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METHODS TO REDUCE COMPLICATIONS IN SURGICAL REMOVAL OF RETENTIONED TEETH

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Abstract

Retained teeth are teeth that have not erupted completely or partially in the jawbone or soft tissues during the physiological period, and they are one of the most difficult cases of diagnosis and treatment in dental practice. In particular, the retention of the third molars of the lower jaw, that is, wisdom teeth, can cause pain, pericoronitis, caries on the distal surface of adjacent teeth, periodontal defects, cyst formation, and inflammatory processes in the jawbone. During the surgical removal of such teeth, complications such as damage to the alveolar bone, alveolitis, infection, bleeding, soft tissue swelling, damage to the inferior alveolar or lingual nerve, and damage to adjacent teeth may occur.

This article discusses the main principles of reducing complications in the removal of impacted teeth - proper patient selection, thorough clinical and radiological examination, assessment of the anatomical location of the impacted tooth, pre-prognosis of surgical risk, atraumatic operative technique, coronectomy if necessary, infection prevention, hemostasis, postoperative follow-up, and patient recommendations. A review of the literature suggests that coronectomy may be an alternative method that reduces the risk of nerve injury in high-risk third molars located close to the inferior alveolar nerve. However, it is emphasized that this technique is not suitable for all patients, and individual patient assessment and long-term follow-up are necessary.

In conclusion, reducing complications in the removal of impacted teeth does not depend on a single surgical technique, but on the comprehensive application of correct diagnosis, risk assessment, surgical tactics appropriate to the clinical situation, asepsis-antiseptics, and quality postoperative care.

Keywords: Retained teeth; impacted teeth; lower third molar; wisdom tooth; surgical extraction; coronectomy; osteotomy; odontotomy; alveolitis; inferior alveolar nerve; lingual nerve; CBCT; atraumatic surgery; hemostasis; infection prevention.

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The failure of teeth to erupt in time or their complete or partial retention between the jawbone, mucous membrane and soft tissues is expressed in dentistry by the concepts of retention and impaction. Retained teeth may be clinically asymptomatic, but in some cases they cause pain, inflammation, displacement of adjacent teeth, damage to periodontal tissues, caries and the development of odontogenic cysts. One of the most common complex cases is the retention of the lower third molars, the anatomical location of which, the shape of their roots and their relationship to the lower alveolar canal determine the complexity of surgical treatment.

The extraction of impacted teeth is usually planned based on the anatomical position of the crown and roots, the direction of tooth eruption, the degree of bone coverage, the relationship to the adjacent

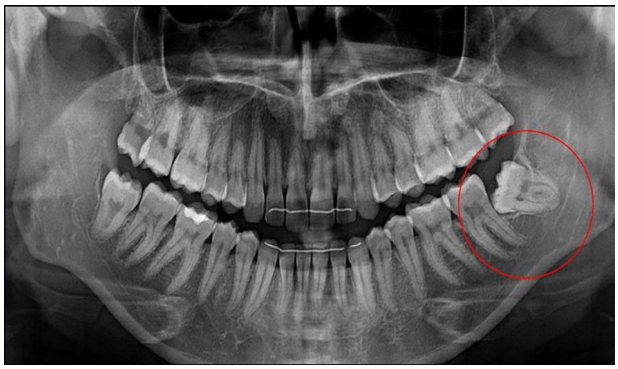
molar, and the proximity to surrounding anatomical structures. Unlike conventional extraction, surgical extraction may require elevation of the gingival-periosteal flap, removal of a portion of bone, segmentation of the tooth, or odontotomy.

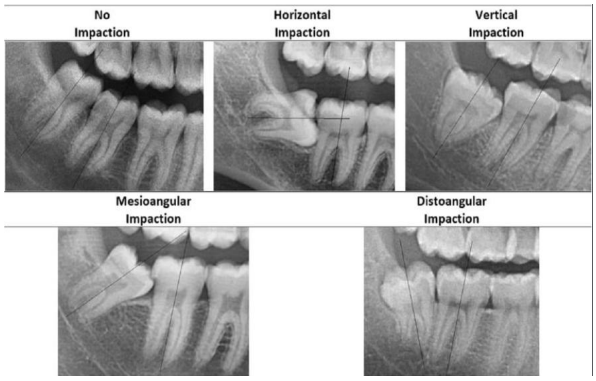
Postoperative complications are divided into early and late groups. Early complications include bleeding, severe pain, swelling, hematoma, soft tissue injury, and nerve damage. Late complications may include alveolitis, wound infection, persistent paresthesia, migration of residual roots, delayed wound healing, and the need for re-surgical intervention.

The main goal in modern dental surgery is not only to remove the impacted tooth, but also to preserve healthy anatomical structures to the maximum extent possible, protect the patient's functional status, and accelerate postoperative recovery.

General understanding of retained teeth and their clinical significance

An impacted tooth is a tooth that has not erupted into the oral cavity during its physiological period of eruption, regardless of whether its development and root formation are ongoing or complete. The failure of a tooth to erupt may be due to mechanical obstruction, insufficient jaw development, malposition of the tooth bud, density of adjacent teeth, or thickness of bone or soft tissues. In clinical practice, the terms retained and impacted teeth are often used interchangeably.





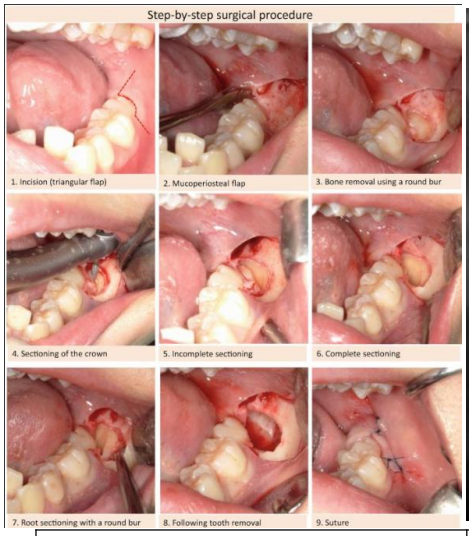
Retained teeth, even if clinically asymptomatic, do not always require surgical removal. The decision should be based on the patient's age, symptoms, pathological changes in the tooth, impact on adjacent teeth, hygiene possibilities, future risks, and possible complications of the operation.

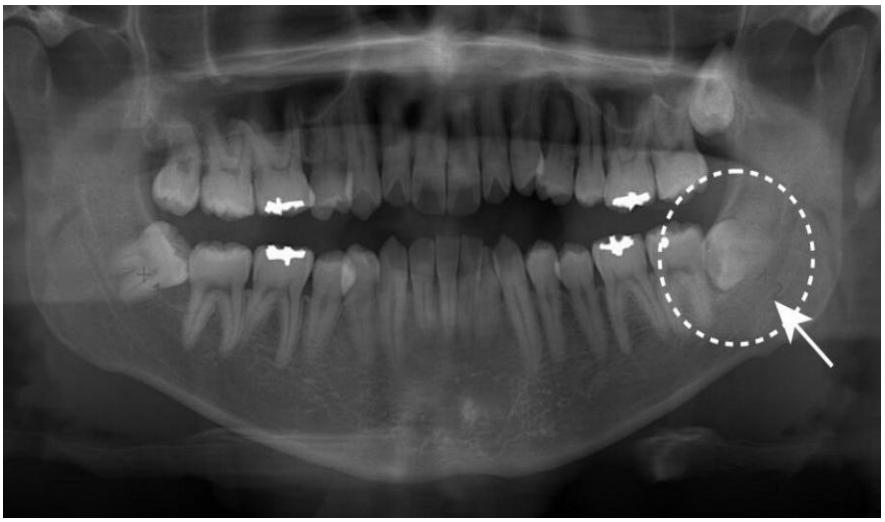
Retention type	Description	Importance in surgery
Complete bone retention	The tooth is located within the bone with its crown and roots.	Bone opening and odontotomy may be required
Partial retention	Part of the tooth protrudes into the oral cavity, the rest is covered by tissue	High risk of pericoronitis and local infection
Vertical impaction	The long axis of the tooth is almost parallel to the axis of the adjacent tooth.	Can be removed relatively easily
Mesioangular impaction	The crown is tilted towards the front molar.	There is a risk of damage to the adjacent second molar.
Horizontal impaction	The crown of the tooth is located almost horizontally	High probability of complex odontotomy and

	towards the adjacent molar.	osteotomy
Distoangular impaction	The crown is facing backwards.	Operational access and field of view may be limited

Major complications of surgical extraction

Complications in the removal of impacted teeth are multifactorial, and the anatomical position of the tooth, the experience of the surgeon, the duration of the operation, the patient's age, the presence of inflammation, smoking, oral hygiene, and compliance with postoperative instructions play an important role in their development.



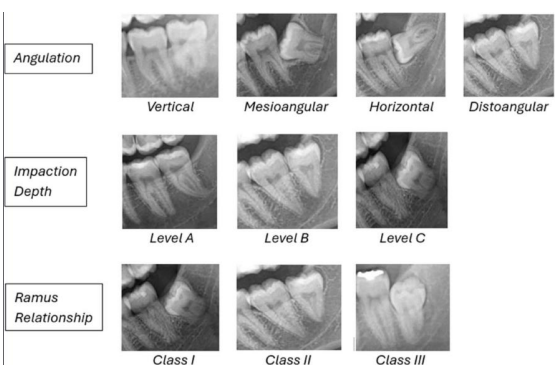


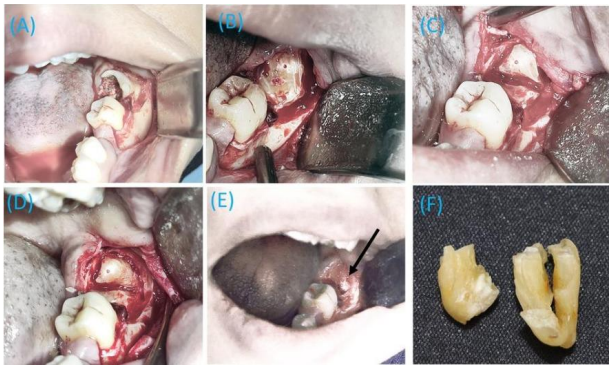
Complication	Main reasons	Reduction methods
Alveolitis	Blood clot breakup or loss, trauma, smoking	Atraumatic technique, clot preservation, smoking cessation
Postoperative infection	Bacterial contamination, food residue, poor hygiene	Asepsis, wound care, antibiotics if indicated
Bleeding	Vascular or bone damage; coagulopathy	Anamnesis, hemostasis, pressure tamponade
Inferior alveolar nerve injury	Proximity of the roots to the mandibular canal, strong pressure	Radiological risk assessment, conservative osteotomy, coronectomy
Lingual nerve damage	Soft tissue injury on the side of the tongue	Controlled moment, careful instrumentation
Adjacent tooth damage	Incorrect elevation, excessive force	Correct access, odontotomy, protection of the second molar
Trismus	Chaynov muscle trauma, long surgery	Reduced operation time, gentle technique
Swelling and pain	Surgical inflammatory response, tissue trauma	Cold compress, appropriate analgesia
Jaw fracture	Excessive bone removal, severe elevation	Bone-sparing method, early risk identification

Preoperative examination and risk assessment

The most important step in reducing complications is a comprehensive examination of the patient before surgery. The risk of surgical intervention is not determined solely by the condition of the tooth on the X-ray; the patient's general health, medications, bleeding tendency, allergic history, and signs of inflammation are also taken into account.

The clinical history includes previous extractions and anesthesia-related complications,





anticoagulant and antiplatelet therapy, blood clotting disorders, diabetes, decreased immunity, allergic reactions, smoking, and poor oral hygiene.

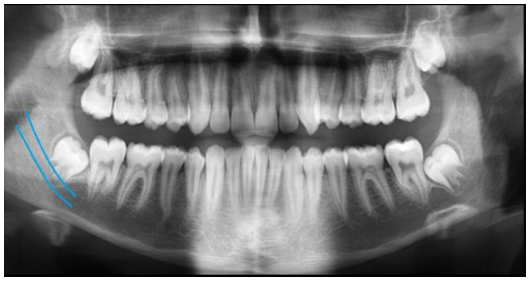
Clinical examination assesses the location of the impacted tooth, the degree of mouth opening, the condition of the mucosa, pericoronitis, purulent discharge, lymph nodes, caries or periodontal damage of adjacent teeth.

Panoramic radiography is sufficient for initial assessment in most cases, showing the tooth's axis, depth of retention, root shape, and approximate relationship to the mandibular canal. CBCT should be used in cases where plain radiography does not provide sufficient information and where the risk of nerve damage affects clinical decision-making.

Inspection method	Information provided	Limitation
Intraoral radiography	Local condition of the tooth, roots and crown characteristics	Extensive anatomical relationships may not be fully visible
Panoramic radiography	Tooth axis, retention level, approximate canal location	Does not clearly show three-dimensional relationships
CBCT	Three-dimensional image of the roots, mandibular canal, bone, and adjacent teeth	Radiation dose and cost are higher
Clinical examination	Pain, inflammation, mouth opening, soft tissue conditions	Does not reveal anatomy within the bone
Laboratory examination	Assessment for bleeding risk or general illnesses	Not all patients require the same amount

Predicting the surgical complexity of a retained tooth

The anatomical location of the tooth and the possibility of operative access are evaluated when creating a surgical plan. For lower third molars, the Pell and Gregory classification is widely used to describe the location of the tooth relative to the ramus and the depth relative to the occlusal plane. The Winter classification describes the direction of the tooth axis.



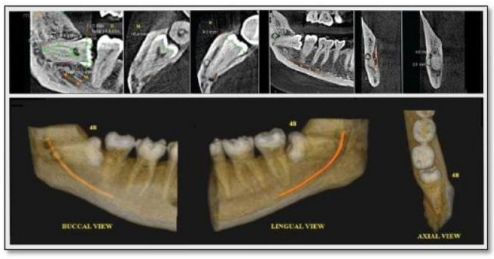


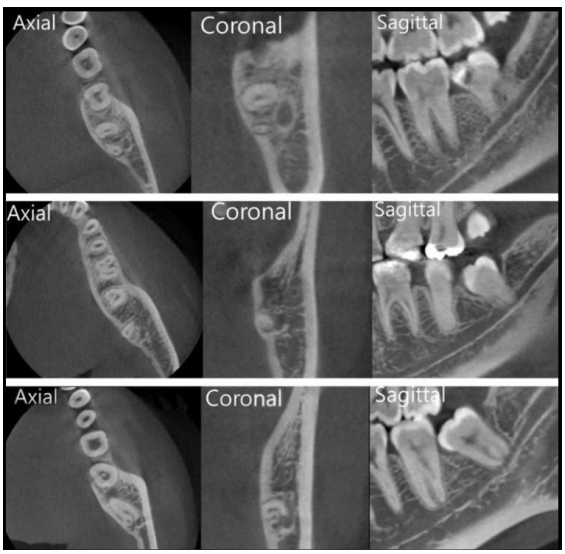
Figure 3. Representative Cross-sectional CBCT Image.
A representative CBCT slice depicting the relationship of the impacted third molar to the inferior alveolar nerve canal. The image highlights critical anatomical landmarks used in preoperative planning.

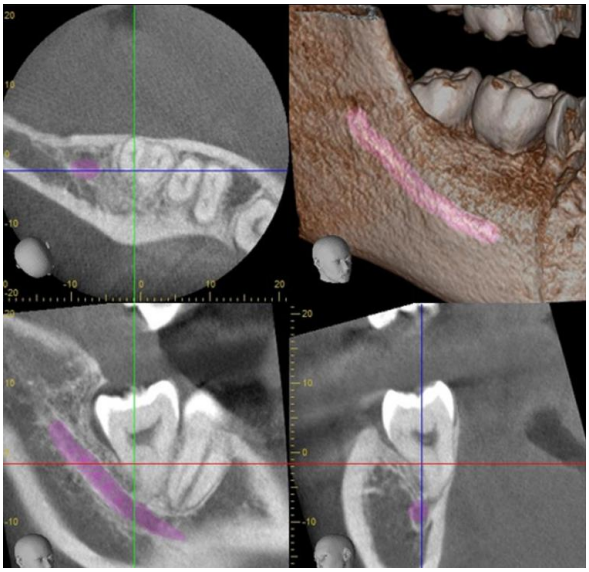
When assessing operative complexity, the depth of the tooth, its relationship to the ramus, the axis of the tooth, the number and curvature of the roots, proximity to the mandibular canal, relationship to the adjacent molar, bone density, mouth opening, active pericoronitis, and the experience of the surgeon are taken into account.

Atraumatic surgical technique

The goal of an atraumatic approach to the removal of impacted teeth is to perform the operation while preserving the minimum but sufficient amount of bone and soft tissue necessary for tooth extraction. The atraumatic technique avoids excessive pressure, uncontrolled elevation, and unnecessary tissue damage during the operation.

- Preparation of the surgical field: patient identification, consent verification, aseptic-antiseptic and





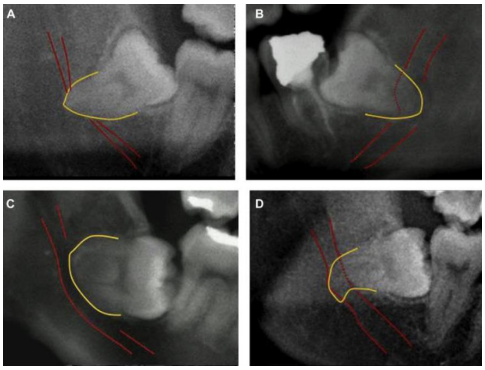
local anesthesia.

- Creation of surgical access: mucoperiosteal flap elevation providing adequate field of view.
- Bone-sparing osteotomy: removing only the necessary amount of bone.
- Odontotomy and tooth segmentation: separation of the crown or roots according to the shape of the tooth.

● Examination of the alveolus and hemostasis: evaluation of fragments, pathological tissue, and bone edges.

● Wound closure and postoperative instructions: return the wound to its anatomical position and provide recommendations to the patient.





Maintaining the blood supply to the wound, avoiding crushing its edges, and avoiding excessive tension during suturing have a positive effect on wound healing. Adequate irrigation and controlled movements are important during bone removal. Dividing the tooth into crown and root parts helps reduce mechanical stress in deeply impacted teeth.

Prevention of inferior alveolar nerve and lingual nerve injury

The inferior alveolar nerve passes through the mandibular canal and provides sensation to the lower lip and chin. When the roots of the lower third molars are located close to this canal, there is a risk of compression, stretching, or direct injury to the nerve during tooth extraction. Injury to the lingual nerve can cause sensory changes on one side of the tongue.

● Preoperative assessment of anatomical relationship using panoramic radiography and CBCT if indicated.

● Avoid forcibly moving the roots in a dangerous position relative to the mandibular canal.

● Controlled bone removal and, if necessary, tooth extraction.

● Control the elevation force and avoid using incorrect support points.

● Avoid unnecessary trauma to the soft tissues on the lingual side.

● If there is a high risk, refer to an experienced oral and maxillofacial surgeon or discuss coronectomy.

Coronectomy is an alternative method aimed at preserving the nerve.

Coronectomy, also known as intentional partial odontectomy, is a procedure in which the crown of a tooth is removed while the roots are left in place if there is a high risk of damage to important surrounding anatomical structures, especially the inferior alveolar nerve. The goal is to avoid attempting to remove roots that may be directly in contact with the nerve.

Coronectomy is only used in carefully selected clinical situations. This procedure may not be appropriate in cases where the tooth has an active root infection, root mobility, certain pathological changes, or where it is not possible to safely remove the crown. If the roots are left in place, they may become displaced, infected, or require reoperation; therefore, follow-up is important.

A systematic review published in 2021 analyzed 2,176 coronectomies. It reported an incidence of inferior alveolar nerve injury of 0.59%, lingual nerve injury of 0.22%, infection of 3.95%, alveolitis of 1.12%, and the need for subsequent removal of remaining roots of 5.28%. These figures are aggregated results from different studies and should not be directly extrapolated to all patients or to every clinical setting.

A systematic review and meta-analysis published in 2025, based on 34 studies involving 7115 lower third molars, showed that coronectomy may reduce the risk of inferior alveolar and lingual nerve damage. However, it was noted that there was a possibility of re-surgery related to the remaining roots.

Criteria	Complete surgical extraction	Coronectomy
Main goal	Removal of tooth crowns and roots	Removing the crown and preserving the roots
Nerve damage	The roots may be higher if they are close to the canal.	Can be reduced by not removing roots
Infection	Depends on surgical and patient factors	In selected patients, near complete extraction may be possible
Alveolitis	Depending on surgical trauma and other factors	Some analyses have reported lower rates
The remaining roots	No, if the extraction is complete	There is a possibility of migration or reoperation
Tracking	Wound healing and standard control	Long-term clinical and radiological follow-up is necessary

Reducing alveolitis and postoperative infection

Alveolitis is a complication associated with insufficient formation, breakdown, or loss of a blood clot in the extraction socket, often manifested by severe pain within a few days after surgery. This may be accompanied by exposure of the bone surface within the alveolus, an unpleasant odor, pain radiating to the ear or temple, and delayed wound healing.

- Avoid excessive damage to soft tissues and alveoli during surgery.
- Ensuring the formation of a blood clot and not removing it unnecessarily.
- Use of adequate irrigation during surgery.
- Avoid vigorous rinsing, digging the wound area, and vigorous suctioning for the first 24 hours.
- Stop smoking before and after surgery, or limit it for as long as possible.
- Continue oral hygiene as directed by your doctor.
- If pain worsens, fever, pus, or an unpleasant odor appears, seek re-examination.

Antibiotics are not automatically prescribed after every extraction. They are selected based on clinical indications, risk of infection, patient's general condition, and local treatment options.

Bleeding prevention and hemostasis

Bleeding is one of the most important complications after the removal of impacted teeth. It can be caused by local vascular damage, bleeding from inflamed tissues, coagulation disorders, anticoagulant therapy, or patient non-compliance with postoperative instructions.

- Controlled pressure tamponade using sterile gauze.
- Use of absorbable hemostatic materials when necessary.
- Visualize the bleeding vessel and perform local hemostatic measures.
- Correct placement and sewing of the lahtak.
- Advise the patient to keep the head elevated and avoid strenuous physical exertion.

Stopping anticoagulants on your own can be dangerous. In such patients, an individual plan is developed between the treating physician and the dental surgeon.

Reducing pain, swelling, and trismus

Pain and swelling after surgical extraction can be a natural part of the inflammatory response. Their extent depends on the depth of the tooth, the duration of the operation, the size of the osteotomy, the tissue damage, and the individual characteristics of the patient. Often, swelling increases in the first 48–72 hours after surgery and then begins to decrease.

Pain management takes into account the patient's age, allergies, renal and hepatic function, gastrointestinal diseases and other medications. Nonsteroidal anti-inflammatory drugs, in combination with paracetamol if necessary, can be effective in many patients. The dosage and combination of drugs are determined individually by the doctor.

To reduce swelling, it is recommended to initially use a cold compress, keep the head elevated, avoid excessive physical exertion, and not disturb the injured area.

Postoperative care and patient education

In addition to the surgery itself, the patient's postoperative behavior is also of great importance in reducing complications. Written and verbal instructions should be prepared for the patient, and danger signs and return procedures should be clearly explained.

- Apply pressure to the gauze pad as directed by your doctor.
- Do not rinse your mouth vigorously or examine the wound area with your tongue or hand for the first 24 hours.
- Avoid smoking, alcohol, and intense physical exertion.
- Take painkillers recommended by your doctor as prescribed.
- Continue oral hygiene as recommended by your doctor.
- Consume soft, comfortable temperature food and sufficient fluids.
- Seek immediate medical attention if there is fever, pus, increasing swelling, ongoing bleeding, or difficulty swallowing or breathing.

A comprehensive algorithm for reducing surgical risk

- Identification of a retained tooth.
- Clinical examination and panoramic radiography.
- Assessing the risk of nerve, adjacent tooth, and bone damage.
- CBCT and specialist consultation if necessary.
- Individual surgical plan: extraction or, in selected cases, coronectomy.
- Atraumatic surgery, hemostasis and wound control.
- Postoperative instructions and follow-up examination.

This algorithm is not a strict standard protocol, but rather a general model for clinical decision-making. The surgical approach and follow-up plan for each patient are determined based on individual risk factors.

Result

An analysis of the scientific literature on the issue of reducing complications during surgical removal of impacted teeth shows that in order to achieve a safe surgical outcome, it is necessary to use a comprehensive approach to diagnostic, technical, and postoperative measures. It is important to assess the risks of surgery in advance, determine the anatomical location of the tooth and the relationship of its roots to the mandibular canal, and also take into account the general condition of the patient.

In studies of lower third molars, coronectomy has been reported as an alternative procedure that may reduce nerve damage in high-risk teeth, i.e. teeth with roots close to the inferior alveolar nerve. A 2021 systematic review analyzed 2,176 coronectomies and reported inferior alveolar nerve damage in

0.59%, lingual nerve damage in 0.22%, infection in 3.95%, alveolitis in 1.12%, and subsequent removal of remaining roots in 5.28%.

A 2025 meta-analysis and systematic review analyzed 34 studies involving 7,115 third molars. It showed that coronectomy may reduce the risk of inferior alveolar and lingual nerve damage, but there is a risk of re-surgery related to the remaining roots.

Atraumatic surgery, blood clot preservation, proper hemostasis, individual drug therapy, and patient education are important in preventing postoperative alveolitis, infection, bleeding, and edema . The patient's cessation of smoking, protection of the wound area from mechanical stress, and attendance at scheduled follow-up examinations also affect the outcome of treatment.

Thus, the available evidence suggests that the best way to reduce complications in the removal of impacted teeth is to develop an individualized risk-based treatment plan, use three-dimensional radiological examination when necessary, use bone- and soft-tissue-sparing surgical techniques, and provide postoperative follow-up.

Conclusion

Surgical removal of impacted teeth is a common, and in some cases complex and high-risk, surgical procedure in dental surgery. The effectiveness of this procedure is assessed not only by the complete removal of the tooth, but also by the preservation of the patient's anatomical structures, functional status, and quality of life.

The most important condition for reducing complications is a comprehensive preoperative examination and individual risk assessment. Panoramic radiography can provide initial diagnostic information, while CBCT is used in selected cases where it is necessary to determine the complex three-dimensional relationship between the nerve and tooth roots.

Atraumatic surgery, minimally invasive osteotomy, accurate odontotomy, avoidance of excessive elevation force, clot protection, and good hemostasis reduce postoperative complications. In some high-risk third molars located close to the inferior alveolar nerve, coronectomy may be considered as an alternative method to minimize nerve injury.

In general, to achieve successful treatment in the removal of impacted teeth, modern diagnostics, surgical skills, individual treatment tactics, aseptic-antiseptic, rational pharmacotherapy, and patient compliance with postoperative recommendations must complement each other.

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