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Clinical Evaluation and Postoperative Management of Impacted Tooth Extraction: Current Status and Prospects

Yu Liu [1,†], Fuguang Zhang [1,†], Qiang Zhang [2,†], Rui Wang [3,*] and Jiye Liu [4,*]

[1] Department of Stomatology, Teaching Base of Huludao Central Hospital Affiliated to Jinzhou Medical University, Huludao 125000, China

[2] Department of Vascular Intervention, Teaching Base of Huludao Central Hospital Affiliated to Jinzhou Medical University, Huludao 125000, China

[3] Department of Radiology, Teaching Base of Huludao Central Hospital Affiliated to Jinzhou Medical University, Huludao 125000, China

[4] Department of Rehabilitation Medicine, Teaching Base of Huludao Central Hospital Affiliated to Jinzhou Medical University, Huludao 125000, China

* Corresponding author: 45486082@qq.com (R.W.); 17704286805@163.com (J.L.)

† These authors contributed equally to this work.

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Abstract: Objective: To explore the clinical evaluation methods and postoperative management strategies for the extraction of obstructed teeth, in order to provide reference for clinical practice, optimize patient management processes, and improve surgical outcomes and patient satisfaction. Method: A comprehensive analysis of relevant research in recent years was conducted to systematically summarize the key points of preoperative evaluation, surgical technique selection, and postoperative management measures for the extraction of obstructed teeth. Result: The accuracy of preoperative evaluation directly affects the success rate of surgery and the postoperative recovery of patients. The choice of surgical technique is closely related to the incidence of complications. Postoperative management strategies play a crucial role in improving patients' quality of life and reducing postoperative complications, but there is currently a lack of unified standards and guiding principles. Conclusion: By systematically summarizing existing research, it can provide a basis for standardized clinical evaluation and postoperative management of impacted tooth extraction surgery, which can help improve clinical treatment level and patient prognosis.

Keywords: impacted tooth; pain; postoperative complications; clinical evaluation

1. Introduction

Impacted teeth refer to teeth that fail to sprout normally due to insufficient space, abnormal tooth growth direction, and other reasons, commonly seen in wisdom teeth [1]. Research has shown that the incidence of impacted teeth varies significantly among different populations [2]. According to a study conducted in Saudi Arabia, the impaction rate of third molars is as high as 68.6% [3]. In research in India, the incidence of impacted teeth also showed a similar trend, especially among young adults, who showed a higher rate of impacted teeth [4]. In addition, the epidemiological characteristics of impacted teeth are closely related to factors such as gender, age, race, and geographical location [5]. For example, the incidence of impacted teeth in males is generally higher than in females, which may be related to differences in jaw structure and growth and development [6]. Impaired teeth may not only cause local infections, gingivitis, and other problems, but also have an impact on adjacent teeth. A study has shown a significant association between the presence of impacted wisdom teeth and distal caries in the second molar, suggesting the need to pay attention to the management of wisdom teeth in clinical practice to prevent potential complications [7]. Another study also revealed that the incidence of pericoronitis is higher in

patients with wisdom tooth occlusion, and is closely related to the specific location and growth angle of wisdom teeth [8]. The surgical removal of impacted teeth (including traditional rotational surgery and emerging ultrasound surgical techniques,etc.) is becoming increasingly common in clinical practice, but its success depends not only on surgical techniques, but also closely related to preoperative evaluation and postoperative management. The prevalence of wisdom tooth extraction surgery in the United States has sparked discussions about its necessity [9]. Some studies have shown that although many impacted wisdom teeth may not cause obvious symptoms, in some cases, they can still have long-term effects on adjacent teeth, such as leading to root resorption or periodontal bone loss [10]. Therefore, regular oral examinations and imaging evaluations are crucial for early detection and treatment of impacted wisdom teeth. In addition, patients should pay attention to postoperative care after undergoing tooth extraction surgery to prevent infection and other complications from occurring [11]. This article will explore in detail the clinical evaluation and postoperative management of impacted tooth extraction surgery.

2. Clinical Evaluation of Impacted Teeth

2.1. Imaging Examination

Imaging examination plays a crucial role in the clinical evaluation of impacted teeth. Through imaging examinations, doctors can accurately determine the position, shape, and relationship with adjacent tissues of impacted teeth, and thus develop a reasonable treatment plan. The commonly used imaging examination methods include traditional oral periapical film, panoramic laminagram, spiral CT and cone beam computed tomography (CBCT) (Figure 1). The specific introductions and advantages and disadvantages of the above four methods are listed in Table 1. Research has shown that CBCT can provide clearer three-dimensional images, which can help evaluate the degree of impaction of impacted teeth and their impact on mandibular second molars, thereby reducing the risk of postoperative complications [12]. In addition, imaging examinations can also help identify possible bone injuries and abnormal tooth root morphology, providing important reference for surgery. Therefore, before performing impacted tooth extraction surgery, doctors should make full use of imaging examinations to ensure the safety and effectiveness of the surgery.

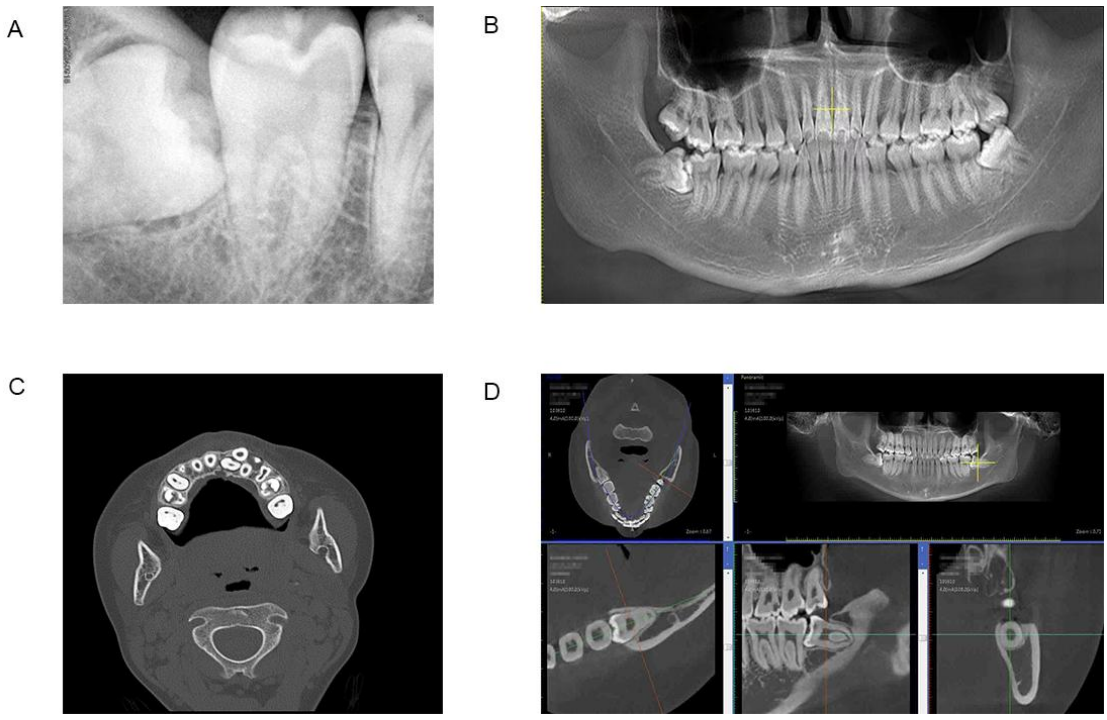

Figure 1. Imaging examination methods for impacted teeth. (**A**): oral periapical film; (**B**): panoramic laminagram; (**C**): spiral CT; (**D**): cone beam computed tomography (CBCT).

Table 1. Imaging examination methods for impacted teeth.

Imaging Examination	Basic Description
Periapical film	Periapical film has the advantages of low exposure for photography, and the system has built-in image processing and storage system functions. The double exposure positioning method is often used to locate the lip and palate side of

	the impacted teeth. However, it cannot display adjacent oral structures and the resolution and contrast of X-ray images may not be sufficient to clearly display all details in complex lesions
Panoramic laminagram	Panoramic laminagram can clearly display the inclination, ambush depth, and relationship with surrounding structures of impacted teeth. However, panoramic X-rays also have certain limitations, for example, the characteristics of two-dimensional imaging may lead to misjudgment of three-dimensional structures. In addition, long-term panoramic X-ray examination may cause cellular genetic damage to oral cells.
Spiral CT	Spiral CT is widely used in the diagnosis of maxillary impacted canines due to its multi-slice scanning technology and four three-dimensional reconstruction techniques: maximum density projection (MIP), volume rendering (VR), multi planar reformation (MPR), and curved reformation (CPR). However, it has shortcomings such as high radiation dose, complex image reconstruction operations, and high fees.
CBCT	CBCT is widely used in various fields of oral medicine due to its advantages of fast scanning speed, low radiation, and high spatial resolution. CBCT images are clear and artifact free, which not only avoids image overlap, magnification, and distortion, but also provides multiple views for diagnosis and research needs. In addition, CBCT can use its built-in software to measure and analyze the images it produces

CBCT: cone beam computer tomography.

2.2. Assessment of Clinical Symptoms

The assessment of clinical symptoms is an important step in the diagnosis of impacted teeth. Patients often experience symptoms such as pain, swelling, and bad breath, which not only affect their quality of life but may also indicate potential infections or complications. Clinical doctors need to inquire in detail about the patient's chief complaint, understand the onset time, duration, and changes of symptoms, and conduct a comprehensive evaluation based on the physical examination results. Related studies have shown that the degree of pain is closely related to the eruption state of impacted teeth and the health status of adjacent teeth [13]. In addition, the evaluation of clinical symptoms should also pay attention to the patient's general health, especially whether there are basic diseases such as diabetes and cardiovascular disease, which may affect the risk and recovery of surgery. Therefore, a comprehensive assessment of clinical symptoms is crucial for developing individualized treatment plans. The evaluation tools for the oral disease symptom scale are listed in Table 2.

Table 2. Clinical symptom related scale.

Scale Name	Content
OHIP	OHIP is a tool used to evaluate the impact of oral diseases on quality of life. Its design includes multiple dimensions, covering physiological, psychological, and social aspects, and can comprehensively reflect the impact of oral health on individual quality of life.
OHAT	The assessment of OHAT mainly includes multiple aspects such as oral hygiene, oral tissue health, and oral function. By comprehensively evaluating these indicators, medical personnel can quickly identify patients who require further treatment. The use of this tool is not limited to clinical settings, but can also play an important role in community care, especially among the elderly and disabled populations. The operability and ease of use of OHAT make it an ideal assessment tool
DAS	DAS is an important tool for assessing the level of anxiety experienced by individuals during dental treatment, and its structure typically includes multiple dimensions, covering patients' fear, anxiety, and related emotional responses to dental treatment.
OPS	OPS is a tool used to assess oral pain, which typically includes the nature, intensity, duration, and other symptoms associated with pain. In addition, OPS can also be combined with other pain assessment tools such as Visual Analog Scale (VAS) and Digital Rating Scale (NRS) to enhance the comprehensiveness and accuracy of its assessment
OFDI	The Oral Function Assessment Inventory (OFDI) is a tool used to evaluate an individual's oral function status, mainly covering multiple aspects such as chewing, swallowing, speech, and oral hygiene. In addition, when evaluating oral function, OFDI can more comprehensively reflect the overall health level of patients by taking into account factors such as their psychological state, social support, and nutritional status

OHIP: Oral Health Impact Profile; OHAT: Oral Health Assessment Tool; DAS: Dental Anxiety Scale; OPS: Oral Pain Scale; OFDI: Oral Function Assessment Inventory.

2.3. Collection of Patient's Medical History

The collection of patient medical history is an important component of clinical evaluation of obstructed teeth. Through detailed medical history inquiry, doctors can obtain information such as a patient's medical history, family history, and medication history, which is of great significance for assessing surgical risks and developing treatment plans. For example, patients who have had dental surgery or complications in the past may have a higher risk of postoperative complications [14]. In addition, understanding the patient's medication history can help doctors evaluate the use of antibiotics and prevent postoperative infections. Research has shown that a patient's psychological state and understanding of surgery can also affect postoperative recovery outcomes. Therefore, in the process of collecting medical history, doctors should pay attention to the patient's mental health and provide necessary psychological support [15]. In summary, comprehensive medical history collection not only helps to assess surgical risks, but also provides patients with more personalized treatment plans.

3. Selection of Surgical Techniques

The choice of surgical technique is one of the key factors for the success of surgical treatment. Different surgical methods and techniques can affect the prognosis, postoperative recovery, and incidence of complications of patients. Therefore, surgeons need to fully consider factors such as the patient's specific situation, the nature of the disease, and the complexity of the surgery when formulating surgical plans, in order to choose the most suitable surgical technique [16]. Research has shown that the choice of surgical technique is not only related to the patient's physiological state, but also closely related to the type of surgery, the operator's experience, and the hospital's equipment conditions [17].

3.1. Methods of Extraction Surgery

During the extraction procedure, different methods may affect postoperative recovery and the occurrence of complications [18]. Traditional tooth extraction often relies on mechanical force to pull out teeth by prying and twisting, which can easily cause damage to surrounding bone and soft tissues, leading to postoperative pain and swelling [19]. At the beginning of the 20th century, with the continuous advancement of oral surgical techniques, the bone chisel tapping method for tooth separation gradually emerged. This technology gradually loosens teeth by tapping, reducing direct pressure on surrounding tissues and thus reducing the degree of damage. In addition, this technology can also reduce the risk of postoperative bleeding and infection to a certain extent, improving the speed of postoperative recovery and quality of life for patients [20–22].

In recent years, minimally invasive surgery has gradually replaced the above two methods. Minimally invasive surgery refers to surgical procedures performed through small incisions or natural cavities, aimed at reducing trauma and pain to patients while accelerating the recovery process [23,24]. Compared with traditional open surgery, minimally invasive surgery has multiple advantages, including reducing the risk of postoperative infection, shortening hospital stay, alleviating postoperative pain, and faster functional recovery [25,26]. These advantages have led to the widespread application of minimally invasive surgery in many fields, such as spinal surgery, cardiac surgery, and tumor resection [27].

In the treatment of impacted teeth, minimally invasive surgery is mainly performed using ultrasonic bone scalpels, high speed airturbine handpieces, and laser equipment. Ultrasonic bone scalpel achieves precise cutting of bone tissue through ultrasonic vibration, which can reduce the incidence of postoperative complications while minimizing damage to surrounding tissues [28,29]. High speed airturbine handpieces are an efficient dental tool widely used in dental surgery and treatment. The basic concept is to generate powerful cutting and grinding forces through a high-speed rotating turbine, which can quickly and effectively remove dental tissue, clean tooth surfaces, and perform root canal treatment. The introduction of high-speed turbo phones not only improves the efficiency of dental operations, but also greatly reduces the pain of patients [30–32]. The model diagrams of the above two devices are presented in Figure 2. Laser treatment for impacted teeth is currently a hot research area. It mainly relies on the high-energy focusing characteristics of lasers, which can accurately cut and evaporate tissues, reducing damage to surrounding tissues. There are many types of lasers, including hard lasers and soft lasers [33–35] (Table 3).

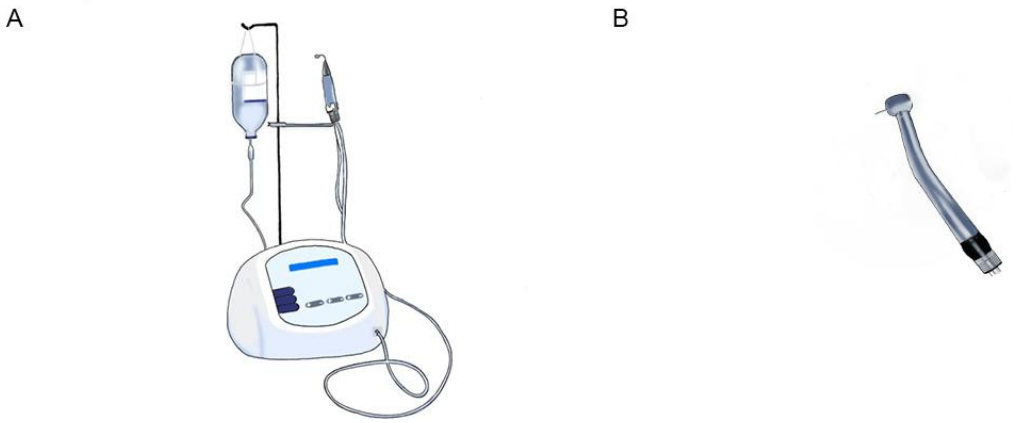

Figure 2. Equipment used in minimally invasive surgery. (**A**): ultrasonic bone scalpels; (**B**): high speed airturbine handpieces.

Table 3. Classification and function of lasers.

Intensity	Name	Wavelength or Power	Function
Hard laser	Er:YAG	2940 nm	Soft tissue incision; Remove bone tissue
Hard laser	Nd:YAG	1064nm	Intraoperative hemostasis and sterilization
Soft laser	Red area light	600 ~ 700 nm or 780 ~ 1100 nm	Relief of postoperative pain and swelling
Soft laser	Diode laser	0.005 ~ 5 W/cm^2	Healing of bone tissue and soft tissue in tooth extraction socket; Treatment of inferior alveolar nerve injury

3.2. Anesthesia Plan

The choice of anesthesia method is equally crucial during surgery. Different anesthesia techniques can directly affect patient comfort, postoperative recovery, and the risk of complications. At present, the anesthesia methods for the extraction of obstructed teeth mainly include local infiltration anesthesia, block anesthesia, and general anesthesia, each of which has different indications, advantages and disadvantages, and clinical application effects (Table 4).

Table 4. Anesthesia methods before extraction of impacted teeth.

Type of Anesthesia	Injection Site	Advantage	Disadvantage
Local infiltration anesthesia	Alveolar processes of maxillary and mandibular teeth	The drug generates tension within the tissue, which reduces capillary bleeding and facilitates tissue separation	Pain during injection
Block anesthesia	Lower jawbone, tongue, and cheek	Reduce the dosage and injection frequency of anesthetics; Reduce pain and prevent the spread of infection	Improper operation can cause nerve trunk damage and infection
General anesthesia	intravenous injection	Used in patients with underlying systemic diseases or low impacted teeth, with fast onset, no irritation to the respiratory tract, and no environmental pollution.	Easy to be accompanied by respiratory, circulatory and other systemic complications

Local infiltration anesthesia is a method of using local anesthetic drugs to block nerve endings in order to eliminate pain in a specific area [36]. The basic principle is that anesthetic drugs inhibit the transmission of nerve impulses by binding to specific receptors on the membrane of nerve cells [37]. This mechanism mainly relies on the effect of anesthetic drugs on voltage dependent sodium channels. Injecting anesthesia near the nerve trunk to block nerve conduction and achieve anesthetic effects in the nerve distribution area is called block anesthesia [38,39]. This method mainly includes alveolar nerve block, maxillary nerve block, and pre palatal nerve block. Due to the generally deep injection site, strict aseptic operation is required to avoid adverse consequences. However, infiltration anesthesia and block anesthesia also have certain drawbacks, such as in some complex surgeries, the above two methods may not provide sufficient anesthesia depth, resulting in patient discomfort [40]. Therefore, in patients with abnormal tension or anxiety, complex oral anatomy, or multiple underlying diseases, general anesthesia is often the best choice. However, studies have shown that general anesthesia may be associated

with a higher risk of postoperative complications, such as respiratory complications, cardiovascular events, and postoperative infections [41]. Therefore, anesthesiologists need to carefully evaluate the patient's health status and develop personalized anesthesia plans before performing general anesthesia to reduce risks. At the same time, screening is also necessary in the selection of anesthetics. The commonly used local anesthetics include lidocaine, bupivacaine, and metoprolol. In general anesthesia, commonly used anesthetic drugs include inhaled anesthetics (such as halothane and isoflurane) and intravenous anesthetics (such as propofol and remifentanil). However, in specific applications, doctors need to conduct a comprehensive evaluation of anesthesia drugs based on the type of surgery, patient condition, and pharmacokinetic characteristics of the drugs. For example, bupivacaine has a strong anesthetic effect and is suitable for surgeries that require longer periods of anesthesia, while lidocaine is suitable for short-term surgeries [42]. The frequently-used anesthetic drugs used in the extraction of impacted teeth are listed in Table 5.

Table 5. Anesthetics commonly used in impacted tooth surgery.

Drug Name	Type of Anesthesia	Effective Characteristics or Scope of Application
Lidocaine	local anesthesia	The effect is rapid and the side effects are minimal, but its duration is short
Bupivacaine	local anesthesia	Its anesthesia duration is long and suitable for complex impacted tooth surgery
Articaine	local anesthesia	It has strong penetration and diffusion, especially suitable for children over 4 years old
Etomidate	general anesthesia	It is a fast acting anesthetic, particularly suitable for patients with cardiovascular disease
Propofol	general anesthesia	It is a fast and short acting intravenous anesthetic that has a rapid onset, stable induction, short duration, complete awakening, and does not cause mental symptoms such as nightmares and hallucinations.
Midazolam	general anesthesia	It has anti anxiety, sedative, and anticonvulsant effects and is commonly used for maintaining general anesthesia and sedation under local anesthesia

3.3. Selection of Surgical Timing

The timing of surgery for impacted teeth is crucial for the patient's oral health. Early or late surgical intervention can lead to unnecessary complications. Research shows that early intervention can reduce the incidence of complications and improve surgical success [43,44]. In addition, the timing of surgery should also consider the patient's age, health status, and psychological factors. The anxiety and pressure felt by patients during surgical decision-making may affect their acceptance of the surgery and postoperative recovery. Therefore, communication and shared decision-making between doctors and patients are particularly important, which can not only improve patient satisfaction, but also promote postoperative rehabilitation and health management [45,46]. As shown in Figure 3A, patients experiencing severe pain, loosening of adjacent teeth, dental caries or periapical lesions, and odontogenic cysts are all indications for surgery [47–50]. However, when patients have serious heart, brain, and hematopoietic organ diseases, it is considered a contraindication for obstructive dental surgery (Figure 3B). It is worth noting that after the contraindications are controlled, surgery can also be scheduled. Therefore, doctors need to weigh the pros and cons and prescribe the best solution for patients.

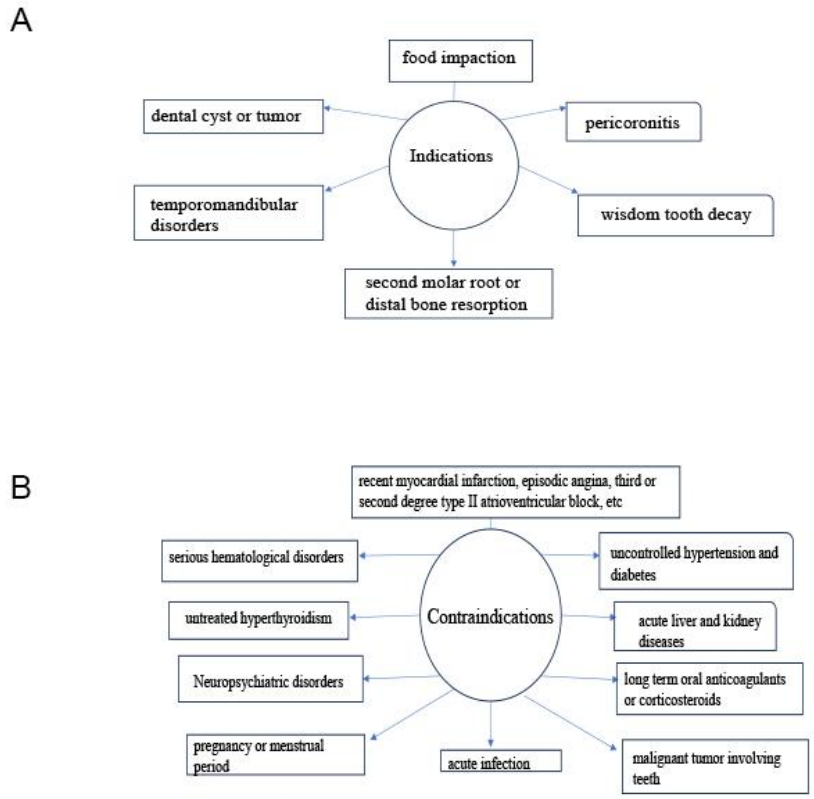

Figure 3. Indications and contraindications for extraction of impacted teeth (**A**): Indication: Early surgery; (**B**): Contraindications: Temporarily suspend surgery.

4. Prevention of Postoperative Complications

Postoperative complications of impacted tooth extraction are important factors affecting patient recovery, and preventing these complications is crucial for improving the quality of life of postoperative patients [51,52]. Effective preventive measures can reduce the incidence of complications such as infection, bleeding, and nerve damage, thereby reducing the impact of postoperative complications on patients [53].

4.1. Preventive Measures for Infection

Postoperative infection is one of the most common complications, and preventive measures should start from various stages before, during, and after surgery. Before surgery, patients should receive appropriate antibiotic prophylaxis to reduce the risk of surgical site infection. Studies have shown that oral antibiotics taken 24 h before surgery can help reduce the incidence of postoperative alveolar bone inflammation [54]. Strict aseptic procedures during surgery are key to preventing infection. The surgical team needs to ensure the aseptic state of the surgical environment and strictly disinfect the surgical instruments. In addition, the risk of postoperative infection cannot be ignored, especially within 48 h after surgery. Nursing staff should closely observe the patient's body temperature, wound healing, and patient complaints to ensure timely detection and treatment of potential problems [55]. The detectable bacteria and corresponding antibiotics after the extraction of impacted teeth are listed in Table 6.

Table 6. Common bacteria after impacted tooth surgery.

Name	Classification	Treatment Plan
Porphyromonas gingivalis	Gram-negative anaerobic bacteria	Tetracycline, chlorhexidine, and Metronidazole, etc.
Bacteroides fragilis	Gram-negative anaerobic bacteria	Metronidazole, carbapenems, etc.
Staphylococcus aureus	Gram-positive bacteria	Penicillins, erythromycin, lincomycin, etc.
Streptococcus	Gram-positive bacteria	Penicillin G, macrolides, first-generation cephalosporins, and lincomycin, etc.
Escherichia coli	Gram-negative bacteria	Gentamicin, third-generation cephalosporins, piperacillin, and aminoglycosides, etc.
Pseudomonas aeruginosa	Gram-negative bacteria	Gentamicin, Pseudomonas Penicillins, and Polymyxin, etc.

4.2. Management of Bleeding

Bleeding after impacted tooth surgery is often caused by local or systemic factors [56]. For bleeding caused by local reasons such as residual granulation tissue, soft tissue tear, and alveolar vascular rupture, scraping and suturing methods can be used to relieve it [57]. For extensive bleeding, a sponge can be placed in the extraction socket and combined with a gauze roll to compress and stop bleeding [58]. For patients with bleeding caused by systemic factors such as coagulation dysfunction, treatment of local bleeding must be combined with systemic factors, and blood transfusion may be necessary if necessary [59].

4.3. Assessment and Management of Nerve Injury

The anatomical location of impacted teeth is often close to the inferior alveolar nerve, which increases the risk of nerve damage during their extraction surgery [60]. The growth direction, position, and relative relationship with the inferior alveolar nerve of the mandibular third molar are important anatomical factors that affect surgical safety. Research has shown that the root morphology of the third molar and its distance from the nerve are important predictors of nerve injury [61,62]. In addition, individual anatomical differences, such as the morphology of the jawbone, the thickness of the alveolar bone, and changes in the course of nerves, may increase the risk of nerve damage during surgery [63,64]. Therefore, conducting a detailed imaging assessment before surgery, especially CBCT, can better identify potential anatomical risks and help surgeons develop safer surgical plans. If nerve damage occurs, edema reducing drugs such as dexamethasone and nutritional nerve drugs such as vitamin B12 can be used.

5. Postoperative Management and Patient Rehabilitation

Postoperative management and patient rehabilitation are important links in ensuring surgical success and patient quality of life. Through scientific management and effective rehabilitation measures, the recovery speed of patients can be significantly improved and the occurrence of complications can be reduced.

5.1. Pain Management Strategies

In impacted tooth surgery, nerve damage and inflammatory response are the main physiological mechanisms leading to postoperative pain. During the surgical process, especially in the extraction of mandibular wisdom teeth, damage to the inferior alveolar nerve is often caused, which may lead to postoperative pain, numbness, and other sensory abnormalities. In addition, the occurrence of inflammatory reactions after surgery can also exacerbate pain. Inflammatory cells gather at the site of injury and release various pro-inflammatory factors, such as cytokines and prostaglandins, which can enhance pain sensitivity and exacerbate pain sensation [65,66]. Therefore, interventions targeting nerve damage and inflammatory response may help alleviate postoperative pain and improve patient comfort.

The classification of postoperative pain in impacted teeth surgery usually includes acute pain and chronic pain. Acute pain is a common phenomenon after surgery, usually reaching its peak within a few days after surgery and gradually decreasing thereafter. Chronic pain refers to pain that persists for more than three months after surgery, which may be related to nerve damage or chronic inflammation [67]. The assessment of postoperative pain typically employs various methods, including self-report, visual analog scale (VAS), and facial expression score [68]. Subsequently, a personalized pain management plan was developed using the above methods, and the specific treatment strategies are shown in Figure 4.

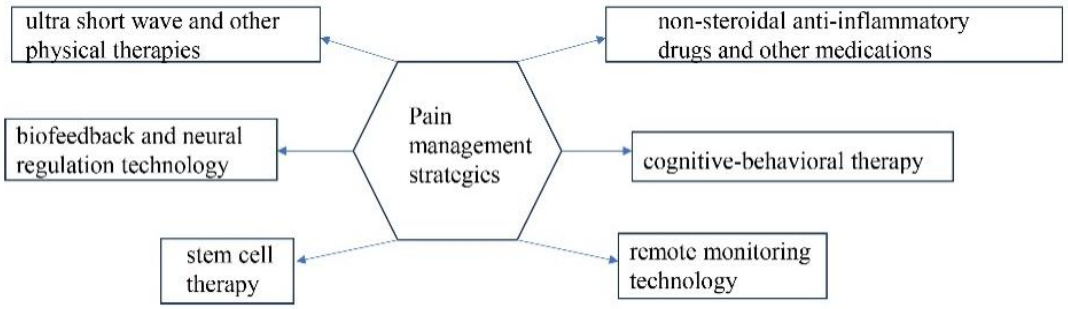

Figure 4. Pain management strategies after impacted tooth surgery.

5.2. Guidance on Diet and Lifestyle

Postoperative care is equally crucial in obstructed tooth surgery, especially in terms of the impact of diet and lifestyle. Improper postoperative care may lead to the occurrence of postoperative complications, thereby affecting the recovery effect [69]. Research shows that appropriate dietary adjustments and lifestyle improvements can promote wound healing, reduce pain, and lower the risk of infection [70].

Generally speaking, eating can only be done 2 h after surgery. It is recommended that patients choose light liquid or semi liquid food after surgery, such as rice soup, congee, fruit juice, etc. These foods are not only easy to digest and absorb, but also effectively supplement water and nutrients, helping to maintain normal metabolism and restore function of the body [71]. As the patient recovers, soft foods such as steamed eggs can be gradually introduced within 48 h after surgery. Within 72 h to one week after surgery, if the patient does not experience any significant discomfort, they can gradually return to a normal diet [72]. However, it is still important to pay attention to food choices and avoid greasy and irritating foods to prevent oral bleeding and inflammatory reactions. In the early stages after suture removal, the patient's nutritional needs significantly increase. Diet should reasonably increase the intake of high-quality protein and trace elements [73].

Postoperative oral hygiene is an important step in ensuring patient recovery and preventing complications. Generally, mouthwash can be performed 24 h after surgery. Research has shown that antibacterial mouthwash containing chlorhexidine can effectively reduce the number of bacteria in the mouth, thereby reducing the risk of gingivitis and other oral infections [74]. However, in clinical application, attention should be paid to the frequency and concentration of antibacterial mouthwash to avoid adverse effects on the oral microbiota [75]. In addition, patients may be advised to temporarily avoid brushing their teeth 24 h after surgery to prevent irritation or bleeding to the wound. At this point, nursing staff should provide alternative oral cleaning methods, such as gently wiping the mouth with wet gauze or using specialized oral cleaning products [76].

5.3. The Importance of Regular Follow-up

Regular follow-up is an indispensable part of postoperative management for obstructed teeth, which can help doctors detect and treat potential complications in a timely manner. Research shows that regular follow-up can significantly improve patient compliance and satisfaction, and reduce the risk of oral infections and bleeding [77]. Through follow-up, medical staff can monitor the progress of patients' recovery, adjust treatment plans, and ensure that patients receive sufficient support and guidance during the rehabilitation process. At the same time, follow-up can also provide psychological support to help patients cope with postoperative anxiety and depression [78].

6. New Technologies and Future Directions

Despite the continuous advancement of technology in the extraction of impacted teeth, there are still some limitations. For example, some complex impacted teeth may require more complex surgical techniques, increasing the risk of surgery and recovery time. In addition, patients' concerns about pain and complications after tooth extraction often lead them to hold a reserved attitude towards the surgery. In order to meet the needs of patients, the dental field is exploring more advanced technologies such as digital guided surgery and robot assisted tooth extraction [79]. The application of these new technologies aims to reduce the invasiveness of surgery, improve patient comfort and satisfaction [80].

Minimally invasive surgical technique is a method of surgery performed through small incisions or natural cavities, which significantly reduces postoperative pain and swelling in the treatment of impacted teeth and shortens the patient's recovery time. Laser technology is a highly concentrated beam generated by the principle of stimulated radiation, which mainly includes carbon dioxide (CO2) laser, helium neon (He Ne) laser, erbium laser (Er: YAG), neodymium laser (Nd: YAG), etc. Laser technology can reduce bleeding, lower postoperative pain, and accelerate the healing process during the extraction of impacted teeth. The combination of computer-aided design (CAD) and 3D printing technology has been a hot topic in the treatment of oral diseases in recent years. It usually uses computer-aided design (CAD) software for modeling, then decomposes the model into multiple layers of data through slicing software, and finally uses a printer to stack the materials layer by layer to form the final product. The difficulty of impacted tooth surgery is often increased due to the complex position of the impacted tooth, and this technology has broad application prospects in this field. Obtaining oral structural data of patients through imaging techniques such as CT or MRI, and using this technology to create personalized surgical guides or models, can significantly improve the accuracy and safety of surgery. The advantages and disadvantages of the above three cutting-edge technologies are presented in Table 7.

Table 7. Advantages and disadvantages of new technologies.

New Technology	Advantage	Disadvantage
Minimally Invasive Surgery	Less trauma, faster recovery, and fewer complications	The complexity of technology, high requirements for surgeon skills, and high equipment costs
Laser technology	Reduce bleeding, lower postoperative pain, accelerate healing process, and maximize preservation of surrounding healthy tissue	High cost and equipment requirements, prolonged overall recovery of patients due to thermal damage caused by lasers, and inability to accurately handle complex cases
Computer aided design (CAD) combined with 3D printing technology	Personalized surgical guides or models can improve the accuracy and safety of surgery. And the material utilization rate is high and the production cycle is short	The material compatibility and mechanical properties have not met the requirements for clinical application, and the printing accuracy and surface smoothness may also be lacking

6.1. Integration of New Technologies and Multidisciplinary Collaboration

With the continuous advancement of medical technology, the importance of interdisciplinary cooperation in the medical field has become increasingly prominent, especially in complex surgeries and treatments. For example, in the extraction of impacted teeth, close cooperation between dentists, anesthesiologists, and nursing staff can optimize the surgical process and reduce the incidence of complications [81]. In addition, with the development of digital health technology, the integration of electronic health records and remote healthcare has provided a new platform for interdisciplinary cooperation, enabling medical teams to share information more efficiently and improve the accuracy and timeliness of decision-making [82]. In the future, with the continuous evolution of medical technology, interdisciplinary collaboration models will become more common, promoting the development of personalized and precision medicine [83].

6.2. Potential Application of Artificial Intelligence in the Extraction of Impacted Teeth

The application prospects of artificial intelligence (AI) technology in the medical field are broad, especially in the extraction of impacted teeth. AI can help doctors evaluate surgical risks and develop personalized treatment plans through data analysis and predictive models. For example, using 3D AI driven models for mandibular nerve injury risk assessment can significantly improve the safety and success rate of surgery [84]. In addition, AI can also play an important role in preoperative image analysis, intraoperative navigation, and postoperative monitoring, helping doctors make more accurate decisions through real-time data analysis [85]. In the future, with the continuous maturity of AI technology, its application in dental surgery will become more widespread, which may completely change traditional surgical methods and patient management models.

6.3. Exploration and Practice of Individualized Treatment for Patients

Individualized treatment is an important trend in the development of modern medicine, especially in the field of dentistry, where customized treatment plans tailored to each patient's specific situation are particularly important. By comprehensively analyzing the patient's genetic information, lifestyle, and medical history, the medical team can develop more effective treatment strategies [86]. For example, the development of individualized anesthesia plans can not only improve patient comfort, but also reduce the risk of postoperative complications. In the future, the exploration of personalized treatment will continuously promote the progress of medical practice, enabling patients to obtain better treatment experience and results.

7. Conclusions

We conducted an in-depth analysis of the multidimensional influencing factors of surgery. Firstly, the importance of preoperative evaluation cannot be ignored. Through comprehensive clinical evaluation, potential risks and complications can be effectively identified, providing scientific basis for the development of surgical plans.

Secondly, the choice of surgical technique also has a direct impact on the outcome, and personalized selection should be made based on the specific situation of the patient in order to minimize postoperative complications and discomfort. In addition, postoperative management is equally indispensable. Scientific postoperative care and rehabilitation guidance can effectively reduce the incidence of complications and improve patient satisfaction after surgery.

It is worth noting that with the continuous advancement of medical technology, the clinical management of obstructed tooth extraction surgery is developing towards personalization and efficiency. The application of emerging technologies such as minimally invasive surgery and 3D printing technology makes the surgical process more precise, with less trauma and faster recovery.

However, we need to maintain a balance between different research perspectives and findings. Although some studies emphasize the importance of preoperative evaluation, while others focus on the impact of postoperative management, the two are not opposing but complementary. Future research should focus more on comprehensive clinical pathways in order to achieve better clinical outcomes and patient satisfaction.

In summary, the success of impacted tooth extraction surgery depends not only on a single factor, but also on the combined effects of multiple factors. Through scientific evaluation, rational technology selection, and effective postoperative management, we are expected to make greater breakthroughs in this field in the future.

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Author Contributions

J.L. was responsible for writing and reviewing the outline of the paper. Y.L., F.Z. and Q.Z. were responsible for writing the paper. R.W. was responsible for providing imaging images. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

All imaging data have been approved by the Ethics Review Committee of Huludao Central Hospital (KY202422). All patients signed informed consent forms.

Informed Consent Statement

Not applicable.

Data Availability Statement

This article documents all creative contributions of this study. If further inquiries are needed, you can directly contact the corresponding author.

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Conflicts of Interest

The authors clearly state that there are no conflicts of interest.

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