Saudi Journal of Medicine and Public Health

https://saudijmph.com/index.php/pub

https://doi.org/10.64483/jmph-110

Clinical Management and Pharmacological Support in Surgical Extraction of Unerupted Teeth: An Updated Review for Dentists, Pharmacists, Laboratory Workers.

Mai Abdullah M Alqunfdi [1], Hanan Muntaha Hassan Al-Moashi [2], Zohour Abduqader Baamer [2], Khdigah Mansour Sarhan[2], Mohammed Almutairi [3], Ali Mohammed Qassim Hazzazi [4], Amal Ahmad Ali Hardi [5], Fatimah Saad Alotaibi[6], Hanan Awad Awaad Alosaimi [7], Zaki Yahya Bawkar Hawbani [8], Abdullah Rashid Alharbi [9], Reem Mohammad Alhumaidan [10], Mohammed Othman AlRethy [11], Dawla Ali Al aqili [11]

[1]*Directorate of health affairs, Ministry of Health, Jeddah, Saudi Arabia*
[2]*Bahar Health Center, Ministry of Health, Jeddah, Saudi Arabia*
[3]*Security forces hospital, Ministry of Health, Dammam, Saudi Arabia*
[4]*Abu-Arish General Hospital, Ministry of Health, Saudi Arabia*
[5]*PharmD, Ministry of Health, Saudi Arabia*
[6]*General Directorate of Nursing.MoH Agency for Therapeutic Services, Ministry of Health, Saudi Arabia*
[7] *King Abdullah Bin Abdulaziz University Hospital, Ministry of Health, Saudi Arabia*
[8]*Irada Hospital for Mental Health in Jazan, Ministry of Health, Saudi Arabia*
[9]*Al Shifa First Health Center, Ministry of Health, Saudi Arabia*
[10]*Nursing Affairs General Agency for Therapeutic Services, Ministry of Health, Saudi Arabia*
[11]*King Salman Hospital, Ministry of Health, Saudi Arabia*

Abstract

Background: The extraction of unerupted and impacted teeth is a common yet complex surgical procedure in dentistry. These teeth, which fail to erupt into the dental arch, can lead to pathologies such as cysts, infections, and damage to adjacent structures, necessitating careful surgical management.

Aim: This review aims to provide an updated, comprehensive guide for dental professionals on the clinical management and pharmacological support for the surgical extraction of unerupted teeth, emphasizing a multidisciplinary approach to optimize patient outcomes.

Methods: The article synthesizes current evidence on diagnosis, classification (utilizing systems like Pell and Gregory and Winter), and surgical techniques. It details the roles of pre-operative assessment, including advanced imaging like Cone Beam Computed Tomography (CBCT) for risk stratification, and outlines the step-by-step surgical protocol from flap design to socket management.

Results: Successful outcomes depend on meticulous planning and execution. Key findings highlight the importance of CBCT in assessing proximity to neurovascular bundles, the efficacy of techniques like tooth sectioning and coronectomy in reducing complications, and the critical need for tailored pharmacological management for pain, infection, and bleeding control. Complications such as alveolar osteitis, nerve injury, and oroantral communication are discussed with evidence-based prevention and management strategies.

Conclusion: The surgical extraction of unerupted teeth requires a systematic, team-based approach. Integrating precise surgical techniques with appropriate pharmacological support and interdisciplinary collaboration among dentists, pharmacists, and laboratory workers is essential for minimizing risks and ensuring patient safety and effective recovery.

Keywords: Unerupted Teeth, Surgical Extraction, Impacted Third Molar, Pell and Gregory Classification, Coronectomy, Pharmacological Management, Dental Surgery.

1. Introduction

Extraction of unerupted teeth constitutes a common procedure across dental disciplines. Unerupted teeth may remain within the alveolus beyond their expected eruption time. Such cases require precise classification to guide management. A retained tooth lacks a mechanical barrier to eruption and shows radiographic signs of continued eruption potential, while an impacted tooth meets a physical obstruction from neighboring teeth bone or soft tissue

*Corresponding author e-mail: Malgonfodi@moh.gov.sa (Mai Abdullah M Alqunfdi).
Receive Date: 21 May 2025, Revise Date: 30 June 2025, Accept Date: 5 July 2025

[2]. Impaction may affect a single tooth or multiple teeth and may be partial or complete depending on the relationship between the tooth crown and the alveolar margin. The prevalence of dental impaction spans maxillary and mandibular arches and affects a range of tooth types in clinical practice [1]. Clinical assessment begins with a focused history and intraoral examination that evaluate symptoms of space relationships mucosal status and the presence of pathology. Radiographic imaging complements the clinical assessment. Periapical and panoramic radiographs offer two dimensional views of tooth angulation root form and proximity to adjacent structures while cone beam computed tomography provides three dimensional details of tooth position cortical bone thickness and relationships to neurovascular bundles [1][2].

Imaging informs risk assessment and surgical planning. Treatment planning integrates patient factors tooth factors and the planned restorative or orthodontic goals. Surgical approaches vary by tooth position and depth. Techniques include soft tissue elevation minimal bone removal controlled sectioning of the tooth and careful extraction with preservation of surrounding bone. In selected cases coronectomy may be an option when removal risks injury to adjacent neurovascular elements. Intraoperative decisions balance access to a hesitation and the need to limit trauma to bone and soft tissue. Antimicrobial and analgesic regimens follow local protocols and patient risk profiles. Complications may include wound dehiscence infection damage to adjacent teeth paresthesia and delayed healing. Preventive measures and informed consent reduce legal and clinical risk. Multidisciplinary coordination improves outcomes when orthodontic prosthetic or endodontic interventions are anticipated after extraction. Postoperative care emphasizes wound management pain control surveillance for infection and timely follow up for rehabilitation. Research into surgical techniques imaging protocols and pharmacologic adjuncts continues to refine best practice for management of unerupted and impacted teeth [1][2].

Anatomy and Physiology

Tooth eruption denotes the directed movement of a developing tooth from its position within alveolar bone to the occlusal plane and requires coordinated remodeling of bone and overlying soft tissues. Eruption proceeds through sequential resorption of bone and, when present, primary tooth roots that occupy the eruption path. A propulsive force drives the tooth in an occlusal direction along this created pathway. Current models propose an initial phase in which localized bone resorption above the unerupted tooth establishes the eruption corridor. This phase is followed by bone apposition on the apical aspect of the tooth, which generates the occlusal thrust that advances the tooth along the pathway. The dental follicle has a central regulatory role in these processes by directing osteoclastic and osteoblastic activity that together permit the tooth to translocate to the alveolar crest [3]. Multiple theories have attempted to explain the mechanics of eruption, but the dental follicle mediated bone remodeling hypothesis remains the most widely accepted mechanism in contemporary literature. Tooth impaction affects a significant minority of the population with reported incidence ranges between 5.6 percent and 18.8 percent and demonstrates a sex distribution skewed toward females [3].

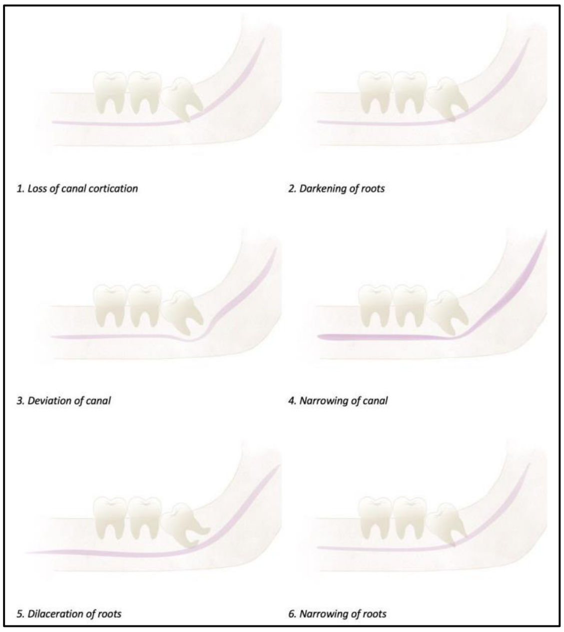

Figure 1: Radiographic Findings.

The pattern of impaction prevalence follows an inverse relationship to the normal chronological eruption sequence. Late erupting teeth show greater susceptibility to impaction because eruptive space within the dental arch often becomes insufficient as adjacent teeth complete their positions. The mandibular third molar shows the highest frequency of impaction followed in descending order by the maxillary third molar, the maxillary canine, mandibular premolars, maxillary premolars, and the second molar. Teeth with the lowest impaction rates include the mandibular incisors, first permanent molars, and primary dentition. When these teeth present as impacted, the cause usually traces to local anomalies such as retained deciduous teeth or space-occupying lesions like odontomas. The leading cause of eruption failure for individual teeth is inadequate arch length and space [4]. Several systemic and syndromic conditions predispose to multiple impactions. Examples include Gardner syndrome, Gorlin syndrome, and cleidocranial dysostosis.

Metabolic and endocrine disorders represent additional etiologies for multiple impactions. Impacted teeth create a local environment that favors development of secondary pathology including dentigerous cysts, odontogenic tumors, dental caries on adjacent teeth, root resorption of neighboring roots, and periodontal breakdown. A practical evaluation of impacted teeth must incorporate detailed knowledge of adjacent anatomic structures to reduce the risk of surgical and neurovascular complications. The mandibular third molar serves as a model for complexity assessment because it represents the tooth most frequently affected by impaction and because its positional relationships determine surgical difficulty. Classification systems aid preoperative planning by characterizing angulation and spatial relationships. The Winter classification categorizes mandibular third molar positions by crown angulation relative to the long axis of the second molar and includes vertical mesioangular distoangular horizontal buccolingual inverted and other less common orientations. Impactions with horizontal or distoangular orientation tend to present greater extraction difficulty because the required path of delivery encounters resistance from overlying cortical bone and the ascending ramus. Accurate clinical assessment combined with targeted imaging permits risk stratification and the selection of surgical approaches that aim to preserve surrounding bone and neurovascular integrity [4].

Pell and Gregory classification

The Pell and Gregory system remains a foundational framework for preoperative assessment of impacted mandibular third molars by describing the tooth's spatial relations in both the vertical and horizontal planes, providing a practical schema to evaluate surgical access and anticipated difficulty [6]. Vertically the classification distinguishes three levels according to the relation of the third molar crown to the occlusal plane and cervical margin of the adjacent second molar. Level A designates teeth whose occlusal surfaces lie at or above the occlusal plane of the second molar. Level B is assigned when the crown lies between the occlusal plane and the cementoenamel junction of the second molar. Level C denotes a lower position in which the third molar's occlusal surface is situated below the cementoenamel junction of the second molar. These vertical distinctions directly influence the volume of bone and soft tissue that must be traversed during surgical access and thereby affect the complexity of the procedure. Horizontally the classification is anchored to the anterior border of the mandibular ramus and stratifies impacted third molars into three classes. Class 1 indicates a crown entirely anterior to the ramus, suggesting an unobstructed path of eruption and relatively straightforward surgical access. Class 2 denotes partial occupation of the ramus by the third molar crown, implying a reduced mesiodistal space that often requires judicious bone removal for extraction. Class 3 represents complete inclusion of the crown within the ramus, a configuration that typically necessitates extensive osteotomy and careful surgical planning. Clinically the combination of class 3 with level C represents one of the most technically demanding scenarios because the tooth is deeply seated and enveloped by bone, requiring substantial osseous removal and advanced surgical maneuvers to achieve atraumatic delivery [6].

Assessment of third molar position must, however, be integrated with anatomic relationships to critical neurovascular structures that influence operative risk. The inferior alveolar nerve is the principal sensory trunk supplying the mandibular dentition as well as the lower lip and chin and courses in close proximity to the apices of mandibular molars. Radiographic and three dimensional evaluations of the relationship between the third molar roots and the inferior alveolar canal is therefore essential to estimate the likelihood of sensory sequelae. Reported rates of transient sensory disturbance after inferior alveolar nerve injury vary between 1 and 5 percent whereas the incidence of permanent sensory loss is lower and estimated between 0 and 0.9 percent; these figures underscore the importance of preoperative risk stratification and informed consent [7]. The Rood radiographic criteria offer a set of panoramic features that correlate with intimate contact between tooth roots and the inferior dental canal and thus serve to flag cases requiring further cross sectional imaging with cone beam computed tomography [8].

Radiographic signs such as loss of cortication of the inferior dental canal, narrowing or darkening of root outlines, deviation of the canal or root dilaceration should prompt escalation of imaging because each sign increases the probability of a close anatomic relationship and elevates the risk of neural injury [9]. The mental nerve, as the terminal branch of the inferior alveolar nerve, supplies sensation to the lower labial gingiva, lower lip and chin and may contribute sensory fibers to mandibular incisors; its variable branching pattern and the potential presence of an anterior loop of the inferior alveolar nerve mandate careful localization of the mental foramen on imaging when extractions involve the premolar region or anterior mandible [10][11][12][13]. Population studies demonstrate that the mental foramen most frequently lies in the premolar region which has implications for incision placement osteotomy design and avoidance of iatrogenic injury, and the documented variability in loop length and branching argues for three dimensional assessments when clinical or radiographic suspicion exists [14].

The lingual nerve traverses the retromolar area between the medial pterygoid and the lingual aspect of the mandibular ramus and is at risk during mucoperiosteal reflection, flap retraction, and lingual plate manipulation; an appreciation of the nerve's typical spatial relationships to the alveolar crest and lingual cortical plate is therefore critical to reduce the incidence of postoperative dysesthesia [15]. Anatomical surveys show that the lingual nerve most commonly lies below the alveolar crest but in a substantial minority of cases approaches or contacts the lingual cortical plate, and average distances from lingual landmarks quantify this variability while reinforcing the need for careful surgical technique near the lingual aspect of mandibular molars [16][17]. In the maxilla, the close approximation of posterior tooth apices to the floor of the maxillary sinus introduces additional considerations when extracting impacted maxillary molars or premolars; the sinus floor extends from the canine region posteriorly to the maxillary tuberosity and may closely envelop tooth roots so that extraction risks oroantral communication, sinusitis and impediments to primary closure [18]. Comprehensive preoperative evaluation therefore combines the geometric descriptors of the Pell and Gregory classification with meticulous imaging-based appraisal of nerve position and sinus relations to devise a surgical plan that minimizes morbidity while achieving successful removal.

Figure-2: Radiographic image of unruptured tooth.

Indications

Not every impacted tooth requires removal. The clinical goal must be to preserve adjacent teeth and support tissues while avoiding harm. Indications for extraction include acute infection with pain and swelling. They include chronic infection that undermines periodontal support. They include carious destruction that cannot be restored. They include periapical pathology that threatens neighboring teeth or bone. They include mechanical damage to adjacent roots or crowns caused by pressure from the unerupted tooth. They include lack of arch space that blocks proper eruption and function. They include ectopic eruption that disrupts occlusion. They include teeth that lie in the line of a planned osteotomy or fracture repair. They include teeth that interfere with trauma management or orthognathic procedures [19].

Clinicians also remove impacted teeth for prophylactic reasons in patients scheduled for systemic therapy or surgical procedures that carry an infection risk. Indications for prophylactic extraction can arise when a tooth lies in a planned radiation field or when immunosuppression follows medical treatment. Extracting an asymptomatic unerupted tooth before such interventions aims to reduce downstream infectious events [19]. Evidence for routine prophylactic extraction in otherwise healthy people remains limited and contested in the literature [20]. The decision to extract prophylactically must therefore rest on a case specific risk benefit analysis that accounts for the planned medical therapy of the tooth's local anatomy and the patient's preferences [20].

Many unerupted teeth remain asymptomatic and disease free for long periods. When orthodontic or surgical repositioning is feasible preserving the tooth may offer functional and esthetic gain. When repositioning is not feasible extraction becomes the only definitive option. The choice depends on patient age, the position of the tooth, the condition of the crown and root the relationship to adjacent structures arch length and the planned restorative or orthodontic plan. Older patients present different tradeoffs than younger patients because healing potential and bone remodeling differ with age. Younger patients tolerate surgical intervention better and may gain from interceptive removal that prevents later pathology. Older patients may face higher surgical risk and slower recovery [20]. Certain patient and tooth level variables increase the probability that impaction will progress to clinically significant problems. Female sex retained lower primary canines delayed treatment and peg shaped maxillary lateral incisors correlate with increased severity of some impactions and with a higher likelihood that interceptive measures will be required [21]. Identifying these risk markers early allows targeted monitoring and timely intervention. In young patients preventive or interceptive procedures such as space regaining extraction of retained deciduous teeth or guided eruption may reduce the need for later complex surgery [21].

Untreated impacted teeth may cause a spectrum of complications. They may become a focus of recurrent infection. They may form dentigerous cysts or give rise to other odontogenic lesions. They may cause caries on the distal surface of second molars. They may induce external root resorption of adjacent teeth. They may displace neighboring roots and alter occlusion. They may ankylose and create infraocclusion or impede prosthetic rehabilitation. Each potential complication alters the balance between surgical risk and long term benefit and thus must figure into the treatment plan. The clinician must integrate clinical examination radiographic assessment and patient factors when deciding on extraction. Imaging should document tooth level angulation depth root morphology and relation to neurovascular bundles and to the maxillary sinus. Risk stratification should guide the extent of surgical exposure osteotomy and the need for advanced imaging or specialist referral. Informed consent must describe the expected benefit of the alternatives and the possible complications including sensory changes infection and need for further procedures. Team based decision making improves outcomes when orthodontic prosthetic or medical needs intersect with the impacted tooth. Close coordination with orthodontists oral surgeons and medical teams clarifies timing and minimizes redundant interventions. Following after extraction must emphasize wound care pain control and surveillance for infection or delayed healing.

Structured follow up ensures timely management of complications and supports return to function.

Contraindications

Extraction of unerupted or impacted teeth is a surgical procedure that demands careful evaluation of systemic, pharmacological, and local dental factors. Certain medical conditions or physiological states increase surgical risk and may contraindicate the procedure temporarily or permanently. A comprehensive assessment of patient health, in coordination with medical specialists, is essential before intervention to minimize complications and ensure patient safety. Epilepsy represents a significant concern in surgical dental care. Patients with epilepsy face risks of intraoperative seizure, aspiration, and injury during extraction procedures. Seizure activity can lead to self-harm, airway obstruction, or sudden patient movement, complicating surgical control and increasing the risk of trauma to surrounding oral structures [22]. Preoperative coordination with the patient's neurologist is necessary to evaluate seizure frequency, medication compliance, and possible perioperative medication adjustments. Scheduling treatment when seizure risk is lowest, ensuring the presence of protective measures, and minimizing procedural stress can reduce adverse events [22].

Cerebrovascular disease also represents a major limitation. Patients with a recent transient ischemic attack or cerebrovascular accident carry a heightened risk of new stroke events during or after dental surgery due to fluctuations in blood pressure and stress-induced vascular responses. Elective procedures should be deferred for several months after a cerebrovascular event. When treatment becomes unavoidable, meticulous blood pressure control and stress management are essential. Preoperative clearance from a neurologist or physician helps identify and mitigate perioperative risks. Cardiovascular conditions require particular caution. Patients with ischemic heart disease, arrhythmias, infective endocarditis, uncontrolled hypertension, or severe coronary artery disease present higher procedural risk profiles [23]. Stress and local anesthesia containing vasoconstrictors can precipitate cardiac events or hypertensive crises. For patients with recent myocardial infarction or unstable angina, elective surgery should be postponed until cardiac stability is achieved. Antibiotic prophylaxis is indicated in patients with a history of infective endocarditis or those with prosthetic cardiac valves or other high-risk cardiac lesions [24]. Close coordination with the patient's cardiologist ensures appropriate antibiotic selection and timing and assists in optimizing cardiovascular management before surgery.

Renal and hepatic diseases contribute further complexity. Severe renal impairment can alter drug clearance, elevate infection risk, and disrupt electrolyte balance. Liver dysfunction compromises the synthesis of clotting factors and prolongs bleeding time [25]. Such patients face higher postoperative hemorrhage risk and may require correction of coagulopathies before extraction. Elective surgical procedures should be deferred in advanced renal or hepatic disease unless medically justified. Dose modification of anesthetic and analgesic agents is also required to prevent toxicity. Immunosuppression, whether from systemic disease, organ transplantation, or medication use, poses an additional contraindication. These patients are vulnerable to infection and impaired wound healing. The benefit of prophylactic antibiotic coverage remains uncertain, but a case-by-case approach guided by immune status and consultation with the treating physician is advised. Strict aseptic technique and short, minimally invasive procedures reduce systemic risk. Bleeding disorders and anticoagulant use demand careful perioperative control. Patients with inherited coagulopathies such as hemophilia or acquired disorders like thrombocytopenia exhibit a high risk of hemorrhage during and after extraction. Those on anticoagulant therapy present similar challenges. Recent evidence supports continuation of anticoagulant therapy for dental extractions since the thromboembolic risks associated with discontinuation exceed the risk of manageable bleeding. For patients taking warfarin, the international normalized ratio (INR) is the primary measure of coagulation status and should be checked within 72 hours before the procedure. Values below 4.0 are generally considered safe for minor oral surgery [26]. Use of local hemostatic agents, absorbable sutures, and gentle tissue handling is recommended to maintain hemostasis and minimize postoperative bleeding [25][26].

Overall, contraindications to surgical extraction of unerupted teeth encompass a wide range of systemic and local factors. Proper assessment includes review of medical history, current medication, and recent laboratory results. Collaboration with medical specialists ensures individualized care, optimizing timing and modifying treatment protocols where necessary. Each contraindication must be weighed against the potential benefits of extraction. When surgical intervention is unavoidable in medically compromised patients, modification of technique, pharmacologic prophylaxis, and postoperative monitoring form the foundation of safe practice.

Use of Radiation Therapy and Antiresorptive Agents

Radiation therapy directed to the head and neck impairs vascularity and cellular reparative capacity of irradiated bone and thereby increases the risk of osteoradionecrosis following dental extraction; this condition presents as persistent exposed nonhealing bone within the oral cavity and may arise spontaneously or after minor trauma including tooth removal [27]. A thorough dental assessment before initiation of radiotherapy is mandatory. Any active infection or nonrestorable tooth should be addressed and, when extraction is necessary, performed with sufficient lead time to permit mucosal and bony healing prior to the start of radiation. Once radiotherapy has commenced clinicians should avoid elective extractions; when extraction is unavoidable conservative surgical technique, meticulous debridement of infected tissue, primary closure when feasible, and close postoperative surveillance help reduce the likelihood of progressive osteonecrosis. Antiresorptive medications, principally bisphosphonates and receptor activator of nuclear factor kappa-B ligand inhibitors, are commonly used to treat osteoporosis, metastatic bone disease, multiple myeloma, Paget disease and malignancy-associated hypercalcemia and they produce a sustained suppression of osteoclastic bone turnover that confers fracture risk reduction while simultaneously impairing normal bone remodeling [28]. The same suppression of remodeling underlies medication related osteonecrosis of the jaws MRONJ which typically presents as a nonhealing extraction socket with exposed necrotic bone or as soft tissue breakdown overlying devitalized bone [29]. The incidence and clinical course of MRONJ vary with drug class dosing schedule and duration of therapy; intravenous oncology regimens carry substantially higher risk than oral agents prescribed for osteoporosis. Additional factors such as concomitant corticosteroid therapy advanced age diabetes poor oral hygiene and invasive dental procedures further increase MRONJ risk and worsen outcomes [30]. Current evidence does not support routine interruption of antiresorptive therapy solely to permit dental extraction because bisphosphonates have prolonged skeletal retention, and a drug holiday has not been demonstrated to reliably reduce MRONJ incidence; decisions must be individualized in consultation with the prescribing physician and weigh oncologic or skeletal benefits against potential oral surgical risk [30].

Tooth position relative to critical anatomic structures often constrains surgical options. The roots of mandibular third molars frequently approximate the inferior alveolar canal, and this relationship elevates the risk of inferior alveolar nerve injury during extraction. Radiographic predictors of nerve proximity should prompt three dimensional evaluations with cone beam computed tomography to refine risk estimates. When the risk of nerve damage is judged unacceptably high coronectomy, the intentional removal of the crown while retaining root fragments, may be indicated as a nerve preserving alternative when clinical criteria are met [31]. In the posterior maxilla intimate contact between tooth apices and the floor of the maxillary sinus predisposes to oroantral communication during extraction; preoperative imaging clarifies the sinus-tooth relationship and informs measures to minimize or repair sinus membrane perforation. Management of patients who have received head and neck radiation or who are receiving antiresorptive therapy requires multidisciplinary coordination. The oral surgeon must integrate oncologic and metabolic treatment details into the surgical plan and apply atraumatic techniques primary closure and extended follow up. The pharmacist and the prescribing medical team must communicate regarding the timing, duration and relative necessity of antiresorptive medication and consider modification only after assessing systemic risk. The general dentist should emphasize preventive care and early treatment of dental disease before systemic antiresorptive therapy or radiotherapy begins. In all cases informed consent must describe the elevated risks of impaired healing osteonecrosis and potential need for further interventions. Proactive dental care, careful imaging based risk assessment, and coordinated decision making remain the principal strategies to reduce morbidity when extractions are required in patients with prior or ongoing radiation exposure or antiresorptive therapy [31].

Preparation

A meticulous clinical examination and an accurate medical history form the foundation of safe extraction of an impacted tooth. The clinician documents systemic illnesses, current medications allergy status and any prior surgical or anesthetic complications. The oral examination records mucosal health tooth position occlusal relationships periodontal status and signs of local infection or pathology. Radiographic assessment complements the clinical data and defines the three dimensional relationships that determine surgical strategy. Panoramic imaging offers a broad overview of dental arch form eruption status and major anatomic landmarks. Periapical and occlusal radiographs add higher resolution detail for root form and periapical pathology and help localize overlapping structures with the Same Lingual Opposite Buccal SLOB technique when two dimensional overlap obscures spatial orientation. When conventional radiography is inadequate cone beam computed tomography provides volumetric reconstructions that precisely depict tooth angulation depth root morphology cortical bone thickness and proximity to neurovascular bundles and sinus walls. CBCT therefore becomes the preferred diagnostic modality for complex impactions near the inferior alveolar canal, the mental foramen or the maxillary sinus because it changes risk assessment and surgical planning [31].

The imaging report should comment on root curvature root number cortical perforation or thinning ankylosis and any signs of associated cystic or neoplastic change. Integration of imaging with the clinical exam permits formulation of a clear operative plan that specifies the type of anesthesia extraction technique needed for osteotomy or tooth sectioning potential requirement for coronectomy and anticipated postoperative management. Preoperative laboratory tests are indicated when the history suggests bleeding disorders, anticoagulant therapy, uncontrolled systemic disease or other conditions that may alter healing; an INR for patients on warfarin and relevant renal or hepatic panels for medically compromised patients guide perioperative decisions. Risk stratification should be documented and communicated to the patient. The clinician must obtain informed consent after explaining the rationale for extraction the expected benefits possible complications alternatives including conservative or orthodontic options and the likely postoperative course. Consent should be written and include discussion of specific risks such as nerve injury oroantral communication infection and delayed healing when these are relevant. Preoperative instructions include fasting guidelines when sedation or general anesthesia is planned medication adjustments in coordination with the prescribing physician and optimization of oral hygiene. On the day of surgery, the surgical team confirms identity medical status and imaging availability performs a targeted clinical recheck and ensures appropriate equipment sterile instruments and hemostatic materials are ready. Effective preparation reduces intraoperative uncertainty, lowers complication rates and supports predictable postoperative recovery [31].

Technique or Treatment

Surgical removal of unerupted or impacted teeth follows a sequence of planned steps that prioritize access control hemostasis and preservation of vital structures. The operative plan normally comprises flap design and reflection bone removal to expose the tooth and luxation with delivery of the tooth or its segments. Each phase demands precise technique and continual reappraisal of anatomy and tissue response. Flap design begins with the choice between full thickness mucoperiosteal and split thickness mucoperiosteal flaps [32]. A full thickness flap includes mucosa periosteum and connective tissue and provides wide exposure with predictable healing. A split thickness flap spares periosteum and may preserve blood supply in specific situations but requires advanced skill to avoid flap necrosis. In either design the flap base must remain broad to preserve perfusion. The width of the flap base determines vascular inflow and limits ischemic complications. Releasing incisions enter the design selectively. They improve access when necessary. They prolong healing when misapplied. They are contraindicated on the palate on the lingual aspect of the mandible at the canine eminence and adjacent to the mental foramen because these areas carry a high risk of compromised blood supply or nerve injury. The envelope flap remains a common choice for impacted mandibular molars because it offers adequate exposure without extensive vertical releasing incisions. When using an envelope flap for third molar access extend the incision from the first molar posteriorly and reflect laterally toward the external oblique ridge to expose the alveolar wall and retromolar area [32].

Patient positioning and operative field control precede soft tissue incision. Position the patient to optimize vision and access. Use a bite block and throat screen when appropriate to reduce aspiration risk. Retractors maintain a dry unobstructed field. Weider retractors stabilize the tongue. Minnesota retractors protect the cheek and improve visualization. Local anesthetic must achieve profound regional blockade before incision. Confirm anesthesia by soft tissue palpation and pinprick testing before proceeding. Incision and flap elevation follow standard techniques. Use a No. 15 blade to create a sulcular incision and a periosteal elevator to raise a subperiosteal flap. Maintain a blunt atraumatic approach when elevating tissue to protect periosteal blood supply. Avoid distal lingual releasing incisions in third molar flaps because the lingual nerve may lie against the alveolus in this region and may be injured by deep vertical cuts [33]. After reflection, I inspect the exposed bone and soft tissue. If the crown remains obscured, begin bone removal with a surgical handpiece and appropriate burs. Use a round or straight tapered fissure bur to create a trough around the crown extending to the cementoenamel junction. Direct the bur parallel to the buccal groove of impacted molars to facilitate sectioning and prevent inadvertent contact with adjacent roots [33].

Bone removal requires controlled technique and continuous irrigation. The handpiece exhaust must direct air away from the wound to prevent emphysema and air embolism. Copious saline irrigation prevents thermal injury to bone that occurs at temperatures above 47 degrees Celsius and can cause irreversible osteonecrosis [34]. Remove only the bone necessary to create a path of delivery. Preserve cortical plates where possible to facilitate later closure and to support alveolar form. When deep impaction or constrained access exists section the tooth. Sectioning reduces the force required for luxation and minimizes transmission of stress to the alveolus and adjacent teeth. The common method sections the crown three quarters of the way toward the lingual aspect then separates the remaining attachment with an elevator. The bur should cut progressively and intermittently. Use sharp instruments and small controlled strokes rather than large sweeping cuts. Luxation and delivery use elevators and forceps appropriate to tooth type and orientation. Begin luxation at the buccal surface when access allows and proceed in controlled rotational movements. Avoid excessive axial forces that could fracture the alveolar wall. When roots approximate the inferior alveolar canal consider alternative strategies such as coronectomy to preserve neural function. Coronectomy reduces the risk of nerve injury when indicated. When the tooth is near the maxillary sinus plan for potential oroantral communication and be prepared to obtain primary closure or local flap repair [34].

Hemostasis is essential at each stage. Achieve local control with pressure packs topical agents and suture techniques. Use absorbable hemostatic materials when required. When closing the flap reapproximate tissues without tension to promote primary healing. Select suture type and pattern that maintain contact between mucosa and periosteum and that allow access for postoperative inspection. Postoperative management begins in the chair with hemostasis verification and patient instructions. Provide written guidance on oral hygiene analgesia and activity restrictions. Schedule follow up to detect early complications such as infection dehiscence or sensory changes. Document the procedure including flap design bone removal extent tooth sectioning and any proximity to critical anatomic structures. Precise documentation supports continuity of care and informed postoperative assessment. Successful surgical extraction of unerupted teeth depends on sound preoperative planning, meticulous surgical technique and vigilant postoperative care. Maintaining respect for tissue perfusion neural anatomy and thermal safety during bone removal reduces complication rates and improves functional and esthetic outcomes. At this stage of the procedure, a surgical elevator is typically employed to luxate and deliver the tooth. Controlled and deliberate movement is essential to avoid transmitting excessive force to adjacent teeth or supporting bone. The elevator should never use a neighboring tooth as a fulcrum because this can result in fracture, displacement, or damage to the periodontal ligament of that tooth. Instead, the alveolar bone around the impacted tooth serves as the stable fulcrum point for controlled leverage. The surgeon must maintain awareness of tactile feedback during elevation to differentiate between normal resistance and potential structural compromise of adjacent tissues [34].

If the tooth cannot be delivered after initial attempts, the surgeon may remove additional bone surrounding the crown or consider sectioning the tooth. Tooth sectioning is a common technique used to facilitate removal, especially in multi-rooted teeth such as mandibular molars. When sectioning the roots of a molar, the surgical bur should follow the long axis of the tooth, cutting through the buccal groove while keeping the bur parallel to minimize unnecessary bone loss. The tooth is generally sectioned about three-quarters of the way through to preserve control over the final separation. The remaining quarter of the structure is then fractured using a thick surgical elevator inserted into the cut, followed by a gentle twisting motion. This approach ensures clean separation while preventing damage to posterior structures, including the lingual plate, inferior alveolar nerve, or soft tissue in the retromolar region. This technique is particularly relevant when working near the mandibular third molar area, where the lingual nerve may course close to the alveolar surface and is highly susceptible to injury [34].

After successful sectioning, the individual tooth fragments are carefully luxated and extracted using elevators or forceps. Each piece must be removed systematically to avoid inadvertent fracture or root tip retention. Once extraction is complete, the socket and surrounding tissues must be thoroughly irrigated with sterile saline to remove bone debris and tooth fragments. Irrigation also allows visualization of the surgical site to ensure that no pathology or complications are present. The surgeon must inspect for any exposure or injury to the inferior alveolar or lingual nerves, which could present as visible canal exposure or bleeding in the region of the nerve path. The alveolar walls are checked for perforation, especially the lingual plate, which can occur with excessive bone removal or uncontrolled sectioning. Additionally, any root remnants, cystic tissue, or granulation material should be removed to promote healing and prevent infection. The socket should also be examined for sinus communication in maxillary extractions, particularly in the region of the upper molars, where the roots may extend close to the floor of the maxillary sinus [35].

After confirming that the site is free from complications, the surgeon must decide whether to close the wound primarily or allow it to heal by secondary intention. Evidence remains inconclusive on whether one method increases the risk of postoperative complications such as alveolar osteitis (dry socket), infection, or delayed healing. Primary closure, achieved by reapproximating the flap margins with sutures, may reduce debris accumulation and facilitate faster mucosal coverage. However, secondary closure, where part of the socket is left open, can aid drainage and reduce internal pressure during healing. The decision depends on the size of the defect, tissue tension, and the surgeon's assessment of optimal healing conditions. When alveolar ridge preservation is necessary, especially for future prosthetic or implant placement, the extraction socket may be filled with bone grafting materials. These materials can include autografts, allografts, xenografts, or synthetic substitutes designed to minimize resorption and preserve ridge dimensions [36]. The graft material is gently compacted into the socket and covered with a resorbable or nonresorbable membrane before flap closure to protect the graft and maintain the contour of the alveolar ridge. Proper closure in ridge preservation cases is crucial to prevent graft contamination and promote stable integration of the material [36].

At the conclusion of the surgery, hemostasis must be achieved before discharging the patient. A sterile gauze pad is placed over the surgical site, and the patient is instructed to apply firm pressure by biting down for at least 30 to 45 minutes. This aids in clot formation and stabilizes the wound environment. The patient should be advised to avoid vigorous rinsing, spitting, or using straws for the next 24 hours to prevent clot dislodgment and secondary bleeding. In addition, patients should receive clear postoperative instructions on oral hygiene, diet, and activity limitations to ensure optimal recovery. The extraction of an unerupted tooth requires meticulous technique, careful handling of instruments, and constant awareness of anatomical structures. Proper bone removal, controlled sectioning, and thorough inspection of the surgical field significantly reduce complications and enhance postoperative healing. These steps, combined with effective communication and patient education, contribute to safe outcomes and preservation of oral function and structure.

Complications:

The surgical removal of unerupted teeth carries predictable and unpredictable complications. These range from localized problems that are resolved with conservative care to severe events that require prolonged intervention. Anticipation, meticulous technique, and structured follow up reduce incidence and severity. The following discussion examines the principal complications, their pathophysiology, clinical presentation, prevention, and management while retaining established citation markers where provided. Alveolar osteitis occurs when the post extraction socket fails to develop a stable blood clot or when the clot is prematurely lost. The socket then fills with necrotic debris and granulation tissue rather than organized healing tissue. Fibrinolytic activity is implicated in the pathogenesis although the precise mechanisms remain incompletely defined [37]. Clinically the patient reports severe throbbing pain that often radiates, a foul taste, halitosis, and an empty feeling at the extraction site. Symptoms typically arise two to four days after surgery. Risk factors include tobacco use, oral contraceptive use, prolonged surgical time, operator inexperience, and early or forceful rinsing that dislodges the clot [38]. Management aims to control pain and promote local healing. The wound is irrigated with saline or chlorhexidine and then packed with a sedative dressing containing eugenol or other agents to reduce pain and protect the socket. Analgesics are prescribed according to pain severity. Antibiotics are not routinely indicated and should be reserved for patients with systemic signs of infection or cellulitis. Prevention includes atraumatic extraction techniques, avoidance of excessive irrigation or suction that could remove the clot, patient education to avoid smoking and vigorous rinsing, and use of atraumatic suturing when indicated.

Postoperative bleeding ranges from minor oozing to hemorrhage that endangers the airway. Immediate management begins with a prompt clinical examination to identify the bleeding source. Simple measures usually suffice. Firm direct pressure with gauze for 30 to 45 minutes often achieves hemostasis. If oozing persists, local hemostatic agents may be applied. Options include adrenaline-containing local anesthetic to induce vasoconstriction, topical agents such as oxidized cellulose, collagen plugs, absorbable gelatin sponge, or fibrin sealants. Tranexamic acid mouth rinse or topical application provides antifibrinolytic effect and is useful in patients with bleeding diathesis or on antithrombotic therapy [39]. For patients on warfarin, an INR measured within 72 hours helps guide perioperative risk; values below 4.0 are generally acceptable for minor oral surgery but local measures must be ready [26]. When bleeding is arterial or cannot be controlled locally, referral for vascular embolization or hospital management may be required.

Nerve injury is among the most consequential complications of mandibular extractions. The inferior alveolar nerve and the lingual nerve are vulnerable during third molar surgery. Injury may result from direct transection, compression from hematoma, stretch during luxation, thermal damage from burs, or neurotoxic local anesthetic effects. Sensory disturbance includes paresthesia, dysesthesia, hypoesthesia, or anesthesia of the lower lip, chin, gingiva, or anterior tongue depending on the nerve involved [40]. Most injuries are transient. Initial recovery often begins at six to eight weeks with progressive improvement over months. Full recovery may take up to two years in some cases [41]. Management requires early recognition, documentation, and a conservative initial approach that includes observation, avoidance of further trauma, and analgesia. If deficits persist beyond three months or if there is progressive deterioration, referral to a specialist for neurosensory testing and possible surgical exploration for repair may be indicated. Prevention involves careful preoperative imaging to identify intimate root-canal relationships, minimizing deep lingual cuts, using coronectomy when indicated, and avoiding excessive force during elevation and sectioning.

Retained root fragments pose a management dilemma. Small root tips less than 5 mm that are fully embedded in bone and uninfected may be left in place with documentation and radiographic follow up [42]. Attempted retrieval can cause greater harm by displacing fragments into adjacent anatomic spaces. Mandibular root tips may be displaced into cancellous bone, the inferior alveolar canal, or the submandibular space. Maxillary root fragments can migrate into the maxillary sinus or the infratemporal fossa. If displacement is suspected or the fragment is symptomatic, three dimensional imaging such as cone beam computed tomography is required to determine exact location and to plan retrieval [43]. Retrieval may be postponed to allow fibrosis to stabilize the fragment if immediate access is hazardous. When retrieval is performed, use an approach that minimizes soft tissue disruption and secures hemostasis.

Oroantral communication and sinus complications arise most commonly during extraction of posterior maxillary teeth whose apices approximate or project into the maxillary sinus. Small communications under 2 mm often close spontaneously and require conservative measures. Communications between 2 and 6 mm may be managed with a collagen plug or resorbable membrane to support clot formation and promote closure. Larger defects greater than 6 mm typically require a local flap such as a buccal advancement flap or a palatal rotational flap to achieve a tension-free primary closure [44]. When an oroantral communication is present, place the patient on nasal decongestants and advise avoidance of nose blowing and other maneuvers that increase sinus pressure. Antibiotics may be necessary if signs of sinusitis develop. Failure to close a chronic communication can lead to persistent sinusitis and oroantral fistula formation requiring more extensive surgical repair. Other complications include wound dehiscence, infection, sequestration, delayed healing, and fracture of the alveolar process or mandible. Mandibular fracture is rare but can occur when extensive bone removal, deep impaction, or preexisting osseous weakness combine with excessive third molar removal forces. Temporomandibular joint dysfunction may be exacerbated by prolonged mouth opening and muscle spasm. Prosthetic considerations such as alteration of alveolar ridge contours can complicate future rehabilitation; ridge preservation strategies may mitigate such sequelae. Systemic complications such as bacteremia, while usually transient, merit consideration in patients at risk for infective endocarditis or with prosthetic devices and may require prophylactic measures according to current guidelines [44].

Prevention remains the central theme in complication avoidance. Adequate preoperative assessment including medical history review, medication reconciliation, and high quality imaging guides risk stratification. Informed consent that documents anticipated benefits and potential complications supports shared decision making and medicolegal protection. Employ atraumatic technique, maintain thermal control during bone removal with copious irrigation, avoid ischemic flap design, and respect neural and sinus anatomy. Use coronectomy when indicated to reduce nerve risk. Apply local hemostatic measures and provide clear postoperative instructions to minimize behaviors that jeopardize healing. When complications occur, timely recognition and appropriate management improve outcomes. Early intervention for hemorrhage, infection, or exposed bone prevents progression. Nerve injuries require longitudinal follow up and specialist referral when recovery is delayed. Displaced fragments and sinus perforations need imaging guided planning for retrieval or closure. Document all findings and interventions carefully. Multidisciplinary coordination with medical colleagues, otolaryngologists, or oral and maxillofacial surgeons optimizes care for complex sequelae [44].

Clinical Significance:

The surgical extraction of unerupted or impacted teeth is a central procedure in oral and maxillofacial practice. Its clinical significance extends beyond the removal of the tooth itself. The procedure represents the intersection of anatomy, pathology, and surgical science. Successful outcomes depend on the surgeon's understanding of oral structures, adjacent neurovascular anatomy, and potential complications associated with surgical trauma. Errors in diagnosis or surgical planning can lead to irreversible outcomes such as nerve injury, sinus communication, or alveolar damage. Therefore, preoperative assessment is a critical phase of patient care. This includes a full medical and dental history, detailed radiographic analysis using CBCT or panoramic imaging, and an individualized risk evaluation. Each surgical plan must align with the patient's medical condition and therapeutic goals. Patients must receive accurate information regarding the risks, expected benefits, and potential alternatives to ensure informed consent and compliance throughout recovery. The clinical significance of unerupted tooth extraction also lies in its preventive value. Impacted teeth can cause cystic lesions, resorption of adjacent roots, and infection of surrounding soft tissues. In orthodontics, retained unerupted teeth often disturb occlusal alignment, impede eruption of adjacent teeth, and complicate prosthodontic rehabilitation. In oral pathology, they may be associated with follicular cysts or odontogenic tumors that demand histopathological assessment. Thus, extraction is both a therapeutic and preventive intervention that helps maintain oral function, prevents future pathology, and facilitates restorative or orthodontic treatment. The surgeon's role extends to postoperative management, including pain control, wound care, and infection prevention. Effective follow up helps identify early complications such as alveolar osteitis, postoperative bleeding, or nerve disturbances. A structured follow up protocol ensures rapid intervention and minimizes long term morbidity [45].

Healthcare Team Outcomes:

The success of surgical extraction relies on coordinated teamwork between dental surgeons, pharmacists, and laboratory specialists. Each discipline contributes unique expertise that enhances patient safety and clinical efficiency. Dentists and oral surgeons serve as the primary decision makers in diagnosis, surgical planning, and operative execution. They evaluate radiographs, determine access design, select appropriate instruments, and implement surgical techniques that minimize trauma. They also assess patient-specific factors such as systemic diseases, medication history, and local infection status. Dentists are responsible for patient education, preoperative preparation, and postoperative guidance. Their communication skills are essential in managing patient expectations and ensuring compliance with postoperative instructions. Pharmacists play a complementary and essential role before and after surgery. They assess drug interactions, verify medication histories, and ensure that prescribed drugs are safe for patients with comorbidities. For example, they review anticoagulant therapy to guide timing of surgery and recommend perioperative management strategies that reduce bleeding risk. Pharmacists also advise on analgesic combinations that provide effective pain control while minimizing side effects or contraindications. In patients receiving antibiotics, pharmacists ensure correct selection, dosage, and duration according to current antimicrobial stewardship principles. They also provide counseling on postoperative drug adherence and adverse reaction monitoring. Pharmacists contribute significantly to preventing medication-related complications and promoting optimal pharmacological support during recovery [45].

Laboratory specialists contribute through diagnostic verification and clinical monitoring. Preoperative blood investigations such as coagulation profiles, complete blood counts, and glucose levels help identify patients at risk for hemorrhage, infection, or delayed healing. Microbiology laboratories perform cultures in cases of suspected infection to identify causative organisms and guide targeted antibiotic therapy. Histopathology laboratories examine extracted follicles, cysts, or soft tissues attached to impacted teeth to rule out neoplastic changes or confirm diagnosis of cystic lesions. Their analyses guide the surgeon in determining whether further intervention or referral is required. Clinical biochemistry laboratories also play a role in evaluating systemic factors influencing wound healing, such as nutritional deficiencies or metabolic disorders. This multidisciplinary approach strengthens patient safety and ensures continuity of care. Communication between the dentist, pharmacist, and laboratory specialist allows early detection and correction of potential risks. For example, when laboratory tests reveal abnormal coagulation, the pharmacist and surgeon can jointly adjust medication regimens to prevent bleeding. Similarly, when microbiology results identify resistant organisms, the pharmacist recommends effective antibiotics and dosing schedules to control infection efficiently. Collaboration reduces redundancy, improves timing of interventions, and enhances the precision of clinical decisions [45].

The combined effort of these professionals also contributes to the rational use of resources. Proper coordination minimizes unnecessary prescriptions, duplicate tests, and unplanned surgical revisions. This leads to faster recovery, shorter treatment time, and better patient satisfaction. More importantly, interprofessional collaboration fosters accountability, mutual learning, and adherence to evidence-based standards. In teaching hospitals and training centers, this teamwork forms the foundation of comprehensive clinical education, preparing future practitioners for integrated patient management. Ultimately, the extraction of unerupted teeth represents more than a surgical act; it is a coordinated clinical process that integrates surgical expertise, pharmacological safety, and laboratory precision. Dentists execute and monitor the surgery, pharmacists safeguard medication use, and laboratory specialists validate diagnostic and therapeutic accuracy. Together, they deliver a standard of care that prioritizes patient well-being, minimizes complications, and supports efficient recovery through structured teamwork and evidence-based collaboration [45].

Conclusion:

In conclusion, the surgical extraction of unerupted teeth is a sophisticated procedure that demands a systematic and interdisciplinary approach for optimal outcomes. Success hinges on meticulous pre-operative planning, which includes a thorough medical history and advanced radiographic assessment, particularly using CBCT, to accurately map the tooth's position relative to critical anatomical structures like the inferior alveolar nerve and maxillary sinus. The surgical technique itself must be precise, employing appropriate flap design, controlled bone removal, and tooth sectioning to minimize tissue trauma. Furthermore, proactive pharmacological management is indispensable for effective postoperative analgesia, infection prevention, and bleeding control. Ultimately, a collaborative model of care, integrating the expertise of dentists, pharmacists, and laboratory workers, is paramount. This team-based strategy ensures comprehensive patient management—from accurate diagnosis and safe surgery to tailored pharmacological support and vigilant post-operative care—thereby significantly reducing complication rates and enhancing patient recovery and satisfaction.

References:

1. Grover PS, Lorton L. The incidence of unerupted permanent teeth and related clinical cases. Oral Surg Oral Med Oral Pathol. 1985 Apr;59(4):420-5.
2. Tecco S, Lacarbonara M, Dinoi MT, Gallusi G, Marchetti E, Mummolo S, Campanella V, Marzo G. The retrieval of unerupted teeth in pedodontics: two case reports. J Med Case Rep. 2014 Oct 09;8:334.
3. Jain P, Rathee M. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Sep 20, 2023. Anatomy, Head and Neck, Tooth Eruption.
4. Msagati F, Simon EN, Owibingire S. Pattern of occurrence and treatment of impacted teeth at the Muhimbili National Hospital, Dar es Salaam, Tanzania. BMC Oral Health. 2013 Aug 06;13:37.

5. Bayar GR, Ortakoglu K, Sencimen M. Multiple impacted teeth: report of 3 cases. Eur J Dent. 2008 Jan;2(1):73-8.
6. Jaroń A, Trybek G. The Pattern of Mandibular Third Molar Impaction and Assessment of Surgery Difficulty: A Retrospective Study of Radiographs in East Baltic Population. Int J Environ Res Public Health. 2021 Jun 03;18(11)
7. Williams M, Tollervey D. Lower third molar surgery - consent and coronectomy. Br Dent J. 2016 Mar 25;220(6):287-8.
8. Rood JP, Shehab BA. The radiological prediction of inferior alveolar nerve injury during third molar surgery. Br J Oral Maxillofac Surg. 1990 Feb;28(1):20-5.
9. Muhsin H, Brizuela M. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Mar 19, 2023. Oral Surgery, Extraction of Mandibular Third Molars.
10. Nguyen JD, Duong H. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): May 29, 2023. Anatomy, Head and Neck, Mental Nerve.
11. Pogrel MA, Smith R, Ahani R. Innervation of the mandibular incisors by the mental nerve. J Oral Maxillofac Surg. 1997 Sep;55(9):961-3.
12. Çorumlu U, Kopuz C, Aydar Y. Branching Patterns of Mental Nerve in Newborns. J Craniofac Surg. 2020 Oct;31(7):2025-2028.
13. do Nascimento EH, Dos Anjos Pontual ML, Dos Anjos Pontual A, da Cruz Perez DE, Figueiroa JN, Frazão MA, Ramos-Perez FM. Assessment of the anterior loop of the mandibular canal: A study using cone-beam computed tomography. Imaging Sci Dent. 2016 Jun;46(2):69-75.
14. Pelé A, Berry PA, Evanno C, Jordana F. Evaluation of Mental Foramen with Cone Beam Computed Tomography: A Systematic Review of Literature. Radiol Res Pract. 2021;2021:8897275.
15. Lin SXY, Sim PR, Lai WMC, Lu JX, Chew JRJ, Wong RCW. Mapping out the surgical anatomy of the lingual nerve: a systematic review and meta-analysis. J Korean Assoc Oral Maxillofac Surg. 2023 Aug 31;49(4):171-183.
16. Ostrowski P, Bonczar M, Wilk J, Michalczak M, Czaja J, Niziolek M, Sienkiewicz J, Szczepanek E, Chmielewski P, Iskra T, Gregorczyk-Maga I, Walocha J, Koziej M. The complete anatomy of the lingual nerve: A meta-analysis with implications for oral and maxillofacial surgery. Clin Anat. 2023 Sep;36(6):905-914.
17. Behnia H, Kheradvar A, Shahrokhi M. An anatomic study of the lingual nerve in the third molar region. J Oral Maxillofac Surg. 2000 Jun;58(6):649-51; discussion 652-3.
18. Danesh-Sani SA, Loomer PM, Wallace SS. A comprehensive clinical review of maxillary sinus floor elevation: anatomy, techniques, biomaterials and complications. Br J Oral Maxillofac Surg. 2016 Sep;54(7):724-30.
19. Ghaeminia H, Nienhuijs ME, Toedtling V, Perry J, Tummers M, Hoppenreijs TJ, Van der Sanden WJ, Mettes TG. Surgical removal versus retention for the management of asymptomatic disease-free impacted wisdom teeth. Cochrane Database Syst Rev. 2020 May 04;5(5):CD003879.
20. Hounsome J, Pilkington G, Mahon J, Boland A, Beale S, Kotas E, Renton T, Dickson R. Prophylactic removal of impacted mandibular third molars: a systematic review and economic evaluation. Health Technol Assess. 2020 Jun;24(30):1-116.
21. Sarica I, Derindag G, Kurtuldu E, Naralan ME, Caglayan F. A retrospective study: Do all impacted teeth cause pathology? Niger J Clin Pract. 2019 Apr;22(4):527-533.
22. Pick L, Bauer J. [Dentistry and epilepsy]. Nervenarzt. 2001 Dec;72(12):946-9.
23. Chaudhry S, Jaiswal R, Sachdeva S. Dental considerations in cardiovascular patients: A practical perspective. Indian Heart J. 2016 Jul-Aug;68(4):572-5.
24. Thornhill MH, Gibson TB, Yoon F, Dayer MJ, Prendergast BD, Lockhart PB, O'Gara PT, Baddour LM. Antibiotic Prophylaxis Against Infective Endocarditis Before Invasive Dental Procedures. J Am Coll Cardiol. 2022 Sep 13;80(11):1029-1041.
25. Rodríguez Martínez S, Talaván Serna J, Silvestre FJ. [Dental management in patients with cirrhosis]. Gastroenterol Hepatol. 2016 Mar;39(3):224-32.
26. Carter G, Goss AN, Lloyd J, Tocchetti R. Current concepts of the management of dental extractions for patients taking warfarin. Aust Dent J. 2003 Jun;48(2):89-96; quiz 138.
27. Chronopoulos A, Zarra T, Ehrenfeld M, Otto S. Osteoradionecrosis of the jaws: definition, epidemiology, staging and clinical and radiological findings. A concise review. Int Dent J. 2018 Feb;68(1):22-30.
28. Ruggiero SL, Dodson TB, Aghaloo T, Carlson ER, Ward BB, Kademani D. American Association of Oral and Maxillofacial Surgeons' Position Paper on Medication-Related Osteonecrosis of the Jaws-2022 Update. J Oral Maxillofac Surg. 2022 May;80(5):920-943.
29. Nicolatou-Galitis O, Schiødt M, Mendes RA, Ripamonti C, Hope S, Drudge-Coates L, Niepel D, Van den Wyngaert T. Medication-related osteonecrosis of the jaw: definition and best practice for prevention, diagnosis, and treatment. Oral Surg Oral Med Oral Pathol Oral Radiol. 2019 Feb;127(2):117-135.
30. Bansal H. Medication-related osteonecrosis of the jaw: An update. Natl J Maxillofac Surg. 2022 Jan-Apr;13(1):5-10.

31. Martin A, Perinetti G, Costantinides F, Maglione M. Coronectomy as a surgical approach to impacted mandibular third molars: a systematic review. Head Face Med. 2015 Apr 10;11:9.
32. Jephcott A. The surgical management of the oral soft tissues: 1. Flap design. Dent Update. 2007 Oct;34(8):518-20, 522.
33. Pippi R, Spota A, Santoro M. Prevention of Lingual Nerve Injury in Third Molar Surgery: Literature Review. J Oral Maxillofac Surg. 2017 May;75(5):890-900.
34. Augustin G, Davila S, Mihoci K, Udiljak T, Vedrina DS, Antabak A. Thermal osteonecrosis and bone drilling parameters revisited. Arch Orthop Trauma Surg. 2008 Jan;128(1):71-7.
35. Bailey E, Kashbour W, Shah N, Worthington HV, Renton TF, Coulthard P. Surgical techniques for the removal of mandibular wisdom teeth. Cochrane Database Syst Rev. 2020 Jul 26;7(7):CD004345.
36. Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis. J Dent Res. 2014 Oct;93(10):950-8.
37. Nitzan DW. On the genesis of "dry socket". J Oral Maxillofac Surg. 1983 Nov;41(11):706-10.
38. Sweet JB, Butler DP. The relationship of smoking to localized osteitis. J Oral Surg. 1979 Oct;37(10):732-5.
39. Jaiswal P, Agrawal R, Gandhi A, Jain A, Kumar A, Rela R. Managing Anticoagulant Patients Undergoing Dental Extraction by using Hemostatic Agent: Tranexamic Acid Mouthrinse. J Pharm Bioallied Sci. 2021 Jun;13(Suppl 1):S469-S472.
40. Sarikov R, Juodzbalys G. Inferior alveolar nerve injury after mandibular third molar extraction: a literature review. J Oral Maxillofac Res. 2014 Oct-Dec;5(4):e1.
41. Bhat P, Cariappa KM. Inferior alveolar nerve deficits and recovery following surgical removal of impacted mandibular third molars. J Maxillofac Oral Surg. 2012 Sep;11(3):304-8.
42. Oishi S, Ishida Y, Matsumura T, Kita S, Sakaguchi-Kuma T, Imamura T, Ikeda Y, Kawabe A, Okuzawa M, Ono T. A cone-beam computed tomographic assessment of the proximity of the maxillary canine and posterior teeth to the maxillary sinus floor: Lessons from 4778 roots. Am J Orthod Dentofacial Orthop. 2020 Jun;157(6):792-802.
43. Jolly SS, Rattan V, Rai SK. Intraoral management of displaced root into submandibular space under local anaesthesia -A case report and review of literature. Saudi Dent J. 2014 Oct;26(4):181-4.
44. Khandelwal P, Hajira N. Management of Oro-antral Communication and Fistula: Various Surgical Options. World J Plast Surg. 2017 Jan;6(1):3-8.
45. Choi, J. F., Park, D. Y., Williams, S. L. S., & Chang, P. (2025). Oral surgery, extraction of unerupted teeth. In *StatPearls [Internet]*. StatPearls Publishing.