article

- Acute exacerbation of TMD can be treated with Ibuprofen and paracetamol.
- If the conservative methods are inadequate and the pain and dysfunction becomes more severe or chronic, Referral of the patient to ORAL MEDICINE SPECIALSIT OR ORAL AND MAXILLOFACIAL SURGEON should be made.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### Treatment option for TMDs include:

Treatment options for TMD include reassurance (patient education, self-care and behavior therapy), physiotherapy (such as ultrasound, acupuncture, short wave diathermy laser, heat exercises, and biofeedback), occlusal splint therapy, drug therapy, occlusal adjustment, surgical intervention and combined treatment.

#### 1. Non-surgical treatment:

- The non-surgical treatment of temporomandibular disorders continues to be the most effective way of managing over 90 percent of patients.

##### a) Explanation and reassurance:

- The first step in the management of temporomandibular disorders is to explain to the patient the cause and nature of the disorder they present with, and to reassure them of the benign nature of the condition.

##### b) Patient education and self-care:

- The next step is to formulate a self-care routine which should include the following; limitation of mandibular function, habit awareness and modification, a home exercise program and avoiding stress.
- Voluntary limitation of mandibular function (i.e., avoid excessive chewing and talking) is encouraged to promote rest or immobilization of muscular and articular structures.
- The patient is advised to maintain a soft diet and avoid foods where a considerable amount of chewing is involved.
- The patient should also be discouraged from wide yawning, singing, chewing gum, and any other activities which would promote excessive mandibular function.
- Massage of the affected muscles with application of moist heat will help soothe aching or tired muscles by promoting muscle relaxation.
- Lengthy dental appointments often exacerbate the TMD so the Dentist must allow the patient to intermittently rest their jaw during their appointment. The use of a mouth prop to hold the jaw open may be useful.

##### c) Pharmacotherapy

- Pharmacotherapy can be a valuable adjunctive aid to the relief of symptoms when they are prescribed as part of a comprehensive management program.
- There is no single drug that has been proven to be effective for all cases of temporomandibular disorders.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### d) Physiotherapy:

- The aim of physiotherapy is to restore normal mandibular function by a number of physical techniques that serve to relieve musculoskeletal pain and promote healing of tissues.
- Physiotherapists may also use adjunctive measures such as dry needling, TENS (transcutaneous electrical nerve stimulation) and pulsed ultrasound therapy to help relieve muscle pain.
- Physiotherapy is especially useful in the management of myofascial pain and TMJ closed lock and is essential following TMJ surgery.

### e) Behavioral therapy:

- Where there are persistent habits which exacerbate or maintain the temporomandibular disorder that cannot be easily modified by simple patient awareness, then a structured program of cognitive behavioral therapy may be required.
- Behavioral modification strategies may include counselling on lifestyle, relaxation therapy, hypnosis and biofeedback which fall in the domain of professional Psychologists.

### f) Occlusal Splint Therapy:

- **The most common form of treatment** provided by dentists for temporomandibular disorders is **occlusal splint therapy**.
- This may be referred to as a bite raising appliance, occlusal appliance or bite guard.
- The idea is to protect the teeth from abnormally high loads in clenchers and grinders and also to reduce the maximum loads on the TMJ, particularly in patients with nocturnal clenching/grinding.
- By distracting the occlusion, maximum contraction of the masticatory muscles is also prevented which theoretically reduces muscle pain.
- The occlusal appliances are considered as deprogrammers or jaw repositioners to establish ideal maxillomandibular relationships and thus relieve pain and restore the function.
- Commonly there are two different materials, based upon consistency, which are used in the fabrication of occlusal appliances:
  - Hard acrylic occlusal splints:** Either Self cured or heat cured which forms hard and rigid tooth borne and occlusal surfaces.
  - Soft or resilient occlusal splint:** Has flexible and pliable tooth-borne and occlusal surface.
  - Dual laminated:** its occlusal surface consists of hard acrylic resin and the tooth-borne surface consist of a soft material.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### f) Occlusal Splint Therapy:

- Hard acrylic resin occlusal appliances can be either custom fabricated at chairside or indirect fabrication in the dental lab rotary by use of stone casts.
- The soft occlusal appliances can be purchased readily from dental supply houses this type of occlusal appliance ("boil and bite") is molded and adapted by boiling the product in water and then placing the material intra-orally with a biting force to establish the preferred correct occlusion.
- Hard acrylic resin occlusal appliances have several advantages over the soft appliances:
  - i. hardness and resistance of the acrylic resin enable easily and quickly adjustments,
  - ii. easily repaired,
  - iii. the fit of a hard acrylic resin is more accurate,
  - iv. methods of fabrication are more reliable
  - v. greater longevity,
  - vi. more color stable,
  - vii. less food debris accumulation
  - viii. more durable than that of the soft version.
- The adjustment of soft material is more difficult and often results in a less adequate occlusal scheme and these appliances are more susceptible to wearing that in turn result in occlusal changes.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### Types of Oral occlusal splints for treatment of TMD:

#### A) Classification of occlusal appliances according to Okeson include:

1. Muscle relaxation appliance/ stabilization appliance used to reduce muscle activity
2. Anterior repositioning appliances/ orthopedic repositioning appliance
3. Anterior bite plane
4. Pivoting appliance
5. Soft/ resilient appliance

#### B) Classification of occlusal appliances according to Dawson include

1. Permissive splints/ muscle deprogrammer
2. Directive splints/ non-permissive splints
3. Pseudo permissive splints (e.g., soft splints, Hydrostatic splint)

#### 1. Flat Plane Stabilization Appliance (Michigan splint)

- Also known as the gnathological splint, Michigan splint, or muscle relaxation appliance.
- This appliance is generally fabricated for the maxillary arch.
- The muscle relaxation appliance is the most commonly used type of occlusal appliance, and it has the least adverse effects to the oral structures when properly fabricated.
- The purpose of the appliance is to provide joint stabilization, protect the teeth, redistribute the occlusal forces, relax the elevator muscles, and decrease bruxism. Additionally, wearing the appliance increases the patient's awareness of jaw habits and helps alter the rest position of the mandible to a more relaxed, open position.

#### 2. Anterior Bite Plane: Traditional Anterior Bite Plane

- These appliances are designed as a palatal-coverage horseshoe shape with an occlusal table covering 6 or 8 anterior maxillary teeth.
- **Not much recommended** as adverse effect includes possible overloading of TMJ.

#### 3. Anterior Bite Plane: Mini Anterior Appliances

- It's an oral appliance that engages only 2-4 maxillary incisors.
- It is also **not recommended** much as the possibility of adverse occlusal changes occurring with continuous and long-term use is of major concern. The design of the appliance only covers the maxillary anterior teeth, leading to the potential for overeruption of the posterior teeth resulting in an anterior open bite.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 4. Anterior Repositioning Appliance (Orthopedic Repositioning Appliance)

- The intent of this appliance, is to alter the maxillomandibular relationship so that a more anterior position assumed by the mandible.
- Acrylic guiding ramp is added to the anterior third of the maxillary appliance that direct the mandible into a more forward position, upon closing.
- It is designed to be used in treating patients with anterior disk displacement with reduction.
- With long term use of this appliance, there are permanent and irreversible occlusal concerns so the anterior bite plane appliance should be used with caution only for short periods of time as a temporary therapeutic measure to relieve internal derangements pain.

### 5. Posterior Bite Plane Appliance (Mandibular Orthopedic Repositioning Appliances)

- These appliances made to be worn on the lower arch.
- These appliances intended to produce vertical dimension and horizontal maxillomandibular relationship changes.
- The major concern regarding posterior bite plane design is that occlusion only on posterior teeth that allow overeruption of the anterior teeth or intrusion of the opposing posterior teeth, that Eventually lead to a posterior open bite, hence not recommended.

### Other Therapies

- Acupuncture
- Botox injections
- Chiropractic/ Osteopath jaw manipulations and other treatments have been tried in TMD management but have yet to be accepted into mainstream practice due to lack of evidence in the effectiveness of these modalities.

### 1. Surgical treatment:

- The literature has shown that about 5–10 per cent of all patients undergoing treatment for temporomandibular disorders require surgical intervention.
- The surgical procedures currently used for the treatment of temporomandibular disorders ranges from
  - i. temporomandibular joint arthrocentesis and arthroscopy to the more complex
  - ii. open joint surgical procedures, referred to as arthrotomy
- Oral & Maxillofacial Surgeons with a special interest in this field will often prefer to see patients undergo a period of non-surgical therapy prior to seeking a surgical opinion.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### 1. Surgical treatment:

**Table 3. Indications for for TMJ surgery**

**Absolute indications**

- 1 Ankylosis – eg. Fibrous or osseous joint fusion
- 2 Neoplasia – eg. Osteochondroma of the condyle
- 3 Dislocation – ie. Recurrent or chronic
- 4 Developmental disorders – eg. Condylar hyperplasia

**Relative indications**

- 1 Internal derangement
- 2 Osteoarthritis
- 3 Trauma

**A General indications**

- i Disorder not responding to non-surgical therapy
- ii Where the TMJ is the source of pain and dysfunction
  - a Pain localised to the TMJ
  - b Pain on functional loading and movement of the TMJ
  - c Mechanical interference with TMJ function

**B Specific indications**

- i Chronic severe limited mouth opening
- ii Advanced degenerative joint disease with intolerable symptoms of pain and joint dysfunction
- iii Confirmation of severe joint disease on CT scan or MRI

### 2. Use of Botulinum Toxin for management of TMD:

There is some evidence for the use of botulinum toxin to manage the symptoms of temporomandibular disorders when conservative measures are inadequate. Ensure patients understand that botulinum toxin is not a cure for temporomandibular disorders, but may be used as part of the overall management strategy. The use of botulinum toxin for temporomandibular disorders is off-label. Dentists require additional training to administer botulinum toxin.\* If the recommended doses and protocols are adhered to, the incidence of adverse effects is low. Local complications include stinging during injections, bruising at the site of injection and excessive muscle weakness. Adverse effects associated with inadvertent injection of botulinum toxin into nontarget tissues are rare, but can include alteration in smile and temporary dry mouth. Systemic adverse effects include an influenza-like syndrome that is transient and hypersensitivity reactions.

Surgery for temporomandibular disorders is rarely required. Only consider referring the patient for a surgical assessment if symptoms have not responded to conservative management and there is definitive evidence of internal joint derangement or other joint pathology on imaging.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### BRUXISM

- It is the repeated clenching and grinding of teeth and bracing or thrusting of the mandible.
- It can occur in sleep or while awake.
- Etiology is complex and multifactorial and not fully understood.

#### Types of Bruxism:

##### 1. Sleep bruxism:

- No evidence to show that occlusal factors cause sleep bruxism.
- In sleep bruxism, Rhythmic masticatory activity peaks in the minutes before REM (Rapid Eye Movement) sleep, suggesting that it has onset related to sleep-stage transitions.
- Sleep bruxism is usually noted by a partner during sleep

common. However, in the sleep laboratory, approximately 50% of people with a history of tooth grinding have low frequencies of jaw muscle contractions and tooth grinding. It remains to be clarified when tooth grinding becomes a disorder associated with negative consequences such as tooth damage and pain.

Bruxism may rarely be a sign of orofacial dyskinesia, or occur following a head injury. Acute oromandibular dystonia or tardive dyskinesia caused by dopamine antagonist antiemetic drugs (eg metoclopramide, prochlorperazine) or antipsychotic drugs may be mistaken for bruxism.

- Management of sleep bruxism: It includes:
  - i. Avoiding risk factors
  - ii. Relaxation techniques
  - iii. Hypnotherapy
  - iv. Biofeedback
  - v. Cognitive behavioral therapy (CBT)
  - vi. Improving sleep hygiene

Full-coverage intraoral occlusal appliances (splints or dental guards) can be used to protect the teeth from attrition during sleep bruxism. They should be custom-made by a dentist with appropriate expertise or an oral medicine specialist, regularly reviewed and adjusted as required. In addition to preventing tooth damage, intraoral occlusal appliances reduce muscle strain and loading of the temporomandibular joints; however, they do not cure bruxism. Partial coverage splints should not be used because of the potential for significant occlusal changes and the risk of aspiration.

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## TMD'S AND SPLINT TYPES AND BRUXISM

### Types of Bruxism:

#### 2. Awake Bruxism

- Occurs when the patient is awake.
- Management requires:
  - i. Habit recognition and reversal
  - ii. Stress management

and stress management. There is no evidence for hypnotherapy, biofeedback or cognitive behavioural therapy for awake bruxism.

- Common Triggers for Bruxism:

Box 17. Common triggers of bruxism	
•	caffeine and other stimulants, including herbal stimulants
•	alcohol
•	smoking
•	snoring
•	obstructive sleep apnoea
•	stress and anxiety
•	antidepressants
–	selective serotonin reuptake inhibitors (SSRIs)
–	serotonin and noradrenaline reuptake inhibitors (SNRIs)
•	antipsychotics
•	amphetamines
–	dexamfetamine
–	lisdexamfetamine
–	metamfetamine
–	MDMA (ecstasy)
•	cocaine

### Signs of Bruxism (parafunction) include:

- cracked teeth, .
- multiple failed restorations
- chipping of incisal edges,
- wear facets
- mobile teeth
- masseteric hypertrophy,
- buccal mucosal ridging and,
- scalloping of the lateral border of the tongue

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# JAW CYSTS AND TUMORS

(Source- Text book of White and Pharoah Radiology, Internet)

## CYSTS

- A cyst is a pathologic cavity filled with fluid, lined by epithelium, and surrounded by a definite connective tissue wall.
- The cystic fluid either is secreted by the cells lining the cavity or derives from the surrounding tissue fluid.
- Cysts occur more often in the jaws than in any other bone because most cysts originate from the numerous rests of odontogenic epithelium that remain after tooth formation.
- Cysts are **radiolucent lesions**, and the prevalent clinical features are swelling, pain (unless the cyst becomes secondarily infected or is related to a nonvital tooth), and association with unerupted teeth, especially third molars.
- Cysts may occur centrally (within bone) in any location in the maxilla or mandible but are rare in the condyle and coronoid process.
- Odontogenic cysts are found most often in the tooth-bearing region. In the mandible, they originate above the inferior alveolar nerve canal.
- Cysts that originate in bone usually have a periphery that is well defined and corticated (characterized by a fairly uniform, thin, radiopaque line)
- However, a secondary infection or a chronic state can change this appearance into a thicker, more sclerotic boundary or make the cortex less apparent.

## A. Odontogenic Cysts:

### 1. Radicular cysts:

- Also known as **Periapical cyst, apical periodontal cyst, and dental cyst.**
- A radicular cyst is a cyst that most likely results when rests of epithelial cells (Malassez) in the periodontal ligament are stimulated to proliferate and undergo cystic degeneration by inflammatory products from a nonvital tooth.
- **Radicular cysts are the most common type of cyst in the jaws.**
- They arise from **non-vital teeth.**
- Often radicular cysts produce no symptoms unless secondary infection occurs. A cyst that becomes large may cause swelling.
- The incidence of radicular cysts is greater in the third to sixth decades and shows a slight male predominance
- Radiographically, in most cases the epicenter of a radicular cyst is located approximately at the apex of a nonvital tooth.

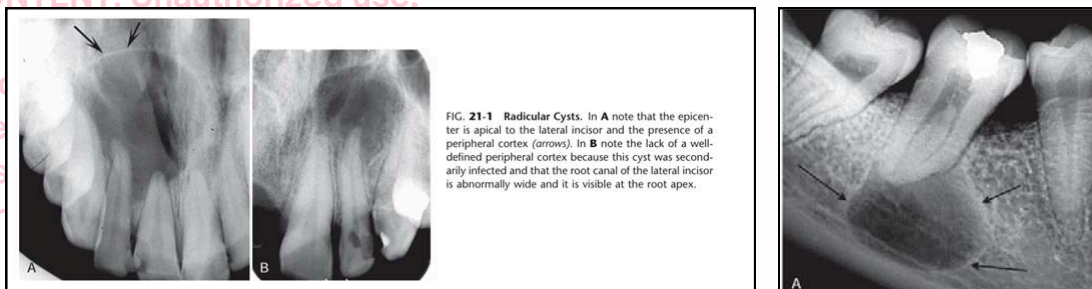


Image: A periapical film of a radicular cyst reveals a lesion with a well-defined cortical boundary (arrows). Note that the presence of the inferior cortex of the mandible has influenced the circular shape of the cyst.

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# JAW CYSTS AND TUMORS

## A. Odontogenic Cysts:

### 1. Radicular cysts:

- Most radicular cysts (60%) are found in the maxilla, especially around incisors and canines.
- Treatment of a tooth with a radicular cyst may include extraction, endodontic therapy, and apical surgery.
- Treatment of a large radicular cyst usually involves surgical removal or marsupialization.
- Recurrence of a radicular cyst is unlikely if it has been removed completely.

### 2. Residual Cyst:

- A residual cyst is a cyst that remains after incomplete removal of the original cyst.
- The term residual is used most often for a radicular cyst that may be left behind, most commonly after extraction of a tooth.
- A residual cyst usually is asymptomatic and often is discovered on radiographic examination of an edentulous area.
- The treatment for residual cysts is surgical removal or marsupialization, or both, if the cyst is large.

### 3. Dentigerous Cysts/ Follicular Cyst:

- A dentigerous cyst is a cyst that forms around the crown of an unerupted tooth.
- It begins when fluid accumulates in the layers of **reduced enamel epithelium or between the epithelium and the crown of the unerupted tooth**.
- An eruption cyst is the soft tissue counterpart of a dentigerous cyst.
- Dentigerous cysts are the **second most common type** of cyst in the jaws.
- They develop around the crown of an unerupted or supernumerary tooth.
- The clinical examination reveals a missing tooth or teeth and possibly a hard swelling, occasionally resulting in facial asymmetry.
- The patient typically has no pain or discomfort.
- The epicenter of a dentigerous cyst is found just above the crown of the involved tooth, **most commonly the mandibular or maxillary third molar or the maxillary canine**.
- **An important diagnostic point** is that **this cyst attaches at the cemento-enamel junction**.
- Dentigerous cysts around supernumerary teeth account for about 5% of all dentigerous cysts, most developing around a mesiodens in the anterior maxilla.
- Some dentigerous cysts are eccentric, developing from the lateral aspect of the follicle so that they occupy an area beside the crown instead of above the crown.
- A dentigerous cyst has a propensity to displace and resorb adjacent teeth
- It commonly displaces the associated tooth in an apical direction.

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## JAW CYSTS AND TUMORS

### A. Odontogenic Cysts:

#### 3. Dentigerous Cysts/ Follicular Cyst:

- Dentigerous cysts are treated by surgical removal, which may include the tooth as well.
- Large cysts may be treated by marsupialization before removal. The cyst lining should be submitted for histologic examination because ameloblastomas have been reported to occur in the cyst lining.

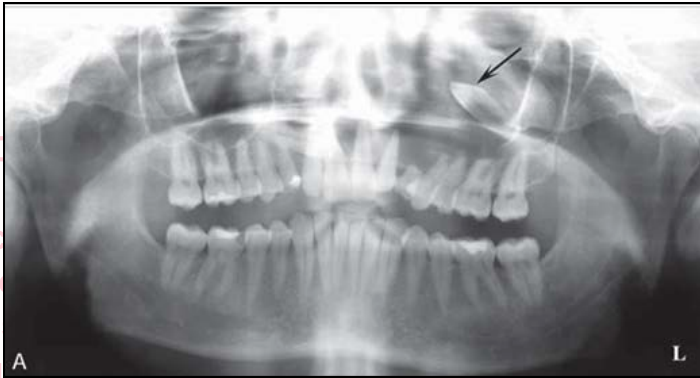


Image: This panoramic image reveals the presence of a large dentigerous cyst associated with the left maxillary cuspid (arrow), which has been displaced.

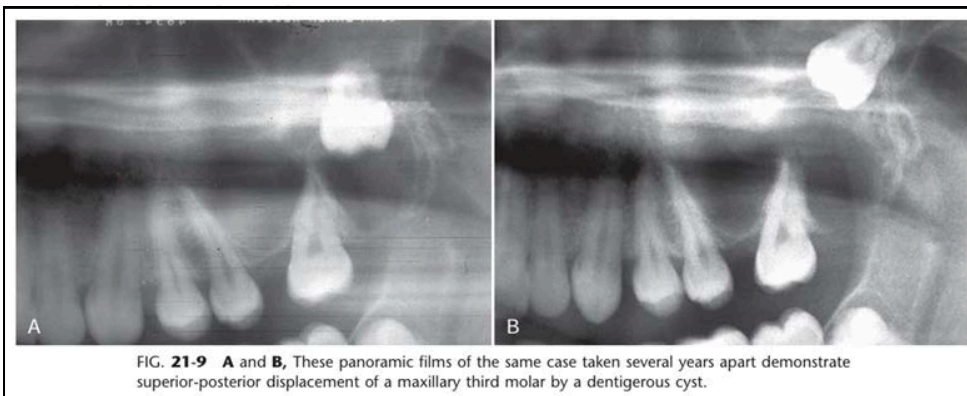


FIG. 21-9 A and B, These panoramic films of the same case taken several years apart demonstrate superior-posterior displacement of a maxillary third molar by a dentigerous cyst.

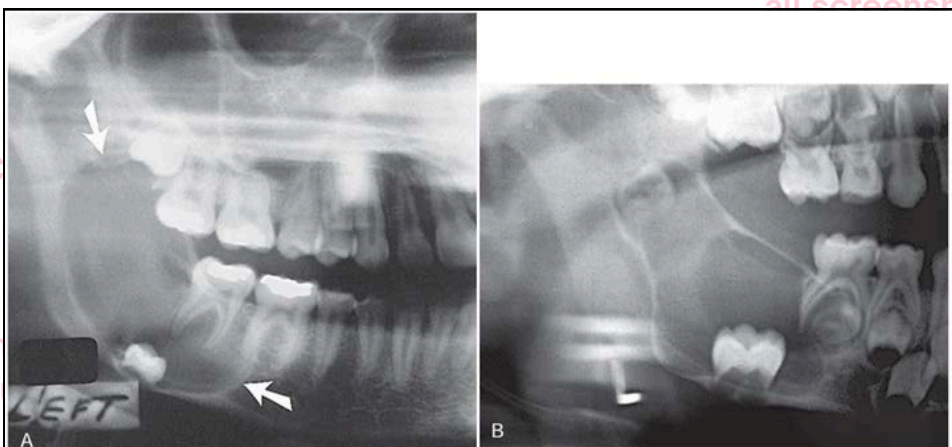


Image: Dentigerous cysts displacing teeth. A, the third molar has been displaced to the inferior cortex. B, the developing second molar has been displaced into the ramus by a cyst associated with the first molar.

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# JAW CYSTS AND TUMORS

## A. Odontogenic Cysts:

### 4. Keratocystic Odontogenic Tumor (KOT)

- Also known as **Odontogenic keratocyst and primordial cyst**.
- The World Health Organization has reclassified this cystic lesion into a unicystic or multi-cystic odontogenic tumor on the basis of the tumor-like characteristics of the lining epithelium.
- The epithelial lining is distinctive also because it is keratinized (hence the name) and thin (four to eight cells thick).
- Occasionally budlike proliferations of epithelium grow from the basal layer into the adjacent connective tissue wall.
- Islands of epithelium in the wall may give rise to satellite microcysts.
- The inside of the cyst often contains a viscous or cheesy material derived from the epithelial lining.
- They occur in a wide age range, but most develop during the **second and third decades**, with a slight male predominance.
- KOTs usually have no symptoms, although mild swelling may occur. Pain may occur with secondary infection.
- Aspiration may reveal a thick, yellow, cheesy material (keratin).
- Unlike other cysts, KOTs have a high propensity for recurrence, possibly because of small satellite cysts or fragments of epithelium left behind after surgical removal of the cyst.
- **The most common location of KOT is the posterior body of the mandible (90% occur posterior to the canines) and ramus (more than 50%)**
- The epicenter is located superior to the inferior alveolar nerve canal.
- Radiographically the cyst is radiolucent and has the affinity to grow along the internal aspects of the jaws causing minimal expansion.
- **This occurs throughout the mandible except for the upper ramus and coronoid process, where considerable expansion may occur.**
- When in a peri coronal position, a KOT may be indistinguishable from a dentigerous cyst.
- The lesion is likely to be a KOT if the cystic outline is connected to the tooth at a point apical to the cemento-enamel junction or if no expansion of the cortical plates has occurred.
- The typical scalloped margin and multilocular appearance of the KOT may resemble an ameloblastoma, **but ameloblastoma has a greater propensity to expand.**
- A KOT may also show some similarity to an odontogenic myxoma, especially in the characteristics of mild expansion and multilocular appearance

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## JAW CYSTS AND TUMORS

### A. Odontogenic Cysts:

#### 4. Keratocystic Odontogenic Tumor (KOT)

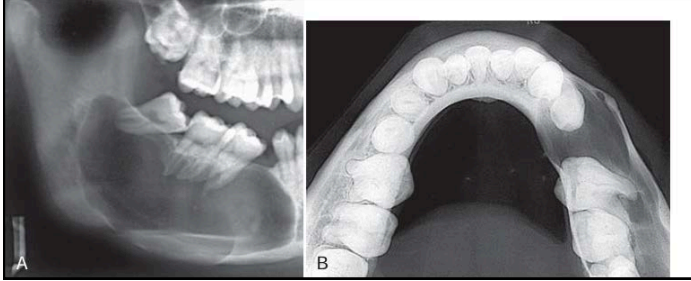


Fig: A large (KOT) occupying most of the right body and ramus of the mandible. Despite the large size, the buccal and lingual cortical plates of the mandible have been expanded only slightly, as can be seen in the occlusal film.

- If a KOT is suspected, referral to a radiologist for a complete radiologic examination is advisable.

#### 5. Lateral Periodontal Cyst

- Lateral periodontal cysts are thought to arise from epithelial rests in periodontium lateral to the tooth root.
- This condition usually is unicystic, but it may appear as a cluster of small cysts, a condition referred to as **botryoid odontogenic cysts**.
- The lesions usually are asymptomatic and less than 1 cm in diameter.
- If these cysts become secondarily infected, they will mimic a lateral periodontal abscess.
- A total of 50% to 75% of lateral periodontal cysts develop in the mandible, mostly in a region extending from **the lateral incisor to the second premolar**.
- A lateral periodontal cyst appears as a well-defined radiolucency with a prominent cortical boundary and a round or oval shape.
- Rare large cysts have a more irregular shape. The internal aspect usually is radiolucent.

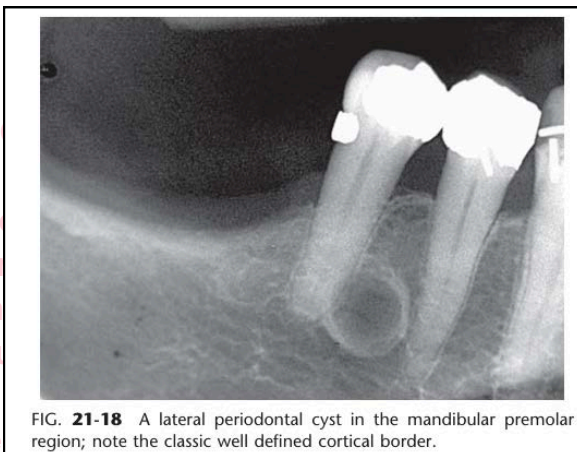


FIG. 21-18 A lateral periodontal cyst in the mandibular premolar region; note the classic well defined cortical border.

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## JAW CYSTS AND TUMORS

### A. Odontogenic Cysts:

#### 5. Lateral Periodontal Cyst

- The botryoid variety may have a multilocular appearance, although this aspect is related more to the histologic appearance.
- Lateral periodontal cysts usually do not require sophisticated imaging because of their small size.
- **Excisional biopsy or simple enucleation** is the **treatment of choice** because these cysts do not tend to recur.

### B. Non- Odontogenic Cysts:

#### 1. Nasopalatine duct Cyst:

- Also known as **Nasopalatine canal cyst, incisive canal cyst, nasopalatine cyst, median palatine cyst, and median anterior maxillary cyst.**
- Nasopalatine duct cysts account for about 10% of jaw cysts.
- The incidence is three times higher in males.
- Most of these cysts are asymptomatic or cause such minor symptoms that they are tolerated for long periods
- The most frequent complaint is a small, well-defined swelling just posterior to the palatine papilla. This swelling usually is fluctuant and blue if the cyst is near the surface.
- If the cyst expands, it may penetrate the labial plate and produce a swelling below the maxillary labial frenum or to one side.
- Most nasopalatine duct cysts are found in the naso- palatine foramen or canal. However, if this cyst extends posteriorly to involve the hard palate.
- Radiographically, the periphery usually is well defined and corticated and is circular or oval in shape. The shadow of the nasal spine sometimes is superimposed on the cyst, **giving it a heart shape.** Most are typically radiolucent.
- Most commonly this cyst causes the roots of the central incisors to diverge, and occasionally root resorption occurs.



FIG. 21-21 Two examples of nasopalatine duct cysts. Note the uniform periodontal membrane space around all the apices.

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# JAW CYSTS AND TUMORS

## B. Non- Odontogenic Cysts:

### 1. Nasopalatine duct Cyst:

- The most common differential diagnosis is a large incisive foramen.
- A foramen larger than 6 mm may simulate the appearance of a cyst.
- The appropriate treatment for a nasopalatine cyst is enucleation, preferably from the palate to avoid the nasopalatine nerve.
- If the cyst is large and the danger exists of devitalizing the tooth or creating a nasooral or antro-oral fistula, the surgeon may perform marsupialization of the cyst.

### 2. Nasolabial Cyst

- **AKA, Naso-alveolar cyst**
- When this rare lesion is small, it may produce a very subtle, unilateral swelling of the nasolabial fold and may elicit pain or discomfort.
- When large, it may bulge into the floor of the nasal cavity, causing some obstruction, flaring of the alae, distortion of the nostrils, and fullness of the upper lip. If infected, it may drain into the nasal cavity.
- It usually is unilateral, but bilateral lesions have occurred.
- Nasolabial cysts are primarily soft tissue lesions located adjacent to the alveolar process above the apices of the incisors.
- Because this is a soft tissue lesion, plain radiographs may not show any detectable changes.
- The investigation could include either CT or magnetic resonance imaging (MRI), both of which can provide an image of soft tissues.
- The nasolabial cyst should be excised through an intraoral approach. These cysts do not tend to recur.

## C. Cyst Like lesions:

### 1. Simple Bone cysts:

- **AKA Traumatic bone cyst, hemorrhagic bone cyst, extravasation cyst, progressive bone cavity, solitary bone cyst, and unicameral bone cyst.**
- An SBC is a cavity within bone that is lined with connective tissue. It may be empty, or it may contain fluid.
- However, because it has no epithelial lining, **it is not a true cyst.**
- SBCs are very common lesions.
- Most occur in the **first two decades of life.**
- lesion shows a male predominance of approximately 2 : 1.
- SBCs are asymptomatic in most cases, but occasionally pain or tenderness may be present, especially if the cyst has become secondarily infected.
- The teeth in the affected region usually **are vital.**
- Most SBCs are discovered only by chance, during radiographic examinations, and for this reason they can become quite large.
- Almost all SBCs are found in the mandible.

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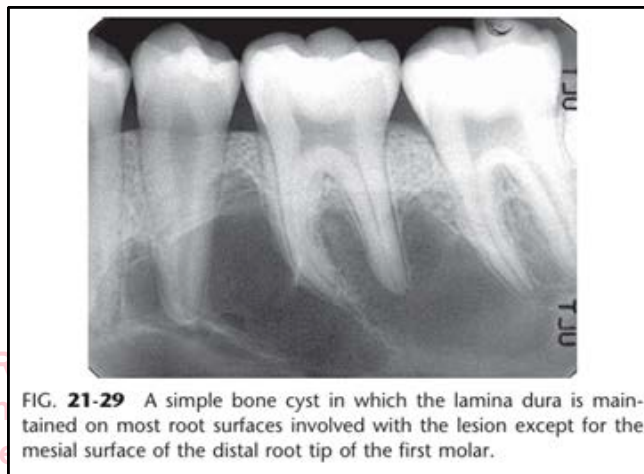
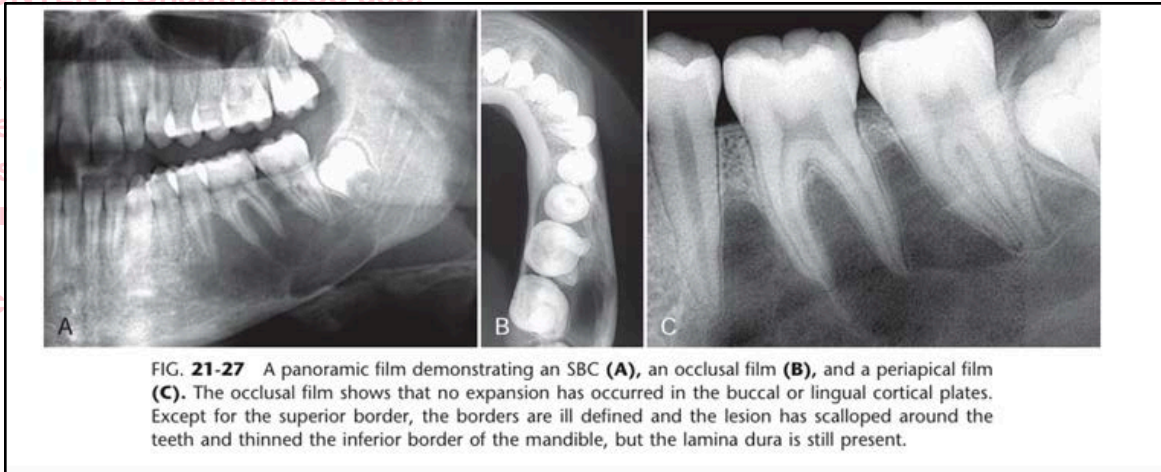


## JAW CYSTS AND TUMORS

### C. Cyst Like lesions:

#### 1. Simple Bone cysts:

- The lesion can occur anywhere in the mandible but is seen most often in the ramus and posterior mandible in older patients.
- SBCs also frequently occur with cemento-osseous and fibrous dysplasia.
- Radiographically, the shape most often is smooth and curved, like a cyst, with an oval or scalloped border. The lesion often scallops between the roots of the teeth.
- The margin may vary from a well-defined, delicate cortex to an ill-defined border that blends into the surrounding bone.



- The customary treatment is a conservative opening into the lesion and careful curettage of the lining; this usually initiates bleeding and subsequent healing. Spontaneous healing has been reported.

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# JAW CYSTS AND TUMORS

## TUMORS:

### Benign tumors of jaw:

- Benign tumors are slowly growing and spread by direct extension and not by metastases.
- Benign tumors typically have an insidious onset and grow slowly.
- These tumors usually are painless, do not metastasize, and are not life threatening unless they interfere with a vital organ by direct extension.
- Benign tumors are usually detected clinically by enlargement of the jaws or are found during a radiographic examination.
- Once the clinician has made a preliminary diagnosis of the presence of a tumor, a full radiologic examination should be made to fully document the extent and characteristics of the lesion.
- **Radiographically**, the internal structure may be completely radiolucent or radiopaque or may be a mixture of radiolucent and radiopaque tissues.
- If the lesion contains radiopaque elements, these structures usually represent either residual bone or a calcified material that is being produced by the tumor.
- Benign tumor exerts pressure on neighboring structures, resulting in the displacement of teeth or bony cortices.
- If the growth is slow enough, there will be adequate time for the outer cortex to remodel in response to the pressure, resulting in an appearance that the cortex has been displaced by the tumor.
- Benign tumors may also cause bodily displacement of nearby teeth.
- The roots of teeth may be resorbed by either benign or malignant tumors, but root resorption is more commonly associated with benign processes.
- The benign tumors especially likely to resorb roots are ameloblastomas, ossifying fibromas, and central giant cell granulomas.
- Benign tumors tend to resorb the adjacent root surfaces in a smooth fashion.
- Bone dysplasia such as fibrous dysplasia do not usually resorb teeth.
- When root resorption is associated with malignant tumors, the resorption is usually in smaller quantities, causing thinning of the root into a "spiked" shape.

### 1. Torus Palatinus

- AKA Palatine torus
- Torus palatinus is a bony protuberance (hyperostosis) that occurs in the middle third of the midline of the hard palate.
- Torus palatinus, the most common exostoses, occurs in about 20% of the population.
- The size and shape of a torus palatinus can vary, and these lesions have been described as flat, lobulated, nodular, or mushroom like.

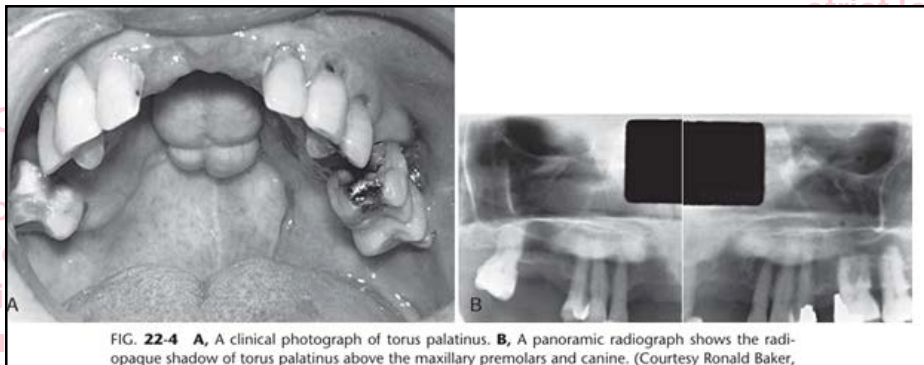
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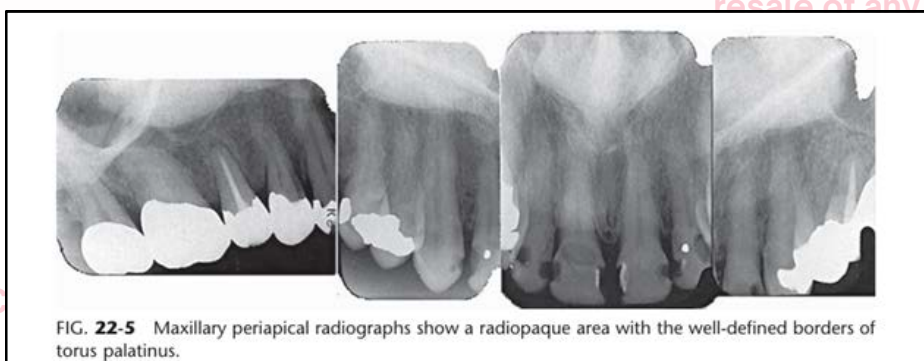
# JAW CYSTS AND TUMORS

## 1. Torus Palatinus

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- Torus palatinus, the most common exostoses, occurs in about 20% of the population.
- The size and shape of a torus palatinus can vary, and these lesions have been described as flat, lobulated, nodular, or mushroom like.



- On maxillary periapical or panoramic radiographs, a torus palatinus appears as a dense radiopaque shadow below and attached to the hard palate.
- It may be superimposed over the apical areas of the maxillary teeth, especially if the torus has developed in the middle or anterior regions of the palate.
- The image of a palatal torus may project over the roots of the maxillary molars but the shadow will usually move in its position relative to the roots of the teeth if another film is taken with a different horizontal or vertical angulation of the central ray.



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# JAW CYSTS AND TUMORS

## 2. Mandibular Torus:

- Torus mandibularis is a hyperostosis that protrudes from the lingual aspect of the mandibular alveolar process, usually near the premolar teeth.
- Tori occur less often on the lingual surface of the mandible than on the palate.
- These tori develop singly or multiply, unilaterally or bilaterally (usually bilaterally), and most often in the premolar region.
- On mandibular periapical radiographs, a torus mandibularis appears as a radiopaque shadow, usually superimposed on the roots of premolars and molars and occasionally over a canine or incisor.
- It usually is superimposed over about three teeth.
- Mandibular tori are sharply demarcated anteriorly on periapical films and are less dense and less well defined as they extend posteriorly
- There is no margin between the periphery of the torus and the surface of the mandible because the torus is continuous with the mandibular cortex.
- On occlusal radiographs a mandibular torus appears as a radiopaque and homogeneous
- Tori usually do not require any treatment.

## 3. Other exostoses:

- In addition to the torus, other exostoses may occur at other sites in the jaws.
- Exostoses may develop most commonly on the buccal surface of the maxillary alveolar process, usually in the canine or molar area.
- They may also occur on the palatal surface or crest and less commonly on the mandibular alveolar process.
- Occasionally they will grow on the crest under a pontic of a fixed bridge.
- They are less common than mandibular or palatine tori, may attain a large size, and may be solitary or multiple.
- They are nodular, pedunculated, or flat prominences on the surface of the bone.
- Maxillary alveolar process is the most common location and usually the image overlaps the roots of the adjacent teeth.
- The periphery of an exostosis is usually well defined and smoothly contoured with a curved border and The internal aspect of an exostosis usually is homogeneous and radiopaque.



Image: A, A periapical film of a region of hyperostosis on the buccal aspect of the maxillary alveolar process, seen as a region of slight increase in radiopacity overlapping the roots of the molars (arrows). B, another example overlapping an edentulous ridge. C, an example occurring on the crest of the alveolar ridge. D, an example occurring under a bridge pontic.

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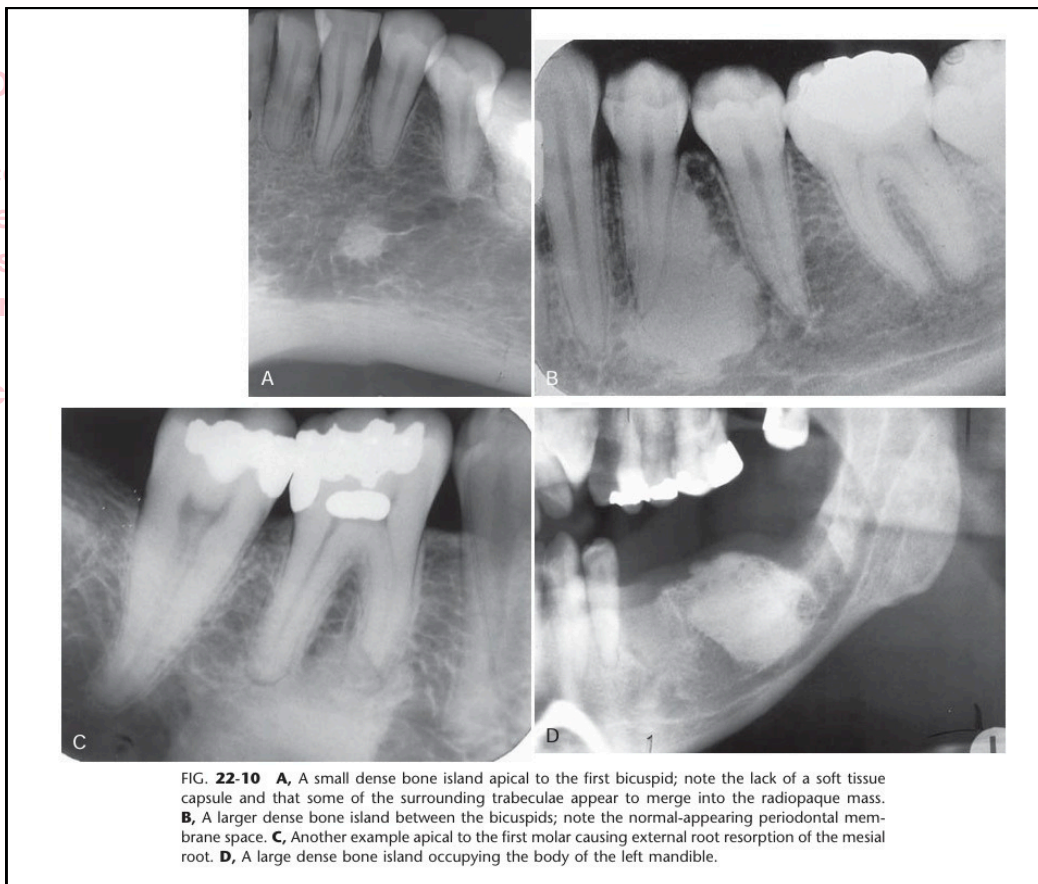
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## JAW CYSTS AND TUMORS

### 4. Dense Bone Islands:

- AKA Enostosis and periapical idiopathic osteosclerosis.
- Dense bone islands (DBIs) are the internal counterparts of exostoses. They are localized growths of compact bone that develop within the cancellous bone.
- They are asymptomatic
- DBIs are more common in the mandible than in the maxilla. They occur most often in the premolar-molar area.
- The tooth most often involved is the mandibular first molar. In all circumstances the tooth is vital.



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# JAW CYSTS AND TUMORS

## A. Odontogenic Tumors:

### 1. Ameloblastoma:

- Also known as Adamantinoma, adamantoblastoma, adontomes embryolastiques, and epithelial odontoma.
- The ameloblastoma, a true neoplasm of odontogenic epithelium, is a persistent and locally invasive tumor; it has aggressive but benign growth characteristics.
- It is an aggressive neoplasm that arises from remnants of the dental lamina and dental organ (odontogenic epithelium).
- Ameloblastomas may be divided into:
  - a) the solid/multicystic type,
  - b) the unicystic type, and
  - c) the desmoplastic type
- The unicystic variant may develop as a single entity or may form from the epithelial lining of a dentigerous cyst, called a mural (within the wall) ameloblastoma.
- There is a slight predilection for this lesion to occur in men, and it develops more often in blacks.
- most patients are between 20 and 50 years, with the average age at discovery about 40 years.
- Ameloblastomas grow slowly, and few, if any, symptoms occur in the early stages. The tumor is frequently discovered during a routine dental examination.
- Usually the patient eventually notices gradually increasing facial asymmetry.
- Most ameloblastomas (80%) develop in the molar ramus region of the mandible, but they may extend to the symphyseal area. Most lesions that occur in the maxilla are in the third molar area and extend into the maxillary sinus and nasal floor. In either jaw this tumor can originate in an occlusal position to a developing tooth.
- Radiographically, The ameloblastoma is usually well defined and frequently delineated by a cortical border.
- The border is often curved, and in small lesions the border and shape may be indistinguishable from a cyst
- The internal structure varies from totally radiolucent to mixed with the presence of bony septa creating internal compartments. These septa can be straight but are more commonly coarse and curved and originate from normal bone that has been trapped within the tumor.
- These septa are often remodeled into curved shapes providing a **honeycomb** (numerous small compartments or loculations) or **soap bubble** (larger compartments of variable size) patterns.
- There is a pronounced tendency for ameloblastomas to **cause extensive root resorption**.
- Tooth displacement is common. Because a common point of origin is occlusal to a tooth, some teeth may be displaced apically.

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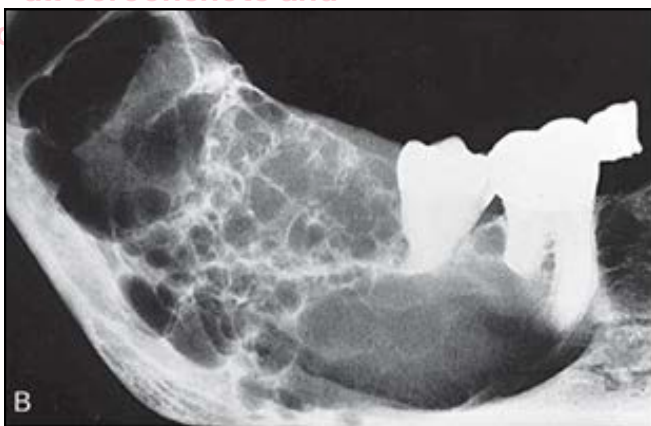
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## JAW CYSTS AND TUMORS

### A. Odontogenic Tumors:

#### 1. Ameloblastoma:

- Computed tomographic (CT) images often reveal regions of perforation of the expanded cortical plate as a result of the inability of the production of periosteal new bone to keep up with the rate of growth of the expanding ameloblastoma.



Images: Examples of ameloblastoma

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## JAW CYSTS AND TUMORS

### B. Mixed Tumors: OF ODONTOGENIC EPITHELIUM AND ODONTOGENIC ECTOMESENCYME

#### 1. Odontoma:

- Also known as Compound odontoma, compound composite odontoma, complex odontoma, complex composite odontoma, odontogenic hamartoma, calcified mixed odontoma, and cystic odontoma.
- The term odontoma is used to identify a tumor that is radiographically and histologically characterized by the production of mature enamel, dentin, cementum, and pulp tissue.
- These components are seen in various states of histodifferentiation and morphodifferentiation.
- Because of its limited and slow growth and well-differentiated tooth tissue, this lesion is considered to be a hamartoma and not a true tumor.
- Odontomas are the most common odontogenic tumor. They often interfere with the eruption of permanent teeth.
- The lesion shows no sex predilection, and most begin forming while the normal dentition is developing. Odontomas develop and mature while the corresponding teeth are forming and cease development when the associated teeth complete development.
- Most odontomas occur in the second decade of life and many times are found during investigation of delayed eruption of adjacent teeth or retained primary teeth.
- There are two types of odontomas.
  - a) Complex
  - b) Compound
- Compound odontomas are about twice as common as the complex type.
- Although the compound variety forms equally between men and women, 60% of complex odontomas occur in women.
- More of the compound type (62%) occur in the anterior maxilla in association with the crown of an unerupted canine.
- In contrast, 70% of complex odontomas are found in the mandibular first and second molar area.
- Radiographically, The borders of odontomas are well defined and may be smooth or irregular. These lesions have a cortical border, and immediately inside and adjacent to the cortical border is a soft tissue capsule.
- The contents of these lesions are largely radiopaque.

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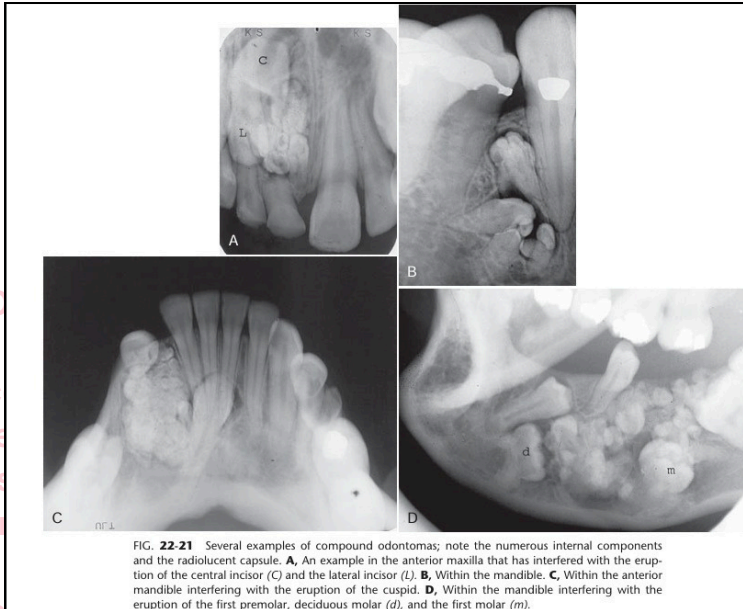
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## JAW CYSTS AND TUMORS

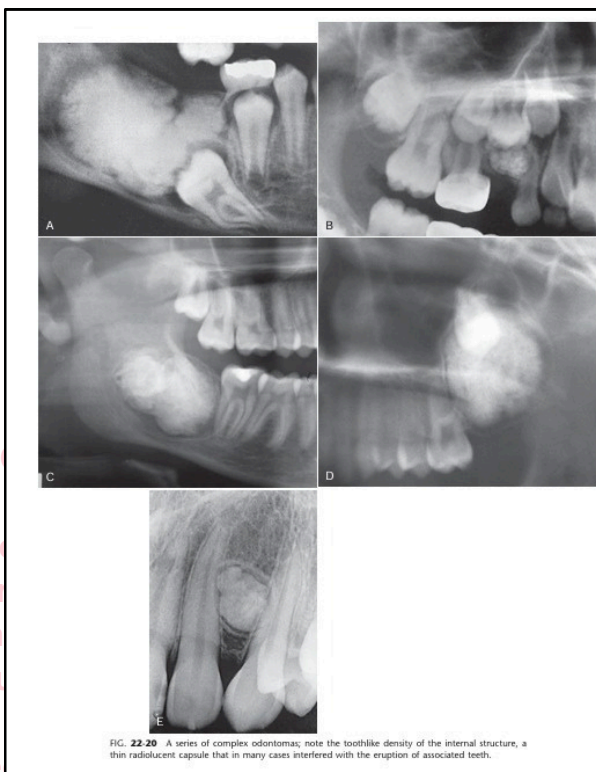
### a) Compound odontomas:

- Compound odontomas have a number of toothlike structures or denticles that look like deformed teeth



### b) Complex Odontomas:

- Complex odontomas contain an irregular mass of calcified tissue.



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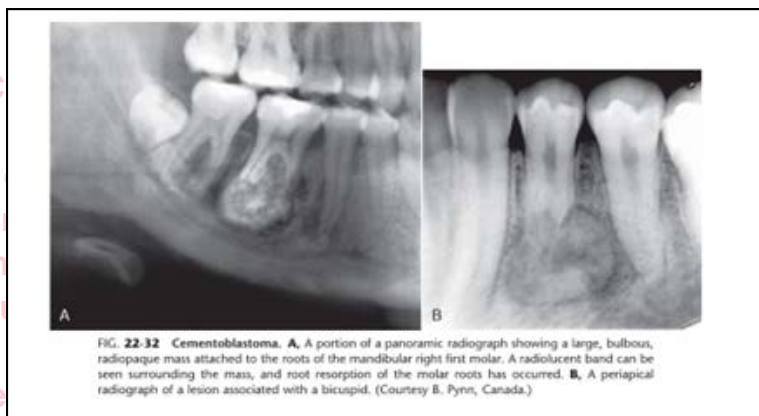
## JAW CYSTS AND TUMORS

### b) Complex Odontomas:

- Odontomas can interfere with the normal eruption of teeth.
- Most odontomas (70%) are associated with abnormalities such as impaction, malpositioning, diastema, aplasia, malformation, and devitalization of adjacent teeth.
- Large complex odontomas may cause expansion of the jaw with maintenance of the cortical boundary.
- Complex and compound odontomas are usually removed by simple excision. They do not recur and are not locally invasive.

### 2. Benign Cementoblastoma

- AKA Cementoblastoma and true cementoma.
- Benign cementoblastomas are slow-growing mesenchymal neoplasms composed principally of cementum-like tissue.
- The tumor manifests as a bulbous growth around and attached to the apex of a tooth root.
- The lesion is more common in males than in females, and the ages of reported patients range from 12 to 65 years, although most patients are relatively young
- The tumor usually is a solitary lesion that is slow growing but that may eventually displace teeth.
- The **involved tooth is vital and often painful**. The pain seems to vary from patient to patient and can be relieved by anti-inflammatory drugs.
- Radiographically, Benign cementoblastomas occur more often in the mandible (78%) and form most commonly on a premolar or first molar (90%). The lesion is a well-defined radiopacity with a cortical border and then a well-defined radiolucent band just inside the cortical border.
- Benign cementoblastomas are mixed radio lucent-radiopaque lesions where the majority of the internal structure is radiopaque. The resulting pattern may be amorphous or may have a wheel spoke pattern.
- This central radiopaque mass as mentioned is surrounded by a radiolucent band, indicating that the tumor is maturing from the central aspect to the periphery.



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# JAW CYSTS AND TUMORS

## 2. Benign Cementoblastoma

- Benign cementoblastomas are self-limiting and rarely recur after enucleation.
- Simple excision and extraction of the associated tooth is sufficient treatment.
- In some cases, the tumor may be amputated from the tooth, which is then treated endodontically.

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## LA TECHNIQUES AND COMPLICATIONS

Sources: (TG, Review Article on Neural Blockade Anesthesia of the Mandibular Nerve and Its Terminal Branches, Methods of administration of local anesthesia by Dr. Elham Hazeim Abdulkareem, nicb article)

- Pain is an unpleasant sensory and psychological experience resulting from actual or potential tissue damage and is commonly associated with dental treatment.
- **Local anesthesia is a safe and effective way of managing pain.**
- Anesthetic agents work by reversibly binding to sodium channels, preventing the entry of sodium into the cells and thereby inhibiting the propagation of nerve impulses. Consequently, nociceptive impulses associated with painful stimuli do not reach the brain, and the patient does not perceive pain.
- Local anesthesia in dentistry can be given as either infiltration or block anesthesia. Generally, infiltration anesthesia is commonly used in the maxilla, whereas block anesthesia is frequently used in the mandible.

### Local Anesthetic Agents

- Local anesthetics are divided into two classes:
  - a) amides and
  - b) esters
- Amide anesthetics are common in dentistry, including lidocaine, prilocaine, mepivacaine, and bupivacaine. Articaine is an amide anesthetic with an ester linkage.
- Ester anesthetics are less frequently utilized in dentistry, but drugs such as benzocaine may be used for topical anesthesia.
- The gold standard and most widely used local anesthetic in dentistry is lidocaine due to its safety and effectiveness.
- Adrenaline is added to lidocaine to counteract its vasodilating properties and delay drug absorption, which prolongs the duration of anesthesia and reduces the toxicity risk.

#### Adding vasoconstrictors to local anaesthetics

Local anaesthetics may be used in combination with a vasoconstrictor to prolong local anaesthetic effects. Vasoconstriction reduces the rate of local anaesthetic loss to the circulation and reduces bleeding, both during and after the procedure.

Adrenaline (epinephrine) is a commonly used vasoconstrictor in dental practice. Avoid adrenaline-containing solutions in patients with known sensitivity to sulfites\*, because metabisulfites are used as a preservative. If adrenaline cannot be used, local anaesthetic solutions containing felypressin or solutions without a vasoconstrictor are alternatives.

Felypressin is an alternative vasoconstrictor to adrenaline (epinephrine) because it has minimal effects on the myocardium at the concentration used in dental cartridges (0.03 international units/mL). Felypressin is safe for dental use in pregnant patients, although previously this was contraindicated.

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## LA TECHNIQUES AND COMPLICATIONS

### Choice of Local anesthetic agent in dentistry: (TG)

#### Choosing a local anaesthetic in dentistry

Table 19 (below) outlines properties of local anaesthetic preparations for infiltration or regional block in dentistry. Consult a source of drug information for precautions, contraindications, drug interactions and adverse effects (for resources, see p.61).

**Table 19. Local anaesthetics for infiltration or regional block in dentistry**

Local anaesthetic	Comments
<b>Short- to intermediate-acting preparations</b>	
lidocaine	shorter acting—use in dentistry may be limited
lidocaine with adrenaline (epinephrine) [NB1]	intermediate acting first line for routine dental procedures
prilocaine [NB1]	shorter acting—use in dentistry may be limited
prilocaine with adrenaline (epinephrine) [NB1]	intermediate acting
prilocaine with felypressin [NB1]	intermediate acting first line for routine dental procedures when adrenaline (epinephrine) is contraindicated
mepivacaine [NB1]	shorter acting—use in dentistry may be limited do not use in children younger than 3 years
mepivacaine with adrenaline (epinephrine) [NB1]	intermediate acting do not use in children younger than 3 years
articaine with adrenaline (epinephrine) [NB1]	risk of prolonged or permanent anaesthesia for infiltration only—do not use for regional blocks (injection close to inferior alveolar, lingual and mental nerves) do not use in children younger than 4 years

**Table 19. Local anaesthetics for infiltration or regional block in dentistry (cont.)**

Local anaesthetic	Comments
<b>Long-acting preparations</b>	
ropivacaine	useful for situations in which prolonged analgesia (eg 12 to 18 hours) is required, postoperative pain, and refractory acute dental pain concentrations up to 0.5% can be used in children
bupivacaine	similar indications to ropivacaine more cardiotoxic than ropivacaine cardiac toxicity may manifest before neurological toxicity do not use in children younger than 12 years
bupivacaine with adrenaline (epinephrine)	similar indications to ropivacaine more cardiotoxic than ropivacaine cardiac toxicity may manifest before neurological toxicity do not use in children younger than 12 years

NB1: Available in dental cartridges.

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## LA TECHNIQUES AND COMPLICATIONS

### Methods of administration:

- The methods of administration of local anesthesia are sub-divided into three methods:

#### a) Topical:

- It is obtained by the application of a suitable anesthetic agent to an area of either skin or mucous membrane in which it penetrates to anesthetize superficial nerve endings. It is commonly used to obtain anesthesia of mucosa prior to injection.
- After topical anesthesia, analgesia occurs approximately 3 mins after administration. (TG)
- It is indicated for minor painful procedures like band removal crown placement, mucosal incision.

Topical administration of a local anaesthetic\* is indicated for minor painful procedures (eg band removal, crown placement, mucosal incision). It may also be used to facilitate injection of local anaesthetic in anxious or needle-phobic patients by eliminating pain on the mucosal surface; however, patients may experience discomfort upon injection of local anaesthetic into the deeper tissues.

#### b) Infiltration:

- In this method the anesthetic solution deposited near the terminal fibers of any nerve, it will infiltrate through the tissues to reach the nerve fibers and thus produce anesthesia of the localized area served by them.
- LA is injected adjacent to the site where analgesia is required.
- Infiltration is sufficient for most teeth, except lower molars.
- Analgesia occurs approximately 2 to 3 minutes after an infiltration injection.
- This technique is subdivided into:

##### i. Sub mucous injection:

- In this technique the solution is deposited just beneath the mucous membrane. This technique is unlikely to produce anesthesia of the dental pulp, it is often employed to anesthetize the long buccal nerve prior to the extraction of mandibular molars or for soft tissue surgery.

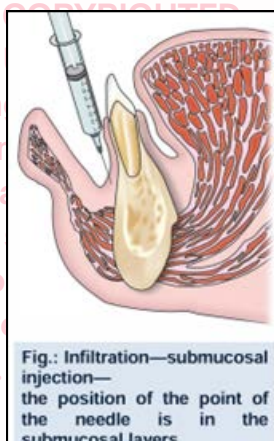


Fig.: Infiltration—submucosal injection—the position of the point of the needle is in the submucosal layers.

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## LA TECHNIQUES AND COMPLICATIONS

### Methods of administration:

#### b) Infiltration:

##### ii. Supra periosteal injection:

- In some sites, such as the maxilla, the outer cortical plate of alveolar bone is thin and perforated by tiny vascular canals.
- In these areas when anesthetic solution is deposited outside the periosteum, it will infiltrate through the periosteum, cortical plate, and medullary bone to the nerve fibers.
- The Supra-periosteal injection is the technique most frequently used in dentistry.

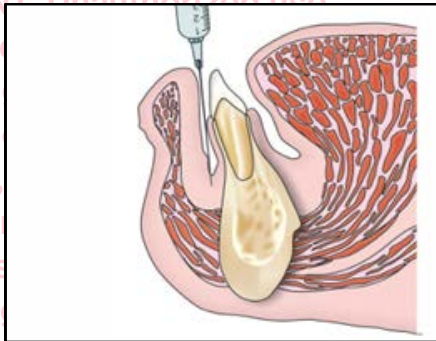


Fig: Infiltration—supraperiosteal injection in anterior maxilla—the position of the point of the needle is at an angle of  $45^\circ$  to the long axis of the tooth



## LA TECHNIQUES AND COMPLICATIONS

### Methods of administration:

#### b) Infiltration:

##### ii. Supra periosteal injection:

##### Buccal Infiltration

- The needle is inserted 2 or 3 mm into the buccal sulcus adjacent to the tooth to be treated. The solution diffuses across the periosteum and alveolar bone to anesthetize the nerves supplying sensation to the tooth, periodontium, and buccal gingiva

##### Palatal Infiltration

- A palatal infiltration can be administered to anesthetize the nasopalatine or greater palatine nerve endings, thus providing anesthesia to the palatal gingiva.
- This injection is often described as painful due to the separation of the tightly-bound mucoperiosteum from the underlying hard palate bone.
- Methods to reduce discomfort may include topical anesthesia, cooling, applying pressure with a mirror handle, or slightly retracting the needle before injection.

##### iii. Sub periosteal injection:

- In this technique the solution is deposited between the periosteum and the cortical plate.
- This technique is painful since the periosteum is firmly bound to the cortical plate.



**Fig.:** Infiltration—subperiosteal injection in anterior maxilla—the position of the point of the needle is at an angle of 90° to the long axis of the tooth and the alveolar bone as seen from the side.

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## LA TECHNIQUES AND COMPLICATIONS

### Methods of administration:

#### b) Infiltration:

##### iv. Intra osseous injection:

- In this technique, the solution is deposited within the medullary bone. The procedure is carried out by the use of bone drills and needles especially designed for this purpose.

##### v. Intra ligamentary injection (Periodontal or peri dental injection)

- It anesthetizes the terminal nerve endings at the site of injection at the apex of the tooth.
- A 27-gauge short needle recommended for this technique.
- Area of insertion is the long axis of the tooth to be treated on its mesial or distal of the root and target area is the depth of the gingival sulcus.

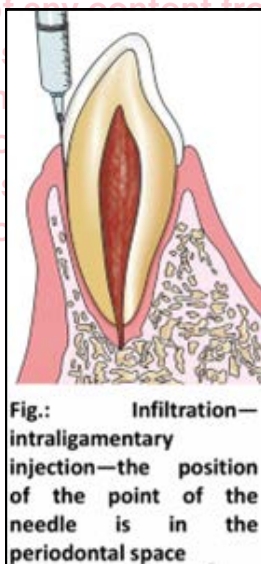


Fig.: Infiltration—  
intra-ligamentary  
injection—the position  
of the point of the  
needle is in the  
periodontal space

##### vi. Intra-pulpal anesthesia:

- This technique is indicated for obtaining anesthesia for procedures which require direct instrumentation of the pulpal tissue.
- A 25 or 27-gauge needle is inserted directly into the pulp chamber.
- The needle should be held firmly or wedged into the pulp chamber or the root canal.
- Initially, slight discomfort is felt by the patient which subsequently gets subsided.
- Sometimes the needle is bent to get a proper angle for good approach.

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## LA TECHNIQUES AND COMPLICATIONS

### Methods of administration:

#### b) Infiltration:

##### vi. Intra-pulpal anesthesia:



**Fig.:** Infiltration—intrapulpal injection—the point of the needle is in the pulp chamber (Courtesy: Dr Vibha Hegde)

#### c) Regional techniques:

- LA is injected adjacent to the nerve proximal to the site where analgesia is required.
- A regional block aims to prevent pain experienced in the area of nerve distribution distal to the site of injection.
- Analgesia occurs approximately 4-5 minutes after a block injection. (TG)
- In this technique, the anesthetic solution deposited near a nerve trunk will, by blocking all impulses, produce anesthesia of the area supplied by that nerve.

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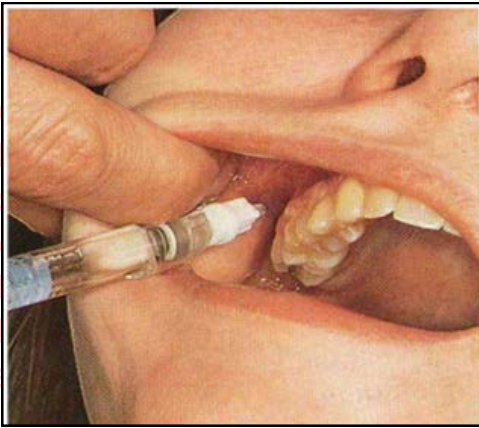


## LA TECHNIQUES AND COMPLICATIONS

### A) Maxillary Blocks

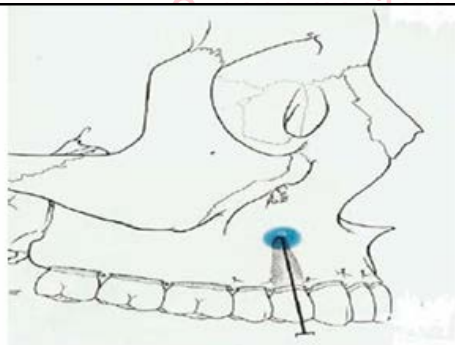
#### a) The posterior superior alveolar block (PSA)

- The posterior superior alveolar block is used to anesthetize the maxillary molars, excluding the mesio-buccal root of the first molar.
- It also anesthetizes their periodontium and the adjacent buccal soft tissues.
- The needle is inserted 15 mm into the buccal vestibule distal to the malar at 45 degrees to the occlusal plane, and 1 ml of anesthetic solution is injected.
- Insert the needle into the height of the mucobuccal fold over the second molar. Advance the needle slowly in an upward, inward, and backward direction in one movement.



#### b) The middle superior alveolar block (MSA)

- It anesthetizes the maxillary premolars, the mesio-buccal root of the first molar, their periodontium, and adjacent buccal soft tissues.
- The needle is inserted 5 mm into the buccal vestibule adjacent to the maxillary second premolar, and 1 ml of anesthetic solution is given.



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## LA TECHNIQUES AND COMPLICATIONS

### A) Maxillary Blocks

#### c) The anterior superior alveolar block (ASA)

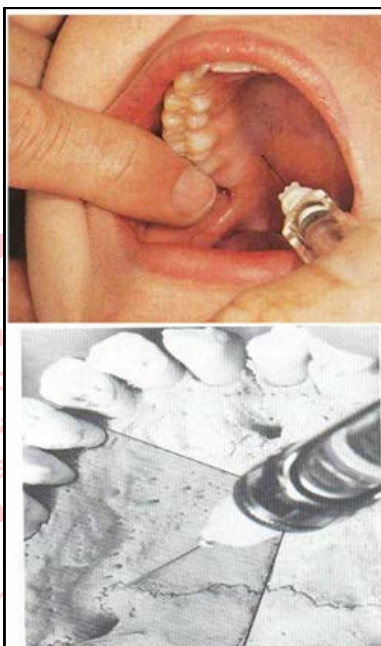
- It anesthetizes the maxillary incisor and canine teeth, periodontium, and buccal soft tissues.
- The needle is inserted 5 mm into the buccal vestibule of the maxillary canine, and 1 ml of anesthetic solution is given.

#### d) The infraorbital block

- It serves to anesthetize the ipsilateral maxillary teeth, periodontium, buccal soft tissues, maxillary tuberosity, and the skin of the lower eyelid, nose, cheek, and upper lip.
- The needle is parallel to the second premolar and inserted into the mucosa above this tooth.
- The operator's fingers of the non-dominant hand are placed over the infraorbital rim, and the needle is inserted until palpated in the vicinity of the infraorbital foramen.

#### e) The greater palatine block

- It anesthetizes the ipsilateral hard palate posterior to the canine tooth.
- The needle is inserted at the entrance of the greater palatine foramen to a depth of less than 5 mm until the bone is contacted and 0.5 ml of anesthetic solution is injected.
- The greater palatine foramen is a palpable depression or soft area on the hard palate, usually at the third maxillary molar level or 5 mm anterior to the hard and soft palate junction and halfway between the gingiva and palate midline.



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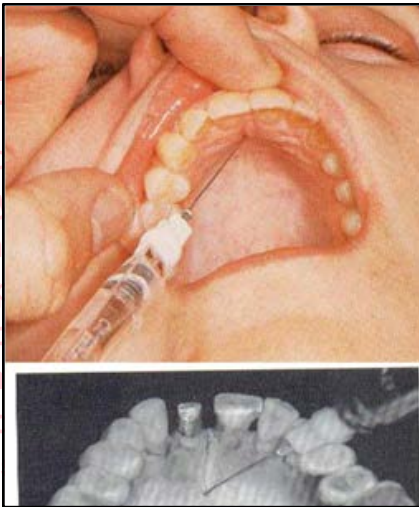
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## LA TECHNIQUES AND COMPLICATIONS

### A) Maxillary Blocks

#### f) The nasopalatine block

- It anesthetizes the palatal premaxilla bilaterally. In some patients, it further provides some anesthesia to the maxillary incisors.
- Following buccal and intrapapillary infiltrations, the needle is inserted into the blanched incisive papilla to a depth of less than 5 mm until the bone is contacted and the tip contacts the lateral soft tissue of the incisive papilla. 0.25 ml of anesthetic solution is usually sufficient.



- In nasopalatine nerve block, the solution is deposited near the incisive foramen, which is located in the midline of the palate about 1cm posterior to the maxillary central incisors.

#### \*Palatal anesthesia

- It could be achieved by:
  1. **greater palatine nerve block**, which provides anesthesia of the posterior portion of the hard palate, or
  2. **nasopalatine nerve block**, which provides anesthesia of the anterior portion of the hard palate, or
  3. by **infiltration technique** in which the solution is deposited in the palatal tissue adjacent to the target tooth.

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## LA TECHNIQUES AND COMPLICATIONS

### B) Mandibular Blocks:

- The portions of the mandible consist of dense, thickened bone, making it difficult for externally deposited local anesthetic to diffuse toward the inferior alveolar nerve (IAN) that lies within the substance of the mandible.
- Therefore, clinicians commonly attempt to anaesthetize this nerve, which supplies all mandibular teeth on the ipsilateral side, before it enters the mandibular canal via blockade anesthesia.
- Many techniques of mandibular blockade are present. However, the most commonly used ones are:

1. The direct inferior alveolar nerve block (IANB)
2. the indirect IANB
3. The Akinosi closed mouth technique
4. The Gow-Gates technique

*\*Some extraoral techniques via the mandibular notch, are useful in some trauma patients.*

#### 1. The Direct IANB:

- Although there are many techniques described, the direct IANB, also known as the direct thrust approach, remains one of the most commonly used to obtain mandibular anesthesia.
- It involves needle insertion into the pterygomandibular space by piercing the buccinator muscle, anteriorly.
- Once in this anatomical space, the objective of this technique is to deposit local anesthetic solution near the inferior alveolar nerve, just before it enters the mandibular foramen that leads into the mandibular canal.
- The exact location of where the needle tip should be located in relation to the IAN is hard to assess in any one patient due to the required 20-25mm depth of tissue penetration, but, it is advantageous to administer the injection so that the tip of the needle contacts bone just superior to the tip of the lingula.

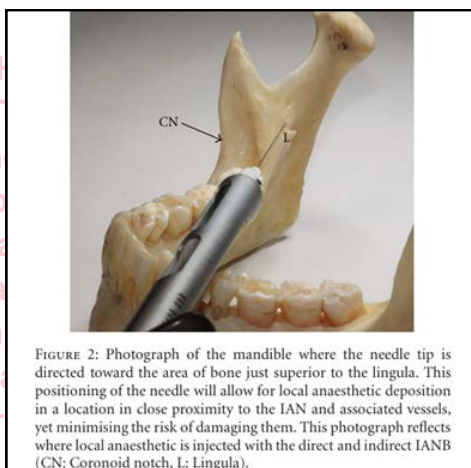


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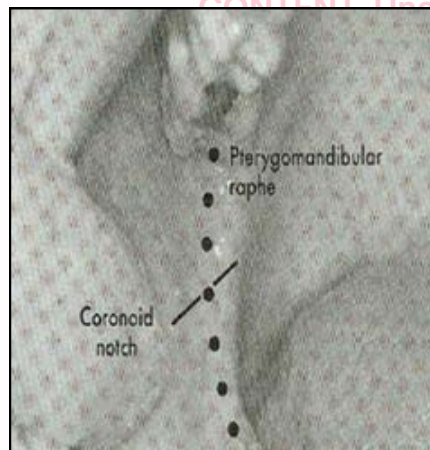
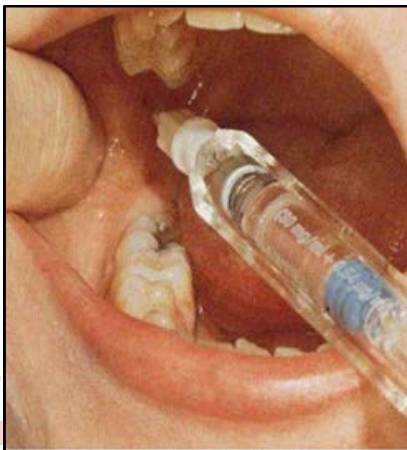
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# LA TECHNIQUES AND COMPLICATIONS

## B) Mandibular Blocks:

### 1. The Direct IANB:

- The lingual nerve lies medial and anterior to the IAN and can be anaesthetized during an IANB by withdrawing the needle and swinging the barrel of the syringe toward the dental midline.
- Upon intra-oral inspection, two important landmarks should be identified: **the retromolar triangle and the pterygomandibular raphe** (this structure passes upward and inward from the posterior end of the mylohyoid line of the mandible to the Hamulus of the medial pterygoid plate, the point of insertion of the needle should be lateral to and Infront of it).
- The thumb of the left hand is passed along the buccal surfaces of the lower molar teeth until the external oblique ridge is felt. The tip of the thumb is then passed inward to lie in the retro-molar fossa.
- The mid-point of the nail should lie in the deepest part of the coronoid notch.
- A long needle is inserted at this point. With the barrel of the syringe held parallel to the mandibular occlusal plane and over the second premolar tooth of the opposite side of the mouth, the tip of the needle is inserted for about 2 - 2.5 cm until its tip lightly contact the bone above the mandibular foramen.
- When bone is contacted withdraw approximately 1mm to prevent subperiosteal injection and about 1.5 ml of the solution deposited. Then slowly withdraw the syringe and when approximately half its length remains within tissues deposit few drops of the solution to anesthetize the lingual nerve.



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# LA TECHNIQUES AND COMPLICATIONS

## B) Mandibular Blocks:

### 2. Indirect IANB:

- The indirect IANB is a variation of the direct technique where the level and site of injection is the same.
- The fundamental difference, however, lies in the method by which the appropriate depth of needle insertion ( 20–25mm) is obtained.
- The indirect technique involves the insertion of the needle using the same landmarks to indicate correct height and mediolateral needle placement, but with a significantly greater degree of syringe angulation on the contralateral side.
- The effect of this is to make early bone contact near the anterior border of the ramus, anterior to the mandibular foramen.
- A variation of indirect IANB is Anterior injection technique that involves the insertion of the needle for approximately 10mm into the pterygomandibular space where the local anesthetic is deposited, allowing for the anesthetic solution to slowly diffuse across the space and toward the IAN.

### 3. Gow-Gates Mandibular Block Technique:

- The Gow-Gates mandibular block is often referred to as a **true mandibular block** as the distribution of its effect is larger than that of lower-level nerve block techniques and it anaesthetizes the auriculotemporal and long buccal nerves in most cases.
- **This technique involves the intraoral insertion** of a needle through the pterygomandibular space until bony contact is made with the anterolateral condylar neck.

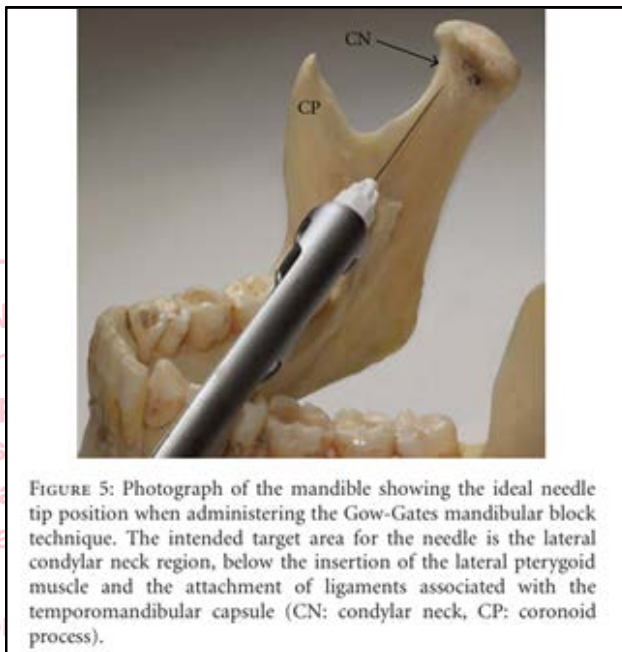


FIGURE 5: Photograph of the mandible showing the ideal needle tip position when administering the Gow-Gates mandibular block technique. The intended target area for the needle is the lateral condylar neck region, below the insertion of the lateral pterygoid muscle and the attachment of ligaments associated with the temporomandibular capsule (CN: condylar neck, CP: coronoid process).

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## LA TECHNIQUES AND COMPLICATIONS

### B) Mandibular Blocks:

#### 3. Gow-Gates Mandibular Block Technique:

- Although different for every patient, the average depth of needle insertion is 25mm, and following needle contact, withdrawal of 1-2mm, and an aspiration test is required.
- Malamed has suggested that the patient should keep their mouth open for 60–90 seconds following injection to allow for more speedy diffusion of local anesthetic as mandibular opening reduces the distance between where the local anesthetic is deposited and the mandibular nerve.

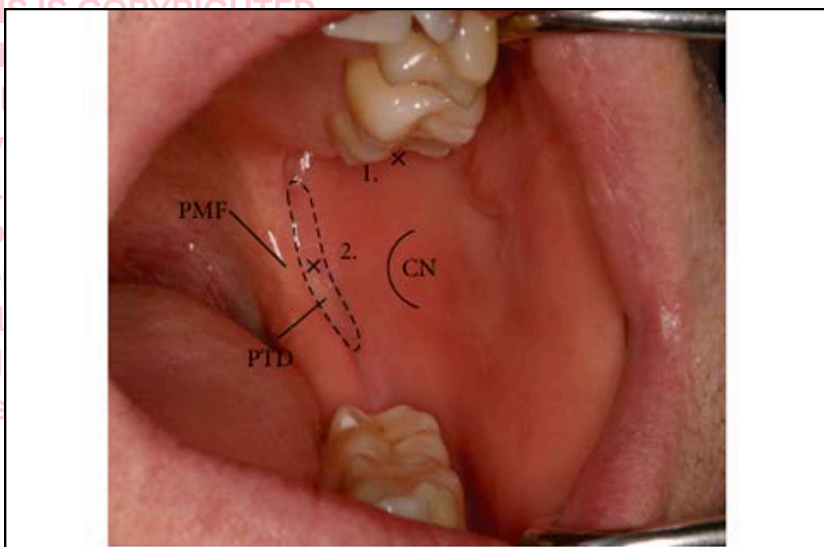


FIGURE 3: Intraoral photograph of the left side of the oral cavity showing the injection sites for different mandibular block techniques. The pterygotemporal depression exists between the pterygomandibular fold and coronoid notch and represents the area where a direct or indirect IANB is administered in the mediolateral plane. The height at which this block is given is approximately the level of the coronoid notch. In contrast, the Gow-Gates mandibular block is administered at a much higher level. The mesiopalatal cusp of the upper second molar determines the height of the injection while the site in the mediolateral plane is the area of tissue just posterior to the upper second or third molar (PTD: pterygotemporal depression, PMF: pterygomandibular fold, CN: coronoid notch, 1: area where a Gow-Gates mandibular block would be administered, 2: area where a direct/indirect IANB would be administered).

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## LA TECHNIQUES AND COMPLICATIONS

### B) Mandibular Blocks:

#### 4. Akinosi Closed-Mouth Technique.

- The Akinosi **closed mouth mandibular block** approach provides an alternate technique for individuals who have limited mouth opening, which is a distinct contraindication for the other block techniques
- This technique involves the intraoral insertion of a needle into the pterygomandibular space for 25–30mm **while the mouth is fully closed**.
- This technique does not involve bony contact, where the desired location of the needle tip should be in the loose areolar tissue medial to the mandibular ramus.
- As with other block procedures, an aspiration test is performed before deposition of local anesthetic.
- The site of injection for this technique is at the level of the mucogingival junction of the maxillary second or third molar.
- Although this technique can be used for anyone, most clinicians reserve it for those who have severe mouth opening deficiencies or are severe gaggers.

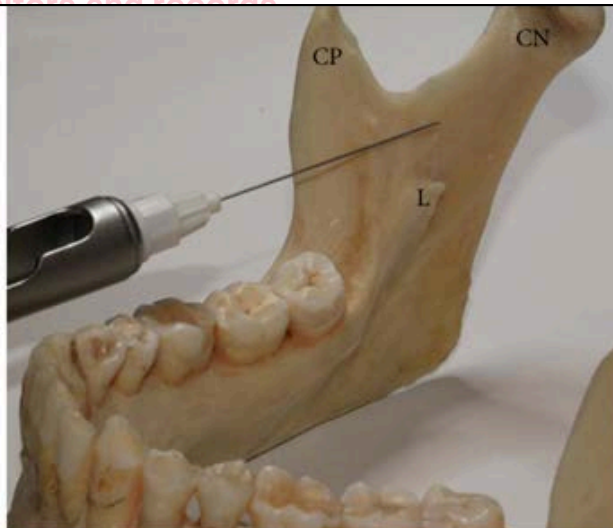


FIGURE 6: Photograph of the mandibular ramus from a medial view showing the needle tip positioning required for the Akinosi closed mouth mandibular nerve block technique. Note that the needle should not contact bone during needle insertion. The needle tip slips along the medial aspect of the ramus to its intended target area, the loose areolar tissue within the superior reach of the pterygomandibular space (CN: condylar neck, CP: coronoid process, L: lingula).

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## LA TECHNIQUES AND COMPLICATIONS

### B) Mandibular Blocks:

#### 5. Supplementation to Blockade Anesthesia with Local Supra-periosteal Infiltrations

- The success rates of some injection techniques can be quite low, especially with direct and indirect IANBs.
- Hence, supplementation of these injections with local infiltrations has been suggested.
- These infiltration injections should not be confused with buccal nerve blocks or infiltrations which are administered following a direct or indirect IANB to anaesthetize the long buccal nerve which innervates the buccal gingivae of lower posterior molars.
- The long buccal nerve and the lingual nerve must be anaesthetized, in addition to the IAN, if lower posterior teeth are to be extracted.

#### 6. Mental and Incisive Blocks

- Although the mental and incisive nerves are anesthetized by an IANB, mental and incisive blocks are useful when bilateral anesthesia is desired on or anterior to the mandibular premolars.

#### 7. Buccal Nerve Block

- The buccal nerve block is administered when anesthesia of the buccal mucosa or the buccal gingiva of the mandibular molars is required.
- The needle is advanced 1 to 3 mm into the buccal vestibule distal to the second or third molar until the bone is contacted.
- The point of insertion is medial to the coronoid notch.
- A small amount of anesthetic solution, usually 0.25 ml, tends to suffice.

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## LA TECHNIQUES AND COMPLICATIONS

### Complications and adverse effects of Local Anesthesia:

- The adverse effects of LA includes
  - a) local complications and
  - b) systemic toxicity
- The incidence of adverse effect is low and differs in different local anesthetic.
- Resuscitation drugs and equipment including oxygen, should be available for immediate management of systemic toxicity.
- If adverse effect occur or are suspected the administration of LA should be stopped and appropriate management should be provided.

### A) Problems in Anesthetic Technique causes:

Problems with the injection technique or injection into the incorrect site (due to interindividual anatomical variation) can result in:

- complete or partial failure of local anaesthetic effect—if this occurs, reassess the patient's anatomy and review the injection technique. A repeat injection may be tried, provided the maximum dose (see Table 20; p.208) is not exceeded
- trauma to the nerves and surrounding tissues—for further information on local complications, see below
- profound systemic effects (see p.204) if injected into a blood vessel (particularly if combined with a vasoconstrictor)—to mitigate the risk of intravascular injection, aspirate to exclude the presence of blood, then inject slowly and monitor the patient's response.

### B) Local Complications:

- It can be subdivided into:
  1. Local neurological complications:
    - It includes paresthesia, dysesthesia and temporary nerve paralysis and prolonged anesthesia.
    - Most cases of prolonged anesthesia resolve spontaneously.
    - Permanent anesthesia is rare.
    - Nerve injuries are rare and can be caused by:
      - a) direct nerve trauma
      - b) indirect nerve trauma (i.e., from bleeding within the nerve sheath)
      - c) Localized neurotoxicity
  2. Trauma to tissues:
    - Hematoma can occur during injection of local anesthetic.
    - Accidental intramuscular injection can cause trismus which can be caused either by direct effect of drug or bleeding within the muscle.
    - If trismus occurs, specialist advice or referral to an oral medicine or oral surgery specialist is required, because early management can improve outcomes.

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## LA TECHNIQUES AND COMPLICATIONS

### Complications and adverse effects of Local Anesthesia:

#### B) Local Complications:

2. • Rarely, local complications can arise from equipment failure like cartridge explosion.

#### c) Systemic Toxicity:

- It can occur after
  - a. Inadvertent intravascular injection of LA
  - b. Excessive dose administration
  - c. Impaired drug clearance
  - d. Rapid systemic absorption (rare)

Adverse systemic effects are usually seen in a continuum as plasma concentration increases, so use the lowest effective dose and do not exceed the maximum recommended dose (for further discussion of doses of local anaesthetics, see p.206).

Systemic toxicity of local anaesthetics is more likely at higher plasma concentrations, so do not exceed the maximum recommended dose.

- The clinical presentation of systemic toxicity is variable and includes:
  - a. Neurological effects
  - b. Psychiatric effects
  - c. Cardiovascular effects
  - d. Respiratory effects
  - e. Allergic reactions
  - f. Rarely, methemoglobinemia
- Early indicators of systemic toxicity are Minor CNS effects like restlessness, anxiety, dizziness, blurred visions, tremors, CNS depressions and drowsiness.
- In longer acting anesthetics particularly bupivacaine CVS toxicity may occur before CNS effects.
- Methemoglobinemia is mainly associated with (BP)
  1. Prilocaine (above 600mg)
  2. Benzocaine
- Occasionally also reported with
  1. Lidocaine
  2. Articaine
  3. Tetracaine

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## LA TECHNIQUES AND COMPLICATIONS

### Methaemoglobinaemia

Methaemoglobinaemia occurs when haemoglobin oxidises to methaemoglobin, resulting in a reduced oxygen-carrying capacity of blood cells, functional anaemia and impaired delivery of oxygen to the tissues. Methaemoglobinaemia can occur after exposure to oxidants, and is a rare adverse effect of local anaesthetics. Onset can occur within minutes or be delayed. Slate-grey skin discolouration and cyanosis are the most distinct features; other signs and symptoms include headache, light-headedness, shortness of breath, fatigue and tachycardia. Blood may appear to be dark red or brown in colour, and can remain so even after administering oxygen.

Methaemoglobinaemia can be life threatening and requires emergency referral to hospital. For management of patients with methaemoglobinaemia, see Box 36 (below).

#### Box 36. Management of methaemoglobinaemia

If methaemoglobinaemia occurs:

- Stop dental treatment.
- Call 000.
- Start supplemental oxygen and airway support if needed.
- Monitor blood pressure, heart rate and pulse oximetry until assistance arrives.
- Start basic life support if required (for 'Basic life support flow chart', see Figure 8; p.235).

If systemic adverse effects of local anaesthetics occur, stop administration of the local anaesthetic and provide appropriate management.

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## PYOGENIC GRANULOMA

Source- Odell case 10, Articles on pyogenic granuloma Pyogenic Granuloma - Hyperplastic Lesion of the Gingiva: Case Reports by Pushpendra Kumar Verma, Pyogenic granuloma Stat pearls (internet),

- Pyogenic granuloma is a reactive hyperplasia of connective tissue in response to local irritants.
- Pyogenic granuloma, refers to a common, acquired, benign vascular tumor that arises in tissues such as the skin and mucous membranes. Pyogenic granulomas tend to ooze, and they break and bleed easily.
- The term “pyogenic granuloma” is a **misnomer** because the lesion does not contain pus and is not strictly speaking a granuloma.
- Pyogenic granuloma is a hyperactive benign inflammatory lesion that **occurs mostly on the mucosa of females with high levels of steroid hormones** (Pregnancy Tumor/Epulis: A variant of pyogenic granuloma arising in pregnancy). It is generally believed that female sex hormones play important roles in its pathogenesis.
- Pyogenic granuloma is a localized proliferation of granulation tissue or very vascular fibrous tissue.
- The scientifically accurate term for this entity is **lobular capillary hemangioma**.

### Etiology and predisposing factors:

- Approximately one-third of the lesions occur due to **trauma and poor oral hygiene** may also be one of the precipitating factors.
- It arises in association with **local irritants** such as poor oral hygiene, calculus or the margin of a restoration.
- It usually arises in response to various stimuli such as low-grade local irritation, traumatic injury, hormonal factors or certain kinds of drugs.

### Presenting signs and symptoms:

- It often presents as a painless, mostly pedunculated, or sometimes sessile mass of gingiva.
- **The lesion grossly appears as a solitary, red, pedunculated papule that is very friable.**
- It is mostly soft and vascular, bleeds readily, and has an ulcerated surface.
- They may be pink, red, reddish-brown or purple.
- It shows rapid exophytic growth, with a surface that often undergoes ulceration and this is often seen on cutaneous or mucosal surfaces.
- When it occurs in the intraoral mucosa during pregnancy, notably on the gingiva, it is referred to as **granuloma gravidarum, granuloma of pregnancy, or epulis gravidarum**, and usually occurs in the second or third trimester.
- For mucosal Pyogenic Granulomas, common locations include lips and gingival mucosa.
- It has been reported many times that pyogenic granulomas may cause significant bone loss.

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## PYOGENIC GRANULOMA

### FIBROUS EPULIS (gingival fibroepithelial polyp/nodule)

- It is a nodule of more fibrous hyperplastic tissue.
- It is not usually ulcerated, is firmer on palpation and does not bleed so readily.
- Some fibrous epulis develop from pyogenic granuloma through maturation of fibrous tissue.
- They are usually associated with a local irritant in the same manner as pyogenic granulomas.

#### Diagnosis:

- Lobular capillary hemangioma/ Pyogenic granuloma is usually a clinical diagnosis based on history and classical clinical findings.
- The history should include inquiries into previous trauma, association with pregnancy, and a thorough review of medications.
- A histologic examination is warranted if a diagnosis cannot be achieved on clinical grounds
- It is strongly recommended that the tissue is sent for histopathologic confirmation to rule out any other sinister lesions.
- The definitive diagnosis will require a biopsy, and excision is indicated as this swelling will not regress spontaneously, after initial management that includes oral prophylaxis and Oral hygiene instructions.

#### Histopathology of the lesion:

- Histologically, it consists of lobular aggregates of capillary-sized vessels, with each lobule containing a central feeder vessel.
- These develop within highly vascular granulation tissue, with the lobules or tufts of thin-walled capillaries embedded within a loose fibrous stroma, with scattered fibroblasts and inflammatory infiltrate.
- Within the stroma, a scarce, mixed inflammatory infiltrate is noted, consisting of lymphocytes, neutrophils, plasma cells, or mast cells, resembling normal granulation tissue.

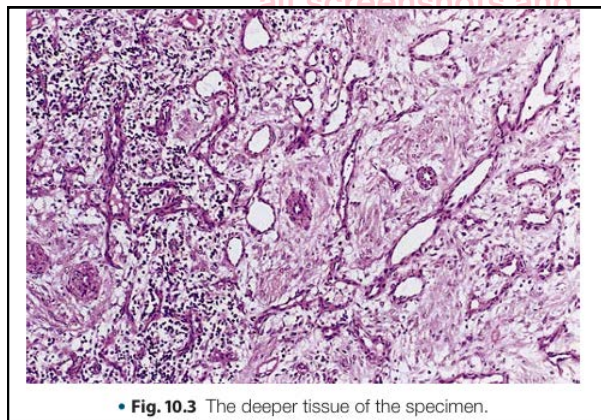
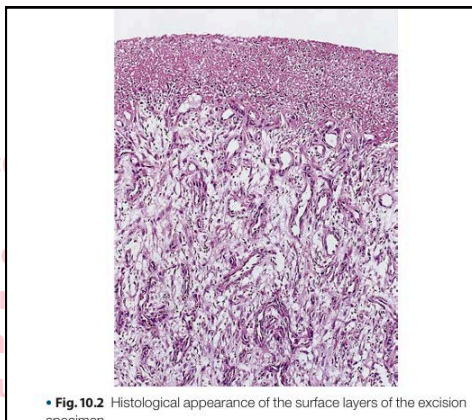


Image: Microscopic appearance of pyogenic granuloma (Odell case 10)

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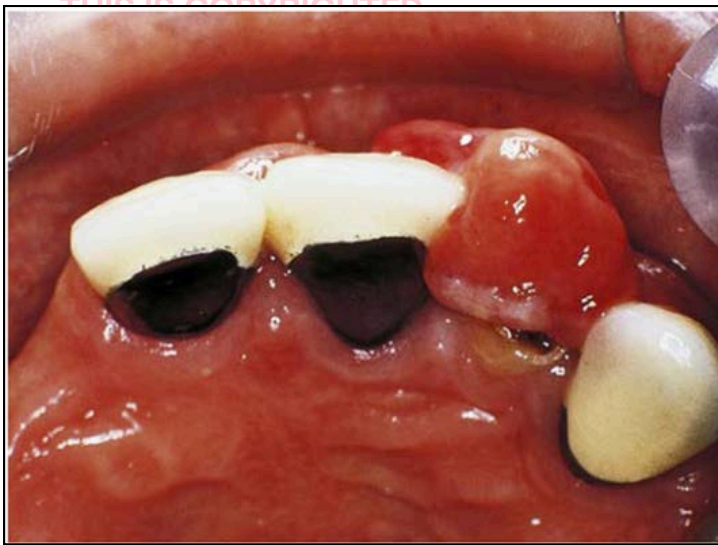
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## PYOGENIC GRANULOMA



Clinical appearance of the lesion: (Source -Internet)

### Management:

- **Elimination of the causative factors** may induce considerable resolution.
- The degree of resolution varies; softer more vascular lesions shrink most and firmer more fibrous lesions hardly shrinks at all.
- **Non-surgical** treatment includes: Removal of calculus and improved oral hygiene may cause partial or very occasionally complete resolution.
- Partial resolution reduces the size of the lesion, which is then easier to excise and also bleeds much less.
- In pregnancy epulis Oral prophylaxis and OHI is done primarily, both because of the wish to avoid the procedure during pregnancy and because excision during pregnancy carries a risk of recurrence.
- The most definitive management is **Complete Surgical Excision** if the lesion.
- Generally, the only way to cure pyogenic granuloma is to:
  - a) Remove the lesion.
  - b) Eliminate any suspected triggers, such as medications, piercings or dental problems causing irritation in your mouth.

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## PYOGENIC GRANULOMA

### Management:

- Granulomas in pregnancy can typically disappear after delivery.
- No matter the treatment, the patient should be counseled about the risk of recurrence.
- These lesions have no malignant potential. However, since they do not regress spontaneously and may bleed, ulcerate, or be cosmetically disfiguring, they may necessitate treatment on these grounds.
- Partial resection by shave excision or curettage may lead to recurrence in the future, hence complete primary excision is preferred. **For recurrence, a complete surgical excision is warranted.**

### Advice to patients:

- Patients typically need reassurance for this condition since they may be worried about more sinister conditions.
- They should be discouraged from scratching or picking at the lesion and must take some precautions to avoid trauma or secondary infection.
- They should be advised about the risk of recurrence with partial excisions and the risk of scarring with a total surgical excision.
- The decision of which modality to use for the lesion must be arrived at jointly by the patient and their physician.



Image: Pyogenic granuloma pre-operative and after complete excision (Internet)

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## PYOGENIC GRANULOMA

Example of management of a case with pyogenic granuloma, (Preoperative – Post operative)



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# RADIOPACITIES OF JAW/ RETAINED ROOTS

## Retained Roots

(Source- Stat pearls Oral Surgery, Extraction of Roots Parker N. Benton; Paul Chang)

\*Link to article: <https://www.ncbi.nlm.nih.gov/books/NBK589696/>

- A residual root is a tooth root which was left over in the jaw after a past extraction.



- These sometimes can give problems such as pain and infection. Usually these can be removed surgically using local anesthetic.
- The retained tooth root is a common consequence of tooth fracture, which may occur for various reasons.
- Tooth roots are a significant contributor to the ease or complexity of dental extraction surgery and often require unique management approaches not typically employed in routine exodontia.
- Root morphology tends to follow a pattern in most individuals.
- In the **maxilla**, **central and lateral incisors** traditionally have single, straight, and typically conical roots.
- **Maxillary canines** are also single-rooted and are the longest of all tooth roots.
- The **maxillary first premolar** often has a long root trunk with bifurcated buccal and palatal roots, but single root variants exist. Maxillary premolar roots are typically thin.
- Unlike the maxillary first premolar, the **maxillary second premolar** is usually single-rooted and rarely presents with two roots or a bifurcated root.
- **Maxillary first molars** typically have two buccal roots and one larger palatal root. Roots may splay and have variable curvature.
- The **second molar** also traditionally has three roots that are usually less splayed than the first molar.
- The roots of the **maxillary third molar** tend to be fused and shorter than the maxillary first and second molars.
- In the **mandible**, **central and lateral incisors** have single roots, with central incisors often lacking apical curvature.
- **Mandibular canines** usually present with single roots, but one unique difference between maxillary and mandibular canines is that mandibular canines may have bifurcated roots similar to those seen in maxillary first premolars.
- The **mandibular first and second premolars** typically present with single roots but may have bifurcated roots in rare situations.
- The **mandibular first and second molars** usually have two distally tilted roots: a mesial and a distal root. The mandibular second molar's roots are usually shorter with less splay than the first molar roots.
- The **mandibular third molars** typically have two shorter, often parallel, mesial, and distal roots. But have significant variation.

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## RADIOPACITIES OF JAW/ RETAINED ROOTS

### Indications of removal of retained roots:

- Retained dental roots may present with one or many indications for removal:
  - i. The presence of acute or chronic infection
  - ii. Partial or complete fracture of the crown
  - iii. Future dental implant placement
  - iv. Pain
  - v. Vertical root fractures
  - vi. Periodontal disease
  - vii. Caries
  - viii. Presence of pathology
  - ix. Future prosthetic restoration of the site with a fixed or removable prosthesis
  - x. Preservation of vital adjacent teeth and structures
  - xi. Patient esthetic concerns
- Sometimes retained roots are removed prophylactically, even in the asymptomatic patient.

### Technique of removal:

- Once consent is obtained and all team members agree with the planned procedure, the patient is locally anesthetized, and the anesthetic is allowed time to take effect before initiating surgery.
- There are a variety of methods:
  1. **Closed surgical technique:**
    - This technique involves elevating, luxating, and delivering the root segment from the coronal aspect of the socket without creating a mucoperiosteal flap.
    - Once appropriate surgical visualization of the root segment is achieved, dental elevators can be used.
    - The instruments can be used using either of three fundamental physical concepts: 1. Wheel, 2. A lever 3. A wedge.
    - When using an elevator as a wheel like while using Cryer's elevator, a rotational arc between the elevator tip and the body of the root develops to lift the root out coronally.
    - When using an elevator as a class 1 lever, a fulcrum point is created between the alveolar crest and the root. This concept requires a reliable purchase point so that force can be applied without instrument slippage or misdirection.
    - A hole can be drilled in the root to allow for a crane pick or similar instrument to lever the root coronally.
    - Another modern advancement in atraumatic tooth extraction is Piezosurgery.

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## RADIOPACITIES OF JAW/ RETAINED ROOTS

### Technique of removal:

#### 2. Open Surgical Technique:

- Removal of root segments using an open surgical technique involves the reflection of a tissue flap to improve visualization and gain surgical access to the root.
- Removal of cortical bone is often necessary following mucosal flap reflection.
- Removing roots usually requires a full-thickness flap, meaning the mucosal flap of soft tissue carries an adherent periosteal layer.

#### 3. Endodontic File Technique:

- Using endodontic files to retrieve retained root segments involves the insertion of an endodontic file through the visible root canal orifice from the coronal aspect and advancing it apically until friction develops within the canal.
- The more contact surface area the file has within the canal, the more generated force when pulling the root segment coronally.
- The type and size of endodontic file best suited for extraction in root tips have yet to be well-studied, but it has been shown that a #25 Hedstrom file generates a tremendous pullout force in all roots, regardless of the length of the root.

## RADIOPACITIES OF JAW/ RETAINED ROOTS

### Radiopacities of Jaw

(Source: Practical Approach to Radiopaque Jaw Lesions Article, White and pharoah radiology)

- A radiopacity is the white area on a conventional radiograph.
- Multiple radiopacities, particularly if they are distributed throughout the jaws, suggest a systemic cause, whereas a single radiopacity suggests a local cause.
- Two most frequent causes of radiopacities in the jaws, includes **dense bone islands (also known as idiopathic osteosclerosis) and sclerosing osteitis**.
- Adenomatoid odontogenic tumor, calcifying epithelial odontogenic tumor, calcifying odontogenic cyst, and dentinogenic ghost cell tumor. All four present radiologically as containing radiopacities.
- The radiologic analysis of these lesions requires a systematic approach and a broad consideration of clinical and imaging characteristics to enable reliable radiologic diagnosis.
- Specifically, the appearance of radiopaque lesions can be described as
  - Densely sclerotic:** All densely sclerotic lesions are benign and have a relatively homogeneous attenuation similar to that of cortical bone or tooth constituents (eg, dentin or cementum), without significant lucent components.
  - Ground glass:** Ground-glass lesions of the jaw have a differential diagnosis of four entities: fibrous dysplasia, cemento-ossifying fibroma (COF), Paget disease of bone (PDB), and renal osteodystrophy. Ground-glass lesions are so named because of their hazy homogeneous intermediate attenuation between lucency and/or absence of bone and dense sclerosis. They are characterized by mineralization of fibrous matrix, which obscures or destroys trabeculae. Fibrous dysplasia is the prototypical ground-glass bone lesion. Fibrous dysplasia is the prototypical ground-glass bone lesion.
  - Mixed lytic-sclerotic:** Mixed lytic-sclerotic lesions are a heterogeneous group of entities including both benign and malignant neoplasms and aggressive processes such as osteomyelitis and osteonecrosis.
- Each category represents a distinct although occasionally overlapping differential diagnosis.

Lesion Type	Densely Sclerotic	Ground-Glass	Mixed Lytic-Sclerotic
Odontogenic	Odontoma Condensing osteitis COD Cementoblastoma	COF	Developing odontoma CEOT
Nonodontogenic	Osteoma Exostoses and tori	Fibrous dysplasia PDB Renal osteodystrophy	Osteosarcoma Metastases Chronic osteomyelitis Osteonecrosis

Note.—CEOT = calcifying epithelial odontogenic tumor, COD = cemento-osseous dysplasia, COF = cemento-ossifying fibroma, PDB = Paget disease of bone.

- Dense radiopacities mainly result from unerupted teeth, aberrant production of odontogenic hard tissues, or local osteosclerosis and cortical thickening.

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# RADIOPACITIES OF JAW/ RETAINED ROOTS

## 1. Odontogenic Lesions

### a) Odontoma and Supernumerary Teeth:

- Odontomas are hamartomas of mixed hard and soft dental tissues.
- These lesions are the most commonly diagnosed odontogenic tumor, with most manifesting before the age of 20 years, without a significant gender predilection.
- Odontomas can be categorized as compound or complex.
- Compound odontomas are well-defined collections of small structures with a toothlike resemblance, termed denticles.
- Complex odontomas exhibit a lower degree of differentiation, reflecting poorly organized enamel, cementum, and dentin.
- **Supernumerary teeth**, which are morphologically normal erupted or unerupted teeth in addition to the full permanent tooth set, share the same pathogenesis as odontomas, namely focal hyperactivity or failed resorption of the dental lamina, a tissue involved in tooth development.
- **Anatomically, compound odontomas** show a predilection for the **anterior maxilla**, typically involving the anterior sextant, while **complex odontomas** are mostly found in the **posterior mandible**.
- The presence of multiple odontomas should raise suspicion for **Gardner syndrome**.



**Figure 3.** Three cases of incidentally identified supernumerary teeth and odontomas at CT. (a) Sagittal CT image of supernumerary teeth shows a morphologically normal unerupted tooth (arrow) with a thin well-defined lucent rim and thin bony capsule. Tooth count confirmed that this is a supernumerary tooth. (b) Sagittal CT image of a compound odontoma shows multiple abnormal-appearing unerupted teeth (arrowhead) encapsulated by a thin lucent and bony rim. (c) Sagittal CT image of a complex odontoma shows an amorphous densely sclerotic pericoronal lesion with a well-defined rim of sclerosis (arrowhead). Mineralized lesion matrix contains components that are isoattenuating relative to the enamel and dentin in the adjacent tooth.

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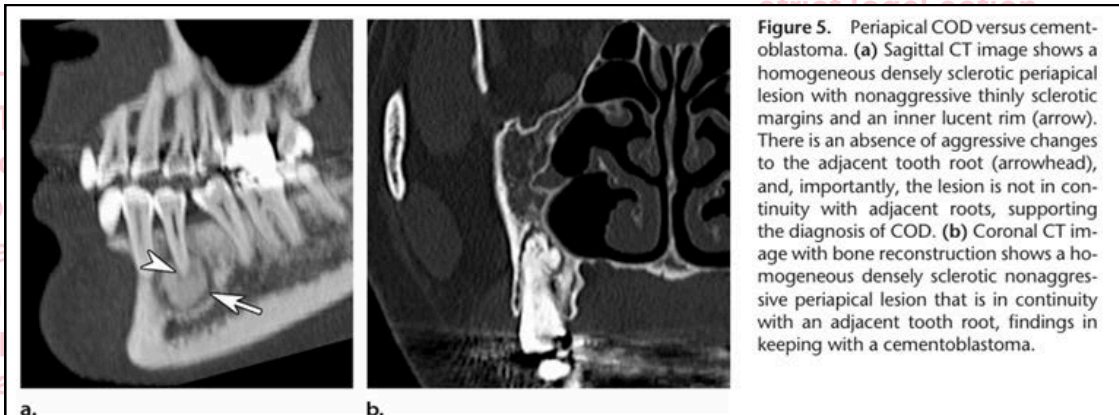
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# RADIOPACITIES OF JAW/ RETAINED ROOTS

## 1. Odontogenic Lesions

### b) Condensing Osteitis:

- Condensing osteitis (also termed sclerosing osteitis or sclerosing osteomyelitis) refers to local reactive sclerosis resulting from chronic odontogenic inflammation, typically related to periodontal or endodontal disease.
- Patients with condensing osteitis are usually symptomatic. Condensing osteitis manifests as **focal ill-defined sclerosis**.



### c) Idiopathic Osteosclerosis.

- Idiopathic osteosclerosis or dense bone island, refers to a focal increase in bone density of unclear origin but may represent a developmental variant.
- Patients are asymptomatic, with idiopathic osteosclerosis typically identified incidentally at imaging for other reasons.
- While idiopathic osteosclerosis manifests as a similar-appearing sclerotic focus to that of condensing osteitis, idiopathic osteosclerosis can be distinguished by well-defined margins lacking a radiolucent rim.
- Idiopathic osteosclerosis is also less frequently associated with the roots of teeth, and if adjacent to a root, pulp vitality testing should be normal, in contrast to that of condensing osteitis.



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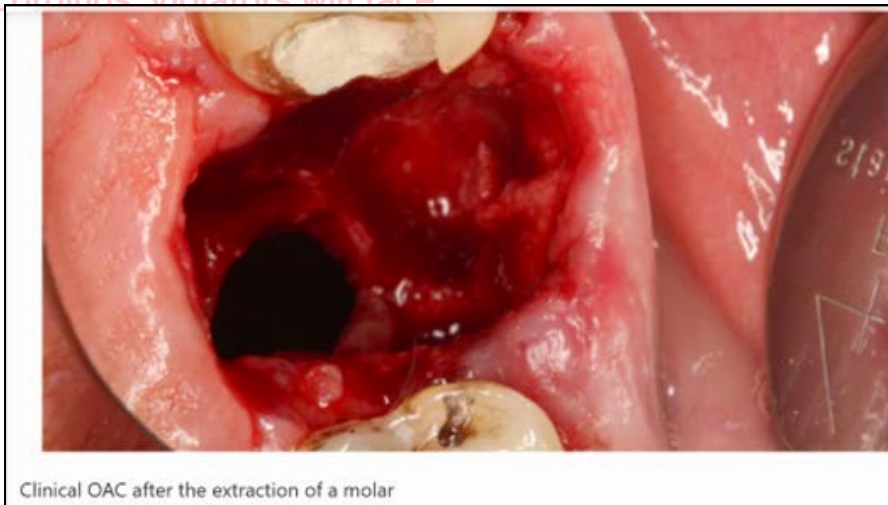
## ORO-ANTRAL COMMUNICATION AND FISTULA

(Sources: Odell case 18, Article on Management of Oro-antral Communication and Fistula: Various Surgical Options Pulkit Khandelwal<sup>1\*</sup>, Neha Hajira, Internet)

- Oro-antral communications and fistulas (OACs & OAFs) are complications frequently encountered by oral and maxillofacial surgeons.

### Oroantral communication:

- Oro-antral communication is an unnatural communication between the oral cavity and the maxillary sinus.
- Oroantral communications either close spontaneously or become epithelialized and persist as fistulae.
- In the absence of any infection of maxillary sinus, the defects which are smaller than 2 mm can heal spontaneously following the blood clot formation and secondary healing.
- However, untreated larger defects can lead to development of acute sinus disease like sinusitis (50% of patients within 48 hours, 90% of patients within 2 weeks)
- Closure of this communication is very important to prevent any food or saliva accumulation. It can cause sinus contamination leading infection, impaired healing and chronic sinusitis.



Clinical OAC after the extraction of a molar

Source- Internet

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Oro antral fistulae:

- An **oroantral fistula** is a persistent epithelialized communication between the maxillary antrum and the mouth, present for more than 48 hours.
- The epithelial lining of the fistula grows from the gingival epithelium, periodontal pocket lining or the antral lining, and it may take up to 7 days for the epithelium to completely line the walls of the communication.
- If the tract is not lined by epithelium, it is known as an oroantral **communication or perforation**.
- It develops when the oro-antral communication fails to close spontaneously, remains patent and gets epithelialized.
- There is migration of oral epithelium into the defect.
- This epithelialization usually occurs when the perforation persists for at least 48-72 hours.
- Within few days, the fistula gets organized and with the epithelialization of the fistulous tract, osteitis of the surrounding bony margins, presence of foreign bodies or development of maxillary sinusitis, spontaneous healing is hampered which may result in chronic fistula formation.
- OAF can be further classified as alveolo-sinusal, palatal-sinusal and vestibulo-sinusal.



Image: Intraoral view showing a left maxillary OAC of 7 mm diameter. (Source-Internet)

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Causes of OACs AND OFCs

- The vast majority of OAF result from dental extraction. Up to 10% of upper molar extractions may create oroantral communications, but very few, only 0.5%, persist to become fistulae. Other causes include malignant neoplasms arising in the oral cavity or in the antrum.
- OACs and OAFs occur most commonly during extraction of upper molar and premolar teeth (48%). The major reason is the anatomic proximity or projection of the roots within the maxillary sinus.
- Other causes of OAC/OAF include tuberosity fracture, dentoalveolar/periapical infections of molars, implant dislodgement into maxillary sinus, trauma, presence of maxillary cysts or tumors, osteoradionecrosis, flap necrosis, dehiscence following implant failure and sometimes as a complication of the Caldwell-Luc procedure.

### Predisposing factors of Oroantral communication:

- Proximity of roots to maxillary antrum, large sinus
- Difficult extraction, unfavourable root morphology
- Periapical lesions such as apical granulomas or cysts
- Bone loss caused by periodontitis or periodontal-endodontic lesion
- Hypercementosis
- Displaced root fragment
- Local infection or sequestrum
- Predisposition to infection (e.g. diabetes)
- Dry socket or other poor healing
- Advanced age
- Pre-existing diseases in the sinus, although this is probably not a very significant factor.

Image: Odell case 18

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Signs and Symptoms:

- The symptoms depend on the size of the fistula.
- **Initially**, there may be **persistent pain localized to the tooth socket** but **later**, when inflammation has subsided, the fistula **will be painless**.
- If pain is a prominent symptom, some additional element such as infection must be suspected.
- The socket may present as an empty cavity or as a pro lapse of antral lining through the socket into the mouth.
- The most characteristic symptoms are the escape of fluids from the mouth into the nose on eating, or air or fluid into the mouth on blowing the nose.
- Due to passage of saliva, food and bacteria into the antrum **sinusitis occurs** and can be presented as unilateral nasal obstruction, a feeling of fullness, pain over maxilla and tenderness on pressure.

### Investigations:

- Investigations need to be performed to
  - a) confirm the communication with the antrum
  - b) to check for associated complications and
  - c) to exclude the possibility that a malignant neoplasm is the cause of either the antral
  - d) communication itself or the failure of the socket to heal.
- Patient usually complains of nasal regurgitation of liquid, altered nasal resonance, difficulty in sucking through straw, unilateral nasal discharge, bad taste in the mouth and whistling sound while speaking.
- Pain may be present at malar region.
- At later stage, there is formation of antral polyp which is visible through the defect intra-orally.
- However, some patients may be asymptomatic. Clinically, a large fistula is easily seen on inspection.
- However, diagnosis of small defects can be made by the nose blowing test. **The patient is asked to close his nostrils and blow gently down the nose with the mouth open.**
- Presence of OAF appears as a whistling sound as air passes down the fistula into the oral cavity.
- It can also be seen as air bubbles, blood or mucoid secretion around the orifice.
- The escape of air through the nostril can be tested by placing a cotton wisp near the orifice.
- A mouth mirror placed at oro-antral fistula causes fogging of the mirror.
- **Probing** (the introduction of a probe into the antrum through the fistula) **should never be attempted.**
- Panoramic radiograph gives an accurate estimation of the dimension of the bony defect of the fistula and also reveals about the presence and location of dental roots or implants or any foreign body that may have been dislodged into the antrum. Computed tomography can be done to rule out the presence of maxillary sinusitis.

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## ORO-ANTRAL COMMUNICATION AND FISTULA

A summary of investigations and their purpose:

TABLE 18.1 Summary of Investigations	
Aim of Investigation	Methods
To demonstrate communication between antrum and mouth, the definitive test for oroantral fistula if there is no history of fluid or air passing between sinus and mouth.	If the fistula is large it may be possible to see into the antrum or pass a probe or large gutta percha point through into the antrum. If not, the patient can be asked to blow air into the nose with the anterior nares pinched closed and keeping the mouth open. You may see air bubbles, hear a hissing noise or detect air movement with a wisp of cotton wool at the socket opening.
To detect retained root fragments or sequestra in the socket.	Radiographs of the socket, ideally a periapical view, possibly also a panoramic tomograph.
To exclude the possibility of other lesions such as malignant neoplasms.	
To detect root fragments displaced into the antrum and exclude other antral disease.	Radiographs of antrum, usually a panoramic tomograph or standard occipito-mental view is sufficient. However, it is difficult to visualize the whole antrum in any one view without superimposition of other structures. Cone beam computed tomography (CBCT) is the best modality to examine the sinus if a root fragment is suspected but cannot be detected on other views. However, it requires a higher x-ray dose, and a plain film should be taken first.
To eliminate dental causes for any pain.	Vitality tests (thermal and/or electric) and examination for mobility of adjacent teeth.
To exclude malignancy or identify other causes for impaired socket healing.	Biopsy. Not usually required but if there is a worrying radiographic appearance or solid tissue in the socket, biopsy is indicated.

### ◆ How Could an Oroantral Communication Be Confirmed At the Time of Extraction? How Might This Help?

If an antral communication is present, an echoing 'wind tunnel sound' will be heard if a small suction tip is held in the socket, the result of air being sucked from the antrum as well as the mouth. If the communication is large, you may be able to see into the antrum or identify nasal regurgitation of your irrigation fluids or blood from the extraction site. Do not ask patient to blow through their nose while holding it. The sinus lining may still be intact but would be burst by the pressure and a small communication might be enlarged.

If a communication is suspected, stabilization of the clot, closure of the socket with resorbable sutures and appropriate warnings to the patient about blowing the nose should prevent a fistula developing. This is likely to be effective if the diameter of the communication is 4 mm or less. If it is larger, it should be repaired immediately using a suitable flap technique to avoid sinusitis and infection.

Image: Odell

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Management:

- If there is a retained root fragment visible in the radiograph then,
  - i. Determine whether the root fragment is loose in the antrum or trapped under the sinus lining or in granulation tissue.
  - ii. **The root will have to be removed.**
  - iii. If it is under the lining or trapped, it is possible to remove it through the socket.
  - iv. If it is loose in the antrum, removal in this way may be impossible, hence elective surgical procedure such as the Clad-well Luc procedure is needed.
- Ways to determine if the fragment is loose or trapped:
  - i. If the fistula opening is large you might try to visualize the fragment directly.
  - ii. If not, a second radiograph at right angles to the periapical, such as an occipito-mental view will help localize it.
  - iii. A further view with the patient's head tilted would reveal whether or not the root moves.

### Preoperative management:

- If the symptoms are severe or pus is present in the fistula consider treating the sinusitis first and closing the fistula later after the sinusitis has partially resolved (it will not resolve completely until the fistula is closed).
- If there is a long-standing infective sinusitis, it should be treated prior to surgical closure otherwise healing will be compromised.
- Preoperatively, the affected maxillary sinus should be irrigated through the fistulous opening with normal saline followed by an iodine-containing solution diluted with normal saline (1:1; betadine) to eradicate infection.
- This regimen should be administered until the lavage fluid is clear and no longer contains inflammatory exudates.
- Numerous surgical procedures have been advocated for closure of OAC/OAF which prevents undesirable and harmful consequences of persistent OAC/OAF.
- These procedures may be categorized into local flaps, distant flaps and grafting.
- **The most common methods** used for closure of OAF are the **buccal flap and the palatal pedicled flap techniques.**

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Surgical procedure for excision of fistula and flap surgery:

- Under local anesthesia, incise around the edge of the socket from gingiva right down into the antrum, removing all the soft tissue in the socket as a cylinder or cone-shaped piece and draw it into the mouth.
- Depending on the size of the bony defect and the amount of bone resorption (which is usually greater in long-standing fistulae), a large hole opens up into the sinus.
- With suction, good light and direct vision, try to identify the root fragment if present, and remove it with fine forceps, sucker tip or another instrument.
- Take care not to displace it into the sinus. If it becomes displaced, it may be possible to wash it out by flushing saline into the sinus. Alternatively, better surgical access to the sinus with Caldwell Luc approach may be done, which is done under GA, and main reason to refer the patient to the hospital.
- The excised tract should be sent for histopathological examination.

### Closing the Defect:

- The **buccal mucoperiosteal flap with advancement (buccal advancement flap)** is the most commonly used technique.
- After excision of the fistula following steps should be followed for buccal advancement flap technique:
  - i. Make two incisions buccally, anterior and posterior to the socket, passing parallel up the attached gingiva and then splaying to provide a wider base to ensure a good blood supply for the flap.
  - ii. The line of the incisions must be compatible with the flap sliding palatally to cover the defect in the alveolus.
  - iii. Elevate the mucoperiosteal flap you have outlined by lifting the soft tissues in the plane beneath the periosteum.
  - iv. Now Advance the flap: The flap cannot yet be pulled across the defect because the periosteum cannot be stretched so Fold the flap back to expose its periosteal surface and make several shallow parallel incisions across the flap that penetrate only the periosteum.
  - v. This must be done very carefully with the flap under slight tension.
  - vi. As the periosteum is incised the flap will be felt to stretch.
  - vii. Make sufficient incisions to lengthen the flap so that it can reach across to the palatal side of the defect with minimal tension.
  - viii. Prepare the palatal aspect of the alveolar defect. Refresh the margin of the palatal side to expose a narrow bony rim at least 1 mm wide, preferably 2 mm. The flap must be sutured into place at a site that has bony support.
  - ix. Suture the flap in place with sutures.

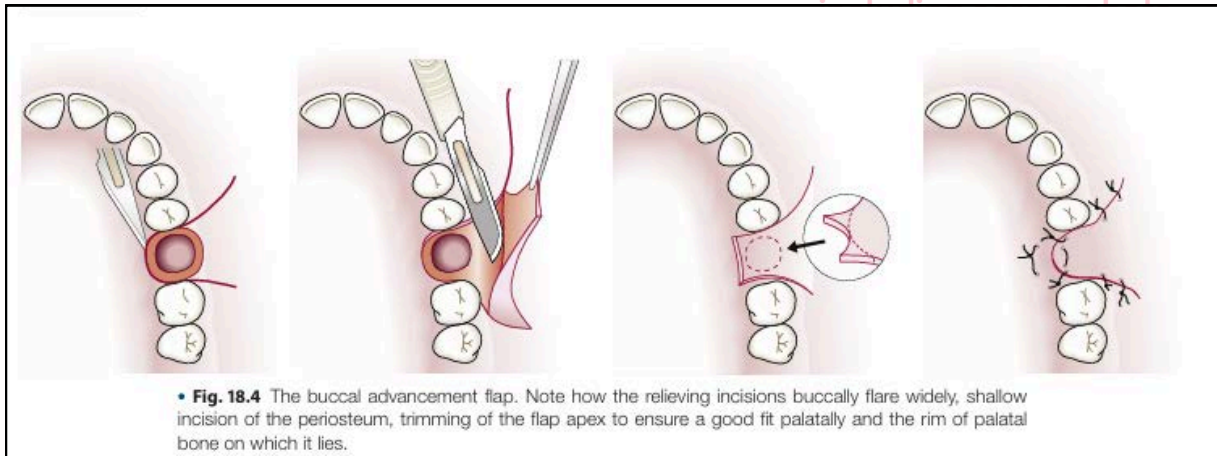
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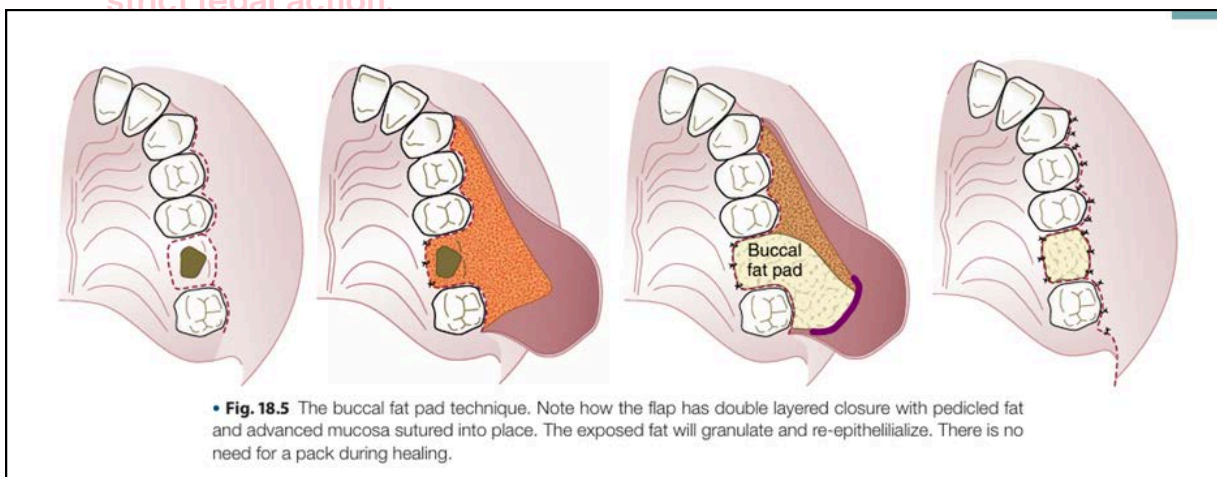


## ORO-ANTRAL COMMUNICATION AND FISTULA

### Closing the Defect:



- The buccal advancement flap may not be possible when the bony defect is very large or when a previous attempt at repair has failed.
- A number of other flaps are possible, including the palatal island flap, submucosal palatal island flap, combined buccal and palatal flaps and even pedicled grafts from the tongue.
- However the buccal fat pad technique is the second most commonly used method.



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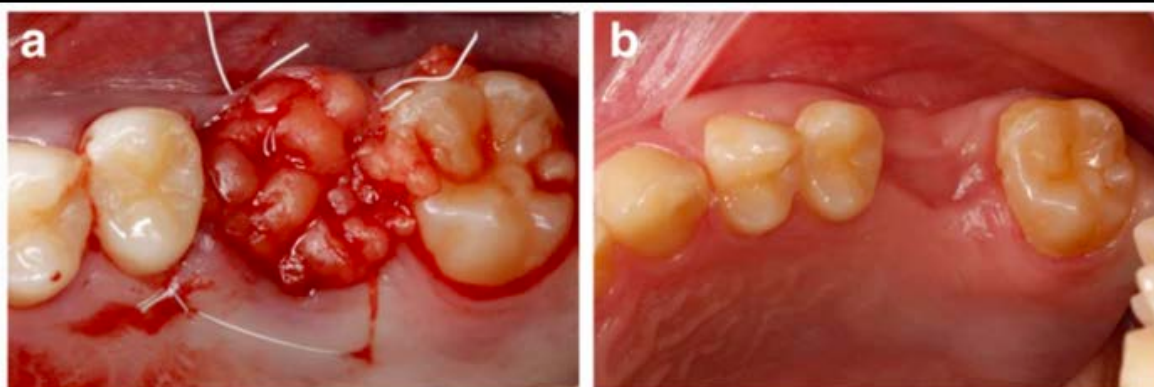
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## ORO-ANTRAL COMMUNICATION AND FISTULA

Various alternative flap design are:

Local Flap Design	Indications/Advantages	Contraindications/Disadvantages
Buccal advancement flap (see Fig. 18.4).	Relatively simple, no flap donor site to heal, suitable for local analgesia.	Not ideal for large defect, advancing the flap reduces the depth of the residual buccal sulcus. Alveolar rather than masticatory mucosa advanced onto the ridge. Flap may break down if under tension.
Buccal fat pad technique. As above, and the buccal fat pad is dissected from under the buccal flap on a pedicle and secure in the socket (see Fig. 18.5).	As above, able to fill a larger defect.	General anaesthesia is required for fat pad dissection, sulcus loss.
Palatal flap.	Possible when buccal flap has failed or would have insufficient length to cover a palatally placed bone defect. Covers the defect with masticatory mucosa.	The flap is of thick tissue and is difficult to mobilize. The donor site is left to granulate and this is painful until healed.



**a** Closure by the buccal fat pad. **b** Healing after 3 months closure by buccal fat pad

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## ORO-ANTRAL COMMUNICATION AND FISTULA

### Postoperative Management of the patient:

- The patients should be instructed not to eat hard food items.
- They should eat soft food items and drink fluid from the opposite side to avoid trauma to operated site.
- Strenuous physical activities which can increase the intra-sinusoidal pressure should be avoided until healing occurs.
- Nose blowing and sneezing with a closed mouth is prohibited for 2 weeks. Patient should open mouth while coughing or sneezing.
- Patients should not roll tongue over suture line or the flap for 07 days after surgery.
- The wound should be kept clean with warm saline mouth rinses.
- Use of straw or smoking is prohibited.
- Use of steam inhalations moistens the airway and stimulates serous gland activity preventing crusting of blood and mucous.
- In addition to the routine instructions given after extraction, the patient must be placed on an antral regime to reduce inflammation and prevent a rise in air pressure in the antrum.
- Decongestants maintain the patency of the opening of the sinus to favor drainage to the nose.

A suitable antral regime would be:

- an absolute ban on blowing the nose for 48 hours
  - sneeze allowing pressure to escape through the mouth
  - nasal decongestant (e.g. ephedrine nasal spray 0.5%)
  - decongestant inhalant.
- In addition, chlorhexidine mouthwash should be given. The repair will fail if there is leakage of saliva and bacteria past the flap from the oral aspect. No rinsing should be performed for 18 hours.

### Prevention:

- The risk of oroantral communication should be assessed routinely on a radiograph before extraction of upper molars.
- If the risk is high, an experienced surgeon should remove the tooth.
- Surgical extraction, possibly with elective sectioning of the tooth, reduces the chances of disrupting the maxillary floor.

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## SUTURE AND SUTURE TECHNIQUES

Management of soft tissue wounds needs a careful assessment of the wound, a good understanding of wound types and healing as well as adequate knowledge and skill for wound care.

Wound closure can be accomplished in diverse ways, but suturing remains the mainstay. A wide variety of materials are available for wound suturing. One has to choose the right material and technique depending on the wound type and closure needs. Alternate techniques such as staples, tapes and adhesives are fast gaining popularity.

### Wound Management:

Wounds are treated by-

Cleansing and debridement,

Haemostasis,

Tetanus immunisation,

Wound dressings,

Wound closure,

Antibiotic medication.

### Purposes of Wound Closure:

The main indication for wound closure is significant exposure of connective tissue.

### Wound Suturing:

Suturing is the process of wound closure by holding the edges of the wound together using a thread. This thread, called a 'suture', is used to approximate the wound edges together and to hold them in position till the tissue healing is sufficiently advanced to maintain themselves in the corrected anatomic position and alignment to each other.

### Suturing Instruments:

Apart from the suture thread and needle, some instruments are used to perform the suturing process. Commonly used instruments include a needle holder, a tissue holding forceps and a pair of scissors.

### Needle Holder:

A needle holder has three parts—a pair of beaks, a joint ('pivot') and a pair of handles with rings. Many designs are available, examples being Webster, Halsey and Mayo-Hegar. Most designs have a serrated or cross-hatching pattern of teeth for the beaks. This helps to grip the needle securely without damaging it. A locking mechanism similar to haemostats is present to lock the needle grasp.

The classical way to hold the instrument is to engage the handle-rings with the thumb and the fourth finger. The middle finger is used for support and the index finger is used to direct or orient the instrument in the required direction.

Alternatively, while suturing on tough tissues, one may be 'palmed', i.e. may be held against the palm with fingers around. While palming the needle holder, some surgeons still rest the fourth finger lightly in the handle-ring.

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## SUTURE AND SUTURE TECHNIQUES

### Tissue Holding Forceps:

The pickup forceps are used to delicately handle and manipulate the wound edge which is being sutured. The fine-toothed Adson forceps is the workhorse for most interior and cutaneous wound closures. The forceps is held in the non-dominant hand and is used to grasp, lift and evert the wound edge so that the surface is made more amenable to a perpendicular needle entry. Fine skin hooks may also be used for the same purpose.

### Suture Cutting Scissors:

The suture cutting scissors is used to cut the suture thread tags after the knot is tied. It is also used to cut the thread during suture removal.

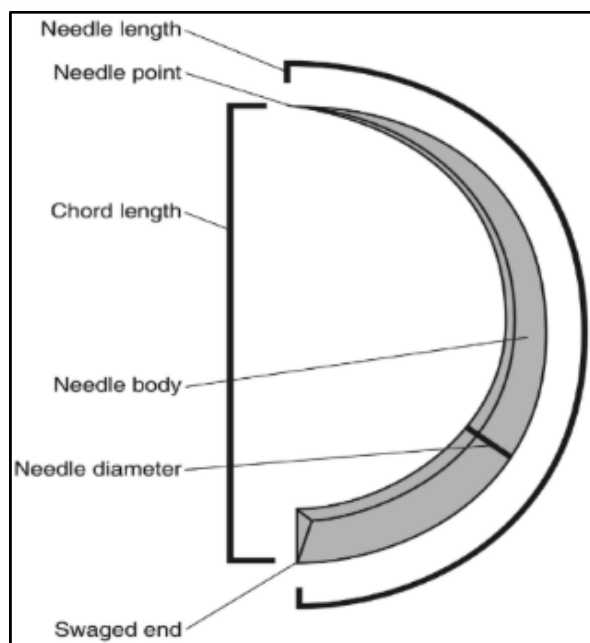
These scissors should be differentiated from scissors used for cutting tissue. Many of them have specifically designed blades and tips, which are uniquely shaped to lift and grasp up the hanging tags or the tied suture thread away from the tissue and to cut it safely without injuring the tissues. Short and long versions are available. The tip may be straight or curved and may have a sharp slot for the thread to be cut. Some manufacturers have incorporated a cutting component in the needle holder itself, using which the surgeon can cut the suture tag without switching instruments.

### Suture Needles:

The suture needles help to pass the suture threads through tissues.

The modern needles are diligently shaped and contoured as per use and are smooth and strong so that they withstand the stresses of suturing and least traumatic to tissues at the same time.

The suture needle has three parts: the tip, the body and the suture attachment. Made of stainless steel or carbon steel, they are thin, smooth and sharp, designed to pass through tissues with ease.



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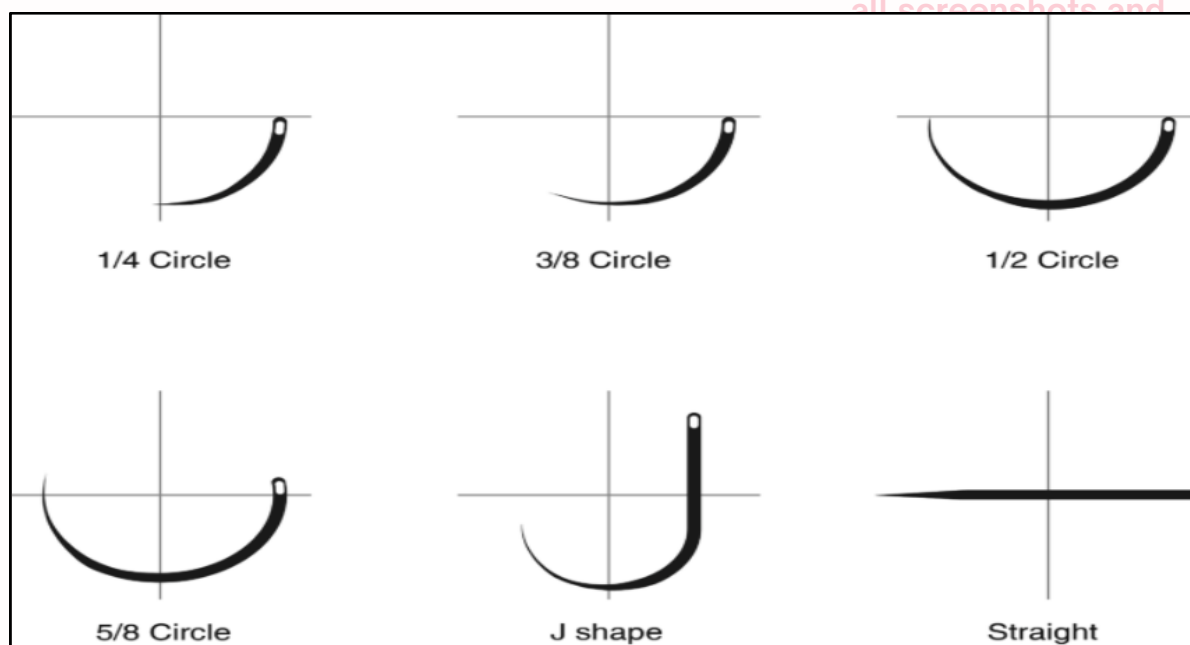
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## SUTURE AND SUTURE TECHNIQUES

### Needle Shape:

The suture needles are usually curved as an arc of a circle. Straight needles, though available, have very limited practical applications. The curvature is described as the span of the arc, in terms of  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$  and  $\frac{5}{8}$  of a circle. Most of the regular suturing in oral and maxillofacial surgery is done with half circle needles. A smaller arc such as  $\frac{3}{8}$  can be used for suturing flat skin surfaces. Longer arc, i.e.  $\frac{5}{8}$  circle, needles are used in narrow tunnelled surgical fields such as in cleft palate or inside the nose.



### Needle Size:

The suture needle size generally depends on the size of the suture. In general, smaller the suture size, smaller the needle. The 'needle length' refers to the end-to-end measurement along the curve of the needle.

### Eyed vs Swaged Needles:

The eye of the needle is a small hole at one end for attaching the suture thread. The suture is passed through the eye, and may then be tucked or tied for better retention. Both tucking and tying further increases the tissue drag and causes additional trauma. The eyed needles are cheaper and can be reused after resterilisation. Modern suture needles do not have an eye. Instead, the suture thread is sealed inside the needle for a permanent attachment. This mechanism, called 'swaging', reduces the tissue trauma significantly as the needle diameter is not increased for thread attachment. Further, only a single thread strand passes through the tissue at all times. So these needles are often called 'atraumatic needles'. The swaged needle with thread is available as a sterile pack, and cannot be reused.

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## SUTURE AND SUTURE TECHNIQUES

### Eyed vs Swaged Needles:

Basis of classification	Types
Source	Natural, synthetic
Absorbability	Absorbable, non-absorbable
Thread size	3, 2, 1, 0, 1-0, 2-0, 3-0.....11-0
Filament type	Monofilament, multifilament (braided)

The basic classification divides them into 'natural' and 'synthetic'. Suture materials sourced from natural sources include catgut, steel and silk. Synthetic plastic materials such as nylon, polypropylene and polymers of glycolic acid, lactic acid, etc., have become popular in recent decades.

Suture materials can also be classified as absorbable and non-absorbable.

Absorbable sutures hold the tissues together till they have healed sufficiently to withstand normal stress, and are then absorbed by the tissues where they are embedded. Non-absorbable sutures, on the other hand, are not absorbed, and they should be removed after the initial stabilisation of the wound edges has occurred. In reality, most or all natural materials will get absorbed by the body in due course of time. Thus, for clinical practice, a suture is considered non-absorbable if it retains its tensile strength in tissues for more than 60 days.

According to the filament type, the sutures may be monofilament or multifilament. A monofilament suture is essentially a single strand of fibre. This simple structure enables these sutures to pass through tissues with least resistance.

The multifilament sutures are made of multiple fibre strands, which are either coated or braided together to make one fine thread. The process of braiding bestows a higher tensile strength as well as better pliability and flexibility. This improves the handling characteristics and the ease of knot-tying. They also better resist the tendency of the knot to untie itself. The cut edges are usually smooth and soft, and are not irritating to oral tissues.

The disadvantages of multifilament sutures include the higher risk of harbouring pathogens in its structure and the tendency to 'wick' the oral fluids into deeper tissues through the suture track. This, in turn, can lead to occurrence to unesthetic suture tracks visible on the skin.

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# SUTURE AND SUTURE TECHNIQUES

## Suture Thread Size:

The most commonly used thread size for intra-oral use is mentioned as 3-0 or 000 size. Sutures are available from size 6 to 11-0.

## A) Natural Absorbable Sutures (Absorbed by Proteolysis):

All absorbable natural suture materials contain predominantly collagen. Over the years, they have progressively fallen out of favour due to the risk of antigenicity and adverse tissue reaction.

### 1. Catgut

Catgut has been the most popular material in this group. The absorption is by proteolytic biodegradation brought about by proteolytic enzymes.

Performance-wise, catgut has good flexibility but relatively poor tensile strength, poor knot stability and high tissue reactivity. Full tensile strength remains only for 7 days.

### 2. Chromic Catgut

It has been found that many poor characteristics of catgut can be overcome by impregnating the suture material with chromic salts. This modified product, called chromic catgut, has higher tensile strength and delayed absorption time. Chromic catgut retains its maximum tensile strength for about 2 weeks. It also has reduced tissue reaction as compared to plain gut. Manufacturers package catgut sutures soaked in the disinfectant isopropyl alcohol solution to retain the flexibility and to increase shelf life. This necessitates rinsing of the suture in sterile saline to remove the irritant alcohol before use. Some manufacturers use a glycerine coating on chromic catgut to do away with the alcohol in packaging. Glycerine-coated chromic gut is smoother and thicker and has better handling characteristics.

### 3. Natural Non-absorbable Sutures

These are the oldest suture materials known to mankind. People tended to use any threaded material known to them for holding the wound edges together. Non-absorbable natural materials include cotton, linen, steel and silk.

### 4. Cotton and Linen

Cotton and linen sutures primarily contain cellulose polymer. Both the materials get absorbed in due course, but are considered non-absorbable because of delayed absorption time. The fibres are twisted to form a suture. It has good tensile strength, but there is moderate tissue reaction. Handling is average but knot-holding is good. Linen has the advantage that it gains tensile strength when wet.

Cotton and linen have largely fallen out of favour because of adverse tissue reactions and the high 'wicking' effect which causes seepage of fluids into the suture track.

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## SUTURE AND SUTURE TECHNIQUES

### Suture Thread Size:

The most commonly used thread size for intra-oral use is mentioned as 3-0 or 000 size. Sutures are available from size 6 to 11-0.

### A) Natural Absorbable Sutures (Absorbed by Proteolysis):

#### 5. Silk

Silk is the most widely used natural non-absorbable suture material. Surgical silk is made from the larvae of the silkworm *Bombyx Mori*. The silk suture consists of a group of strands braided around a core and has a wax or silicon coating. It is usually dyed black in colour for better visibility.

The most impressive property of the silk suture is the ease of handling. It is extremely pliable and smooth and has good knot-holding capability. But the tensile strength is pretty low. The other drawbacks include high levels of tissue friction, capillary action and tissue inflammatory response. The wax coating helps to counteract all these negative attributes.

Silk is now not considered an appropriate material for cutaneous suturing, except on specific sites such as eyelids and lips. It is very often used for ligating blood vessels and for hitching drains. **It is the most popular material used in dentistry. Its soft and pliable nature makes it suitable for use in oral mucosa which is mobile and wet.**

### B) Synthetic Non-absorbable Sutures

#### 1. Polyamide/Nylon-

Monofilament nylon sutures are very popular for cutaneous suturing. The main advantages are their high tensile strength, exceptional elasticity and low tissue reaction. The elasticity helps the material to accommodate tissue swelling and maintain wound edge apposition. The nylon sutures are dyed black in colour. The biggest shortcoming of this material is its shape memory, which negatively affects its knot-tying and knot-holding properties. Often, one needs 3-4 knots to hold a stitch in place. Also, the monofilament may be stiff. Multifilament nylon sutures are available with increased pliability and handling features. Addition of fluid (alcohol) in the package reduces the shape memory and improves pliability.

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# SUTURE AND SUTURE TECHNIQUES

## Suture Thread Size:

### B) Synthetic Non-absorbable Sutures

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#### 2. Polypropylene(Prolene)

Polypropylene is another thermoplastic polymer used as a non-absorbable suture material. It is produced by chain-growth polymerisation of the monomer propylene. It is pigmented blue to enhance visibility, hence the name polypropylene blue. Similar to nylon, polypropylene has a very high tensile strength, excellent elasticity and minimal tissue reaction. It can extend up to 30% without breakage, making it highly suitable for suturing cutaneous wounds. The shape memory is also similar to nylon and can contribute to knot slippage. This feature, though, is advantageous in subcuticular suturing since it slides out smoothly during suture removal.

The excellent mechanical properties and inert nature have made polypropylene the material of choice in stressful sites. It is widely used in the management of hernia and vaginal prolapse, often in the form of a mesh in addition to sutures.

#### 3. Polyester (Dacron)

Polyester is a non-absorbable, braided, surgical suture with high tensile strength and low tissue reactivity. The braided nature adds to enhanced handling, knot-tying and retentivity. Thus, it combines the positive features generally attributed to monofilaments and multifilaments. It is thus the suture of choice in cardiovascular surgery, prosthetic implants and facelifts.

Polyester braided sutures are usually dyed green in colour. They may be coated or uncoated. The uncoated variant has a rough surface which produces drag in the tissues. The coating is made of PTFE or polybutylate.

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# SUTURE AND SUTURE TECHNIQUES

## Suture Thread Size:

### B) Synthetic Non-absorbable Sutures

#### 4. Polybutester

The polybutester monofilament sutures are designed to have high strength, elasticity and pliability. The flexibility and lack of memory allow it to be handled with ease resulting in a high knot security. The unique features have made this a popular material for abdominal wound closure.

The elasticity of polybutester is phenomenal. It can stretch 50% of its length at initial loads. It has a biphasic expansion curve wherein it expands well in response to initial stress and maintains pressure without cutting the tissue, and at the same time withstanding creep by not undergoing permanent deformation even under constant pressure.

#### 5. Polytetrafluoroethylene (Teflon)

PTFE is a strong, tough, waxy, non-flammable material popular for its non-stick properties. **PTFE suture is considered as the ideal material for oral surgeries, especially for dental implant surgeries.** It is inert, non-absorbable and monofilament in nature. The strong fluoro-carbon bond is thought to be the reason for its inertness. Unlike other synthetic monofilament sutures, PTFE is smooth, supple and soft. The cut ends cause no irritation to delicate oral tissues. It has no shape memory. It is well tolerated in the oral cavity and has excellent handling, knot-tying and knot-holding abilities. Thus, it has most of the positive attributes of braided sutures, at the same time avoiding the risk of bacterial contamination by wicking effect.

#### 6. Stainless Steel

It can be monofilamentous or multifilamentous. The obvious advantages of stainless steel sutures are strength and low tissue reaction. Its drawbacks include very poor flexibility that makes it highly demanding in suturing skills. Incorrect technique can cause an excessive pull or tear on the tissues resulting in necrosis of wound edges. Barbs at the end can cause glove punctures and trauma to adjacent tissues.

Stainless steel suture is used in sternal closure and in orthopaedic procedures involving cartilage and tendon repair. It is also sparingly used for abdominal wound closure and hernia repair.

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# SUTURE AND SUTURE TECHNIQUES

## Suture Thread Size:

### C) Synthetic Absorbable Sutures (Absorbed by Hydrolysis)-

The synthetic absorbable sutures are all polymers based on glycolic acid, L-lactic acid, paradiioxanone, trimethylene carbonate and ε-caprolactone [2]. They are sterilised either by ethylene oxide gas or by gamma radiation. These polymers have definite advantages over chromic catgut in clinical use. They are much stronger, evoke minimal tissue reaction, stay longer before absorption and leave no reactive changes after they are resorbed. They are absorbed typically by hydrolysis reaction which breaks the polymer chains. The hydrolysis end products are CO<sub>2</sub>, H<sub>2</sub>O and the monomer.

#### 1. Polyglycolic Acid (PGA)

It is braided homopolymer of glycolic acid. The uncoated version is beige in colour while the polycaprolate-coated product may be undyed or dyed green, violet or bicoloured. When compared to catgut, the tensile strength and knot security are excellent. It retains 65% of its tensile strength after 2 weeks, by which time catgut would have lost all its strength. The polyglycolic acid soon became very popular but fell out of favour later as better products were developed in due course of time.

#### 2. Polyglactin 910 (Vicryl, Polysorb)

This is a multifilamentous, braided suture with a lubricant coating of polyglactin 370 (30:70 ratio) and calcium stearate. The final product is usually dyed violet in colour, but an undyed beige version is also available. The main advantages of polyglactin over polyglycolic acid include consistently higher residual tensile strength and faster absorption. The absorption happens between 40 and 70 days. The coating ensures smooth passage. Since the coating is made of similar material, the risk of flaking is very low. Calcium stearate used in the coating is an absorbable organic lubricant. The shelf life of polyglactin is as high as 5 years. By treating the coating with γ-radiation, it is made to lose strength by second week and is fully absorbed by sixth week. This variant is widely used in oral surgery, where faster resorption is desired.

A study at Sweden indicate that it is possible to use irradiated polyglactin 910 sutures in oral implant surgery without affecting the rate of early implant failure. However, it is recommended to add interrupted "security sutures" if a continuous suture technique is used in combination with fast-absorption suture material.

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# SUTURE AND SUTURE TECHNIQUES

## Suture Thread Size:

### C) Synthetic Absorbable Sutures (Absorbed by Hydrolysis)-

#### 2. Polyglactin 910 (Vicryl, Polysorb)

IRPG is a versatile and useful suture for oral and maxillofacial surgery. It can be used in a variety of applications, both intra- and extraorally, for pediatric as well as adult patients. The use of IRPG suture results in little wound inflammation. IRPG is absorbed over 12 to 14 days and does not require removal. It is also much more cost-effective than PTFE sutures and only slightly more expensive than catgut, chromic or PGLA sutures. Future evaluations, using clinical and economic parameters, will be necessary to compare IRPG with newer, absorbable, monofilament polymers such as the polydioxanones and caproclactones.

#### Antibacterial suture vs silk for the surgical removal of impacted lower third molars.

The most significant antibacterial effect of Monocryl® Plus suture occurred in the first 3 days. Nevertheless, 7 days after surgery there was some bacterial reduction vs silk suture. Commensal species (*Streptococcus viridans* group) were more frequently isolated than pathogenic organisms (*Prevotella spp.*, *Fusobacterium spp.*). The postoperative infection rate was close to zero per cent with both sutures. In extraction of impacted third molars, Monocryl® Plus suture does not seem to improve substantially of the rate of SSI.

#### 3. Polydioxanone

As a monofilament suture, it has much less drag through the tissues than polyglactin or polyglycolic acid. Since it retains its tensile strength over a long span of time (80% strength at 2 weeks and 60% after 6 weeks), it is considered a better alternative to polyglactin for suturing of fascia.

#### 4. Poliglecaprone 25

Often seen as the monofilament alternative to polyglactin, poliglecaprone is a segmented block polymer consisting of 75% glycolide and 25% ε-caprolactone. It is available as an undyed or a violet dyed version. The key feature that differentiates poliglecaprone from other monofilament sutures is the high level of pliability and handling properties. The tensile strength of the undyed poliglecaprone suture degrades to 50% in 1 week and 30% in the second week. The dyed version retains 70% strength after 1 week. Complete absorption by hydrolysis happens in about 100 days.

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## SUTURE AND SUTURE TECHNIQUES

### Suture Thread Size:

#### C) Synthetic Absorbable Sutures (Absorbed by Hydrolysis)-

##### 5. Polyglyconate

Polyglyconate has good handling properties. But its main advantage is the retention of tensile strength over a long time span. It retains at least 50% of its strength 4 weeks after implantation, making this an excellent choice in situations where long-term retention is needed. The slow absorption makes it relatively unsuitable for subcuticular sutures, since the dyed suture may be visible under the surface.

##### 6. Glycomer 631

It is a synthetic absorbable coated monofilament polyester suture. It passes through the tissues easily but has poor knot-holding capability. Degradation and absorption are similar to polyglactin. Full absorption is complete in around 100 days.

##### 7. Polyglytone 6211

It is a monofilament, uncoated, absorbable suture which is undyed or dyed violet. Polyglytone 6211 is a suture for the short-term approximation of tissues. Because of its quick disintegration, it offers an inert alternative to catgut that can evoke inflammatory response. Its strength decreases to 50–60% at 5 days and to 20–30% at 10 days post-implantation.

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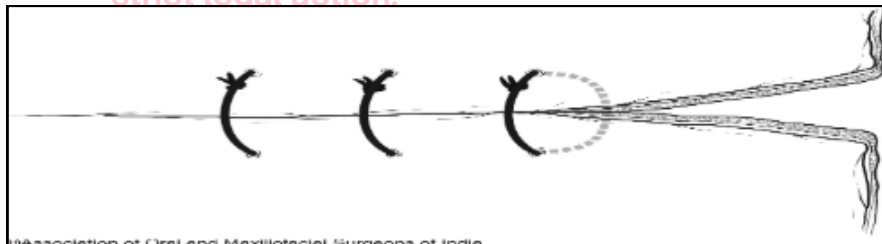
# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

### 1. Simple Interrupted Suture

A simple interrupted suture ('simple loop') is the most common method to suture a wound. This is the simplest design of wound closure. The suture passes once through each side of the wound in a simple loop and is then tied in a knot above the surface. Multiple such ties are made over the length of the wound, resulting in several independent sutures collectively securing the tissue edges together. The needle penetrates the surface 2–3 mms away from the wound edge on one side and proceeds into the subcutaneous tissue. The curve of the needle is then used to pass it through to the subcutaneous tissue on the opposite side. The needle then exits through the surface. The initial and final tags, now outside of the tissues, are then tied in a knot. The configuration inside the tissue is thus in the form of a loop. If the wound sides are of unequal depth, then the needle should travel deeper in the lower side while staying superficial on the higher side. This will help to correct the depth disparity and ensure proper surface levelling.

This technique is easy to learn and employ. This suture provides good tensile strength and carries minimal risk of wound oedema or impaired circulation. Several adjustments to the design are possible with this method depending on the wound characteristics. Since there is a series of multiple sutures, even if one suture fails, the others may provide sufficient strength to keep the wound edges together.



The major drawback of this method of suturing is the high possibility of 'rail-road track' shaped scars caused due to the ingrowth of epithelium into the suture tracks. There is also a tendency to cause 'wound inversion' (depression of the surface at the wound site) due to tissue contracture during healing.

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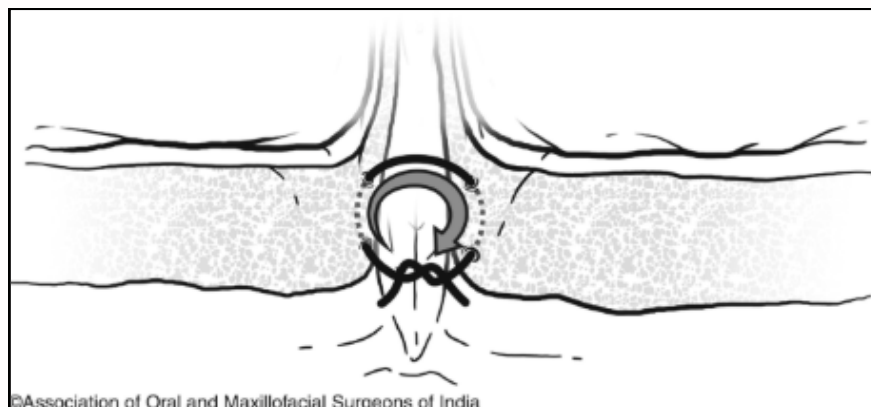
# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

### 2.Simple Buried Suture

The buried suture is a modification of the simple interrupted suture and is reserved for stitching the inner (deeper) tissue layers. The only difference is that the knot ends up in the tissues deeper to the suture loop, i.e. away from the surface. In essence, this is a simple interrupted suture in the reverse orientation.

The wound edge is first reflected using fine forceps or hooks. The needle is then inserted into the underside of the dermis on one side. The needle then proceeds along its curvature to exit in the wound edge more superficial to the initial bite. The needle then pierces the dermis wound edge (near the surface) on the opposite side, proceeds in a path mirroring its motion in the first side and comes out at a deeper point which corresponds to the first bite. Though the tie is done outside, the knot gets buried deep inside the tissues as it is tightened. This technique is extremely useful in suturing the inner tissue layers before the surface closure. As the knot is buried deep, it does not interfere with the closure of superficial layers. This aspect is extremely useful while closing cutaneous facial wounds.



Two major drawbacks have been observed with this suture. One is a skin dimpling which typically happens if the suture arc inadvertently involves the epidermis. Another problem is the tendency for wound inversion to occur. Small modifications such as a set-back dermal buried suture or a vertical mattress buried suture can be employed to overcome this problem. These modifications attempt to pass the bridging suture segments to be deeper, thus resulting in wound eversion.

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# SUTURE AND SUTURE TECHNIQUES

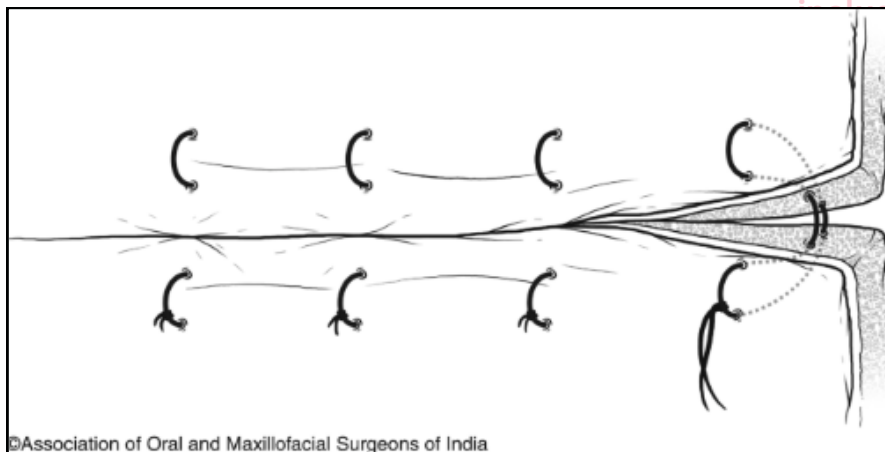
## SPECIFIC SUTURING TECHNIQUES

### 3. Vertical Mattress Suture

The vertical mattress suture is in part similar to simple interrupted sutures but includes an additional suture bridge close to the wound edge. Also known as Donati Suture, or 'far-far, near-near' suture, this is the most frequently used suturing technique to obtain wound eversion. This suture design is very popular in abdominal and limb surgeries.

The needle is first penetrated far from the wound edge (about 6 mm), and then proceeds through the deeper tissue to the opposite side and emerges out at an equal distance from the edge. The needle is then reinserted at a point closer (2–3 mm) to the wound edge on the second side itself. It is then rotated superficially through the tissues and is exited on the other side at a corresponding near point. This results in a double bridging of the wound, one deep in the tissues and another superficial and nearer to the wound edge. Thus, both tags of the thread are now on one side of the wound. They are tied together gently.

The primary advantage of this suture is the resultant wound eversion. This eversion is expected to compensate for the anticipated contracture occurring along the wound margin. As the suture is bridging the wound twice, the binding strength is more. Elimination of dead space is another obvious advantage. The suture thread does not pass the wound edge on the surface, minimising the chance of track marks. On the flip side, fine wound edge approximation is almost never achieved with this suture. Excessive tightening could lead to over-constriction and sometimes exposure of the raw area. This may necessitate placement of additional interrupted sutures for better results.



The vertical mattress concept can be used in a buried suture situation also by ensuring that the more superficial suture thread passed back to the first side in a path parallel to the first, deeper suture bridge. This will result in a better wound eversion.

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# SUTURE AND SUTURE TECHNIQUES

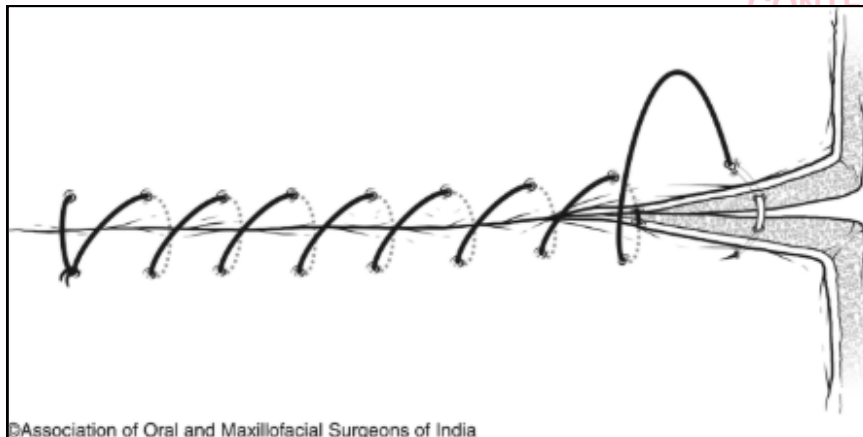
## SPECIFIC SUTURING TECHNIQUES

### 4. Simple Continuous Suture

Simple continuous suture ('running loop', 'standard running suture') is a good method for rapid closure of small wounds. It gives an even distribution of tension all along the wound span. It combines many benefits of the simple interrupted sutures with the additional advantage of a quicker finish.

The technique is very simple. The first part follows the same process as a simple interrupted suture. The first knot becomes the anchoring knot for the ensuing running line. The tags are not cut and the longer tag (with the needle) is used for making the remaining loops. The needle is inserted back into the tissues a few millimetres away from the first piercing. Then the needle (followed by the thread) passes through the tissues in a path parallel to the first loop. Once it comes out of the second loop, it is not tied. Instead, the loop is tightened and the thread crosses over obliquely across the wound and enters the tissue surface again, a few millimetres away from the second piercing. This process continues over and over until one reaches the other end of the wound. As the last loop goes through the tissues, the thread is only partially pulled through, leaving some loose thread on the opposite side. The suture is then tied to this loose thread for the final knot. Thus, the suture material runs across the wound in repetitive loops, and there are only two knots—one at either end.

The obvious advantages of this technique are the quickness of suture placement and the ease of avoiding many knots. Also, if the tissue wells up in one site, the remaining part of the suture can provide some compensatory slack.



The principal drawback is that the integrity of the entire suture line is vested in just two knots. Any breakage to the suture at any point leads to the entire line getting untied. Since the loops are in continuous succession, fine-tuning of design for each loop is not possible. Also, since the tension is the same across all loops, the areas of the wound with greater tension, usually the central part, may tend to gape.

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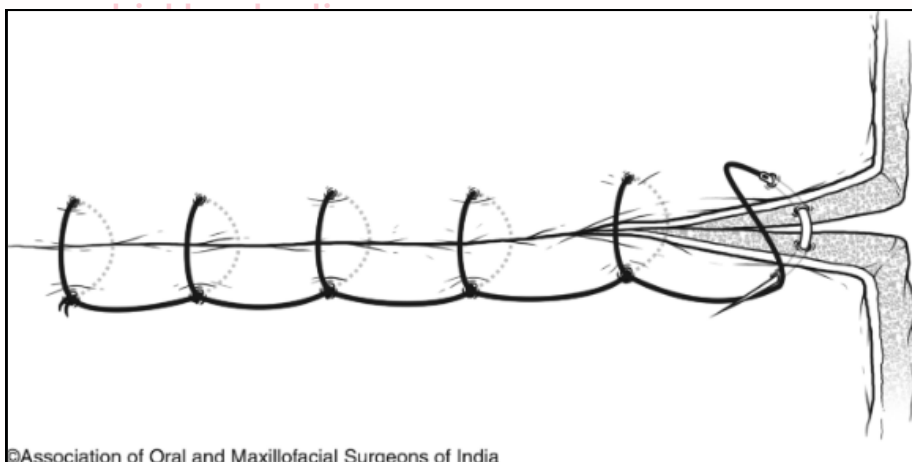
# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

### 5. Locking Continuous Suture

This is a variation of the simple continuous suture technique used for surface wounds. Each loop of the continuous suture is 'locked' on itself before making the next loop. This is the most popular continuous suturing technique especially for closing wounds over long spans. As with other superficial continuous sutures, this method is frequently used as a surface layer after the internal tissue layers have been closed.

Similar to the simple continuous technique, the first loop is passed and the knot tied. After the second loop has gone through the tissues and exited, the suture is not immediately tightened. The needle and the leading thread it is made to pass through the earlier loop. After making this 'lock', the suture is tightened and is then passed into the tissues for the third loop. The assistant should maintain this tension until the next loop is passed. This process is repeated for the entire line of succeeding loops. The locking helps to align the tissues in a proper anatomic orientation perpendicular to the wound. There is an added haemostatic effect due to the tension on tissues. Uniform degree of tension is maintained across all the loops. At the same time, the running locks partially detach the tension on the individual loops from one another. Thus, to an extent, individual control of tension depending on the site can be obtained.



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This technique inherits the main disadvantage of the simple continuous sutures of being dependent on only two knots, and the risk of complete loss of suture integrity in case of breakage at any point. The locks, if they are too tight, may cause vascular compromise of underlying tissues.

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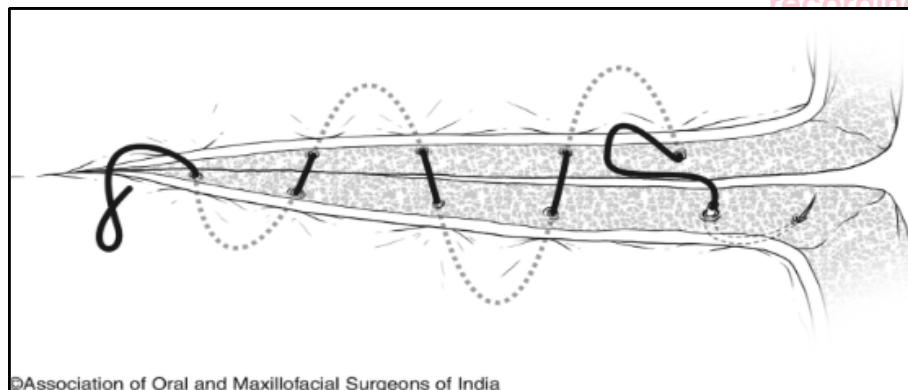
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# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

### 6. Subcuticular Suture

This is a mostly buried, continuous, epidermal wound closure which is used for surface closure. The suture ends exit a few mms away from the wound corner. The subcuticular suture is employed only after the deeper structures and dermis have been secured well with absorbable sutures. It is popular as an aesthetic suture for face.



The suture may be absorbable or non-absorbable, and is usually thin (size 5-0 or 6-0). The needle insertion is at one end of the wound, 2-5 mm away from the apex. It is passed along the curve into the wound, where it exits in the interior, close to the apex. Then the needle is inserted again into the dermis on any one side of the wound edge walls. Thereafter, it passes horizontally parallel to the surface, and following the needle curve to come out into the wound interior a small distance away. The same step is then repeated on the other side of the wound. This process is repeated till one reaches the other end of the wound, wherein the needle is made to pierce the far end apex and to come out in the surface. This last step is a mirror image of the initial steps. Then each of the suture tags on both sides is tied separately on to itself. Alternatively, the tags may be secured with adhesive strips, surgical tape or tissue glue.

The biggest advantage of this technique is the much-decreased risk of scars. The close approximation achieved in the dermis region makes the need for a further surface suturing unnecessary. The tension is aligned centrally across the wound and is evenly distributed all along the length of the suture. Also, this technique is highly suitable in cases where the suture material is required to stay in place for a long period of time.

On the negative side, the subcuticular suture takes longer time to perform. Leaving a large quantity of foreign material in situ can increase the risk of foreign body reaction and infection. If non-absorbable material is used, there is a minor risk of long and thin suture track following removal. If absorbable material is used, an undyed suture should be chosen to prevent cutaneous visibility. Incorrect technique can leave small segments of exposed raw area, which need to be addressed with additional surface sutures.

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# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

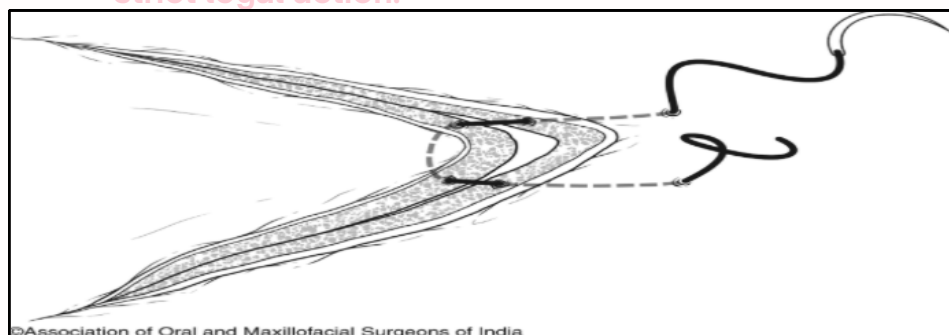
### 7. Purse-String Suture

This is essentially a modification of the simple continuous suture, and is designed to reduce the size of a two-dimensional surface defect. It is not a cosmetically superior technique and is rarely used in the face. The purse-string effect causes a puckering in the surrounding skin tissue. But this is an effective method to reduce wound area. It may also be used to achieve haemostasis.

At first, the wound edges of the defect need to be freshened and underlined. The needle and thread is passed along the edge of the defect in a course running parallel to the wound edge. Thereafter, it continues in a series of loops running along the edge of the surface wound along its entire circumference. As the thread completes the full distance and reaches near the initial needle entry, it is pulled taut, leading to complete or partial closure of the wound. Then the tags are tied together.

### 8. Three-Point Suture

Also known as 'tip stitch' or 'half-buried horizontal mattress suture', this technique is used for managing a situation where three ends of the tissue have to be sutured together. In maxillofacial surgery, this situation is encountered while repairing V-shaped lacerations and while closing flaps with sharp corners (such as the triangular flap at the vermillion border for cleft lip repair)



This suture is placed only after the flaps are brought into position using buried dermal sutures. The surface suture thread is used, that is, 6-0 for face and 3-0 for scalp. The needle is first inserted into one side of the non-flap side of the wound. It follows the needle curve to exit in the inner aspect of the wound. The next tissue insertion is into the superficial dermis of the flap tip. Then the needle passes horizontally and comes out through the dermis on the other side of the flap tip. After releasing from the flap tip, it re-enters the dermis of the non-flap side on the other side and comes out through the skin at a point corresponding to the initial entry. The tags are then knotted together.

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# SUTURE AND SUTURE TECHNIQUES

## SPECIFIC SUTURING TECHNIQUES

### 9. Frost Suture

The Frost suture is a temporary eyelid suspension suture, used to ensure proper lower eyelid placement during the post-operative period.

After the closure of the lower eyelid incision, a needle bite is taken on the tarsal plate or just inferior to it. Then a second bite is taken just above the eyebrow, ensuring the anatomic position and alignment of the lower lid. These tags are then tied or secured with tapes or tissue glue.

These sutures may be removed on third post-operative day, but need to be kept longer if there has been significant trauma to the tissues.



### 10. Drain Anchoring Suture

Different types of drains are used in surgery, such as corrugated rubber drain, the suction drain, intercostal drain, etc. After the drain has been inserted, it needs to be securely fixed to the body to prevent displacement.

The most common means to secure drains is the Roman Garter method, which uses silk sutures. A strong bite is first taken on the skin near the drain entry site. After making a knot, the two suture tags go around the drain tube in a series of windings. A knot may be tied after each 2 or 3 turns around the tube. The large number of windings around the tube increases the friction, holding the tube in position without dislodgement.



Other techniques which have been described include the use of nylon suture, safety pin, drain clip, adhesives and Tie-lok.

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# SUTURE AND SUTURE TECHNIQUES

## DENTOALVEOLAR SUTURING

Wound closure in dentoalveolar surgery involves suturing in situations such as-

- Suturing of buccal and/or lingual flaps back to its place after dentoalveolar surgery around teeth or implant accessories.
- Wound closure after tooth extraction.
- Flap closure in edentulous ridge.

In most cases, the needle passage is through keratinised mucosa with little or no subcutaneous tissue, obviating the need for multilayered closure. The presence of teeth or artificial crown on one side of the flap forces the surgeon to innovate on the basic suture design. Another difference is when the extraction wound is closed—the wound is usually closed only at the edges and is largely left open in the middle.

### 1. Simple Interrupted Suture (Interdental Suture)-

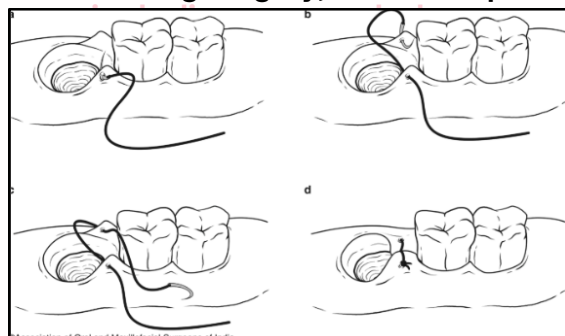
As in any case of wound closure, the simple interrupted suture is the mainstay in closing dentoalveolar flaps. In general, it involves suturing the detached interdental papillae together. The needle passes from the buccal aspect of the buccal flap, emerges on the inside of the flap and then passes between the tooth roots to enter the inner aspect of the lingual flap. As it pierces the lingual flap and emerges through the mucosa, the needle is turned back and is taken back via the interdental region to the buccal side. The two suture tags are then tied together. Thus, the knot remains on the buccal side and is accessible for removal.

If only one flap (usually buccal) has been raised, the needle can still pass through the attached lingual flap and the suture design stays the same. In post-extraction wounds also, the procedure is the same, and the tooth socket space is not totally closed.

### 2. Interrupted Reversing Suture

In this modified interrupted suture, the direction of the needle is reversed for engaging the lingual papilla. Once it passes through the buccal papilla and reaches the lingual side, the needle orientation is reversed and it is made to enter the lingual papilla from outside (lingual side). The needle exits the flap on the inside, passed across to the buccal side and is then tied. Thus, both the papillae are engaged in an 'outside-to-inside' orientation, ending in a figure-of-eight formation in the vertical plane.

This technique is especially useful in cases where both buccal and lingual flaps are raised during surgery, such as in periodontal surgeries.



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# SUTURE AND SUTURE TECHNIQUES

## DENTOALVEOLAR SUTURING

### 3. Vertical Mattress Suture

Vertical mattress technique in dentoalveolar surgery is a modification of the papilla-attaching simple interrupted technique. After the initial passage of the needle through the buccal and lingual papillae, the needle is turned back and picks a small bite at the tip of the lingual papilla before passing back to the buccal side. Then it again pierces the tip of buccal papilla before knot-tying.

While this technique helps in pressing the papilla into the interdental space, it is not a popular technique because of the difficulty in getting a solid bite at the papilla tip without 'cutting through'. Obviously, one needs to use an atraumatic needle with a small thread (4-0 or smaller) for this purpose.

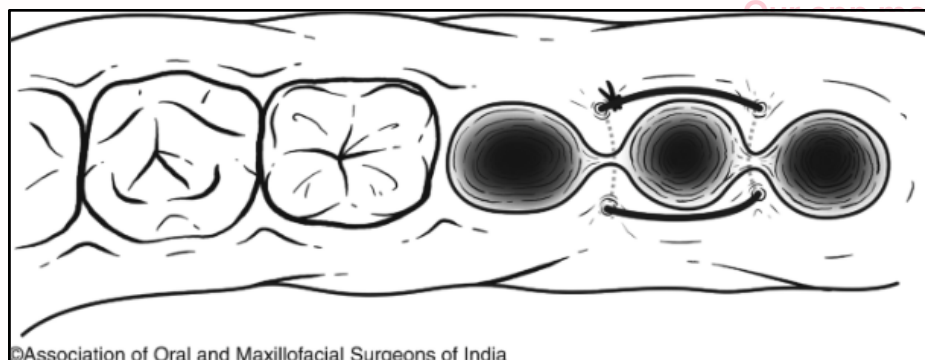
### 4. Horizontal Mattress Suture

This is a two-dimensional suturing technique where the suture thread is spread in a horizontal fashion in the tissues. It is not very popular for general cutaneous suturing but is especially useful in dentoalveolar surgery.

When closing flaps in edentulous areas, the needle first passes through both flaps. Then it is reinserted into the flap on the same side, a little distance away from the earlier exit point. The reinserted needle now passes through both flaps and emerges out a similar distance away from the initial entry point. Both the thread tags, now on the same side, are tied together.

In dentulous areas, this technique sutures two adjacent papillae together, eventually tying four papillae segments around a tooth in a horizontal square fashion. To close extraction wounds, only the papillae are approximated and the tooth socket space is not closed completely.

The advantage of this technique is that a single horizontal mattress suture serves like two separate interrupted sutures, thus helping to reduce the number of sutures. It compresses the wound from four corners and helps in haemostasis. It also results in some degree of wound eversion.



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## SUTURE AND SUTURE TECHNIQUES

### DENTOALVEOLAR SUTURING

#### 5. Horizontal Mattress Modification: Dental Anchor Suture

In this modification, the suture does not pass through the lingual soft tissues. After passing through the buccal papilla, the suture passes through the interdental region into the lingual side. Without engaging the lingual papilla, it goes around the tooth and comes back to the buccal side via the interdental space on the other side. Then it engages the buccal papilla before being tied. In this way, it secures the papilla to the bone using the tooth as its 'anchor'.

This technique can also be used in a reversing fashion, where only the papilla on the lingual side is engaged and the buccal side papillae are not pierced.

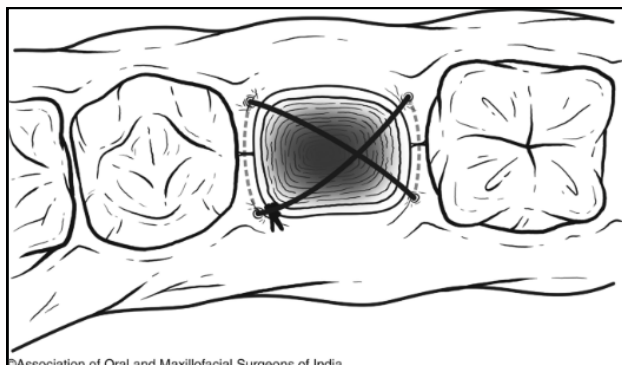
#### 6. Horizontal Mattress Modification: Mattress Sling Suture

This technique attempts to combine the benefits of vertical mattress suture with those of horizontal mattress suture. The basic technique goes similar to the horizontal mattress but the final tag re-enters the buccal papilla at the tip and traverses a reverse path around the tooth to exit near the initial entry. In this way, it ensures the engagement of both buccal papillae in a vertical mattress fashion.

#### 7. Horizontal Mattress Modification: Figure-of-Eight Suture (Cruciate Mattress Suture/Cross Suture)

The figure-of-eight suture is the most popular modification of the horizontal mattress technique. This is used mostly in closure of extraction wounds, and never in the presence of teeth at the wound site.

The needle first penetrates the buccal papilla on one side and then the lingual papilla. Then the thread crosses across the edentulous site, and the needle is reversed in orientation to pierce the buccal papilla of the other side from outside (buccal side) to pass through the lingual papilla and exit on lingual side. Then the thread passes across the site to be tied with the initial tag. The suture thus ends with the appearance of suture material crossing the wound site in a 'cross' shape.



Many surgeons consider the figure-of-eight suture to be the most comprehensive way to suture a single tooth extraction site. This method ensures an even tension on the tissues from four corners, effectively constricting the wound. There is a positive effect on haemostasis also, due to the tension on the flap and due to its presence a mechanical barrier to clot loss.

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# SUTURE AND SUTURE TECHNIQUES

## DENTOALVEOLAR SUTURING

### 8. Simple Continuous Suture

The continuous sutures are almost exclusively used for edentulous situations including post-extraction closure. After making a conventional interrupted suture knot, the longer tag is not cut and is instead used to make a series of 'running loops' approximating the succeeding pair of papillae one after the other. Gentle tension must be maintained on the thread to keep the loops tight while the needle passes through the next tissue. Knots are not tied for each loop but is done only at the other end of the long wound. Some surgeons prefer to tie a knot after 3 or 4 running loops. In the end, the part of the suture passing through the inner tissues are perpendicular to the wound, and the superficial, exposed parts lie across the wound in an oblique fashion.

The continuous sutures save time and effort while closing wounds of long span. It also ensures an even distribution of tension across the wound. The obvious disadvantage is the fact that if one loop or part of the suture is compromised (by untying, cutting through or loosening), the entire suture line gets loosened.

### 9. Continuous Locking Suture

The continuous locking suture is a continuous suture in which a 'lock' is incorporated by passing the thread under the previous loop before it is pulled through the tissue. It is important to keep maintaining the tension on the previous loops as the needle makes the next pass through the tissue.

This technique ensures a better orientation of the sutures with respect to the wound. The superficial, exposed parts of the suture are oriented perpendicular to the wound, leading to better anatomic wound approximation.



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## SUTURE AND SUTURE TECHNIQUES

### SUTURE REMOVAL

Sutures on facial skin and in oral cavity are usually removed in 5–7 days. The recommended interval is 3–5 days for eyelids, 7 days for neck and 7–10 days for scalp. Those on trunk and limbs should remain in place for 10–14 days. In the case of a continuous suture, every single loop should be cut and pulled out separately. A subcuticular suture is removed by cutting the knot off at any one end, and then pulling the suture out gently from the other end. It is important to make sure that the suture does not break within the tissues.

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