Clinical Research Progress on Extraction Techniques and Methods for Impacted Lower Third Molars

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Abstract: With the evolution of humans, as well as changes in diet and living conditions, impacted lower third molars (ILTM) have become increasingly common. The presence of ILTM can bring many potential risks to the human body, such as deep distal periodontal pockets, osteomyelitis, and other conditions that affect the patient's health and quality of life. Therefore, early extraction treatment is necessary for ILTM patients to reduce these adverse effects. However, due to the special positioning of the molar, the surgical difficulty is high, the risks are greater, and complications are more frequent, which must be given due attention. Thus, there is a continuous need to explore new extraction techniques and methods to promote bone tissue healing. In light of this, the author summarizes the extraction techniques and methods for impacted lower third molars as studied by various scholars in recent years and provides the following review.

***Keywords*:** impacted lower third molar; extraction techniques; methods; clinical research progress

1. Introduction

Impacted teeth are a common condition in oral and maxillofacial surgery, resulting from the mismatch between bone volume and tooth size, with the lower third molar being the most frequent. This condition is related to genetic factors, dietary structure, and other aspects. Some scholars have stated that [1] if ILTM is not treated promptly, it can lead to complications such as pulp necrosis, which can adversely affect chewing function, periodontal health, and more. Extraction techniques for ILTM require high skill, as they often involve wide flap elevation, bone removal, and have a complicated relationship with neurovascular structures, which may result in severe postoperative complications, such as pain, infection, and nerve damage [2]. Additionally, due to the specific nature of ILTM, traditional extraction methods may lead to deep distal periodontal pockets (PD) that do not heal for a long time and tend to recur, thus increasing the difficulty of clinical treatment [3]. With the advancement of modern tooth extraction techniques, various novel extraction methods have been introduced. This review summarizes several improved techniques for ILTM extraction, aiming to provide a reference for clinical practice.

2. Extraction Techniques

2.1 Improvement of Tooth Sectioning Methods

2.1.1 Crown Amputation Extraction

Due to the close relationship between ILTM and the inferior alveolar nerve canal, ILTM may cause inferior alveolar nerve injury (IANI) [4]. Crown amputation can be used for ILTM that compresses the inferior alveolar nerve canal [5]. The procedure involves first removing the crown of the ILTM while temporarily preserving the tooth root. Then, orthodontic traction or other methods are used to create a sufficient distance between the tooth root and the nerve, followed by a secondary root extraction. Lu Zhou et al. [6] stated that crown amputation can remove mesial bone resistance and adjacent tooth resistance, thereby reducing the occurrence of related complications. Liu Jianwei et al. [7] found that the T-shaped crown amputation method also offers advantages such as shorter extraction time and less damage to the alveolar socket. However, since the tooth root moves slowly, it is difficult to achieve an ideal prognosis. Additionally, patients undergoing crown amputation are more likely to experience postoperative pain, infection, and other related issues. Wu Xingchen et al. [8] pointed out that when performing crown amputation, it is necessary to consider whether the resistance removal is sufficient and whether the protection of the inferior alveolar nerve canal is adequate. However, whether the pulp is exposed after crown amputation has no significant impact on wound healing. Therefore, before performing crown amputation on a patient, the advantages and potential risks should be comprehensively considered to ensure the treatment's specificity.

2.1.2 "Root Extraction" Method

Since ILTM is generally located deep in the alveolar bone, typically below the advancing lower alveolar bone, separating the crown of the tooth during extraction often faces certain resistances, such as bone resistance, which can lead to issues like prolonged surgical time and difficulty in crown displacement. Therefore, performing the "root extraction" method before attempting other techniques can help alleviate bone resistance. Zhang Shuyin [9] compared the effects of the "root extraction" method versus the "crown extraction" method, and concluded that the "root extraction" method shortens surgical time and reduces the incidence of adjacent tooth damage. This is because the "root extraction" method retains part of the bone wall, which helps in the healing and regeneration of the alveolar bone and promotes gingival reattachment, ensuring periodontal health and reducing complications. Furthermore, due to the complex relationship between ILTM and the inferior alveolar nerve, performing a window approach can reduce bone resistance and make root displacement easier, thus minimizing injury to the inferior alveolar nerve. With traditional extraction methods, it is difficult to prevent damage to adjacent tooth roots when displacing the crown first. In contrast, with the "root extraction" method, the tooth root is displaced first, and the crown displaces toward the distal alveolar bone, which helps reduce damage to the periodontal tissue of adjacent teeth.

2.2 Improvement of Flap Techniques

2.2.1 Envelope Flap and Triangular Flap

The first step in performing an ILTM extraction is to incise and reflect the mucoperiosteal flap to expose the extraction site. Some scholars have noted that when designing the mucoperiosteal flap, it can cause damage to the periodontal tissue of adjacent teeth to some extent. Ou Mingming [10] stated that, compared with the triangular flap, the envelope flap causes more damage but can shorten the surgical time and reduce postoperative pain and swelling.

2.2.2 Modified Skin Flap

The modified skin flap is an improvement on the envelope and triangular flaps. It involves moving the flap 1-2 mm up or down to maintain the integrity of adjacent teeth, effectively reducing the occurrence of periodontal complications. In ILTM extraction, the use of the modified skin flap can significantly reduce the incidence of distal periodontal lesions. Moreover, the modified skin flap and standard skin flap show some similarity in terms of preoperative and postoperative gingival index and plaque index. The reason for this is that plaque accumulation is not related to the incision difference but is related to the preservation of the gingival margin around adjacent teeth.

2.3 Bone Grafting Technique

Bone grafting technique involves removing a bone flap from the surgical site. During the surgery, the bone flap is lifted to expose the affected area, and after the procedure, the bone flap is repositioned to provide a good surgical pathway and visibility while avoiding extensive resection of the alveolar bone and preventing bone defects. To ensure the stability of bone flap repositioning, internal fixation can be applied, such as through the use of percutaneous screws. In addition, with the aid of ultrasonic bone knives and good intraoperative visibility, bone grafting technique can avoid serious bleeding and early infections, thus reducing postoperative complications and leading to a milder reaction, making it more acceptable to patients. Yi Chen et al. [11] stated that the bone grafting technique can reduce postoperative bone tissue defects, minimize complications, and promote bone tissue recovery, making it an ideal choice for the extraction of lower jaw teeth with a low-positioned bony impaction. However, bone grafting also has limitations, such as the need for skilled surgeons and the necessity for precise bone removal.

2.4 Suturing Techniques

As the final step in ILTM extraction, suturing aids in wound healing [12]. Different suturing techniques can have varying effects on periodontal tissue [13]. In general, the surgeon's first choice is intermittent suturing. Both "8-shaped" suturing and anchoring suturing can maintain periodontal health and reduce postoperative periodontal issues associated with ILTM extractions. Specifically, "8-shaped" suturing and anchoring suturing can form a barrier to prevent food impaction, create a favorable environment, and promote periodontal tissue regeneration and repair. Compared to intermittent suturing, "8-shaped" and anchoring suturing offer better outcomes in ILTM extractions, with a more definite effect on periodontal tissue healing, thus reducing the occurrence of related periodontal problems.

3. Improvement of Surgical Instruments

3.1 Combined Use of Ultrasonic Bone Knife and Dental Micro-Driven System

The ultrasonic bone knife can precisely cut hard tissue with minimal soft tissue damage, resulting in fewer postoperative adverse reactions such as pain, and it almost does not affect bone tissue healing [14]. After improving the ultrasonic bone knife, using a 45° pneumatic cutting handpiece can release gas from the head and disperse it in all directions without spraying in the surgical area, which helps prevent subcutaneous hematomas. However, it has a poor effect on bone tissue retention, making it difficult to achieve ideal bone tissue healing outcomes [15]. In the past, clinicians commonly used the ultrasonic bone knife in combination with high-speed turbines. Gui Chang [16] stated that the use of high-speed turbine drills in minimally invasive tooth extraction was effective in reducing pain, improving mouth-opening restrictions, and reducing complications. However, with the development of clinical research, the combined use of the ultrasonic bone knife and high-speed turbine drill has become outdated. The ultrasonic bone knife combined with the dental micro-driven system has now started to be used clinically. The dental micro-driven system consists of a shell, rotor, end cap, and other components. When the diameter of the dental drill shell remains unchanged, it can effectively utilize the overall space of the dental motor, significantly improving the rotational speed and work efficiency, thus shortening the surgical time. Moreover, the dental micro-driven system can provide auxiliary lighting, addressing the issue of insufficient light with high-speed turbines, shortening surgical time, and improving patient satisfaction. Some scholars [17] have stated that the combined use of the ultrasonic bone knife and dental micro-driven system yields good outcomes, high safety, short surgical time, and improves the patient's psychological state, with reduced postoperative pain, swelling, mouth-opening restrictions, and lower incidence of complications. The combination of these two systems allows for complementary advantages, compensating for each other's shortcomings and reducing the occurrence of adverse reactions such as soft tissue damage and joint discomfort, ultimately facilitating early patient recovery.

3.2 Painless Anesthesia Devices

In recent years, with the development of society, there has been an increasing emphasis on comfortable dental treatments. Traditionally, anesthesia for patients could cause pain due to punctures, and pain from flow rate pressure was another major issue. This led to the development of the C-CLADS. With the research and development of various anesthesia systems, painless anesthesia devices have been introduced and are now widely used in clinical practice, gradually being incorporated into dental injection techniques. The painless anesthesia device for single-tooth anesthesia, namely C-CLADS, consists of the main unit, foot pedal with tubing, and other components, with its core component being the automatic precision-controlled plunger. The painless device can adjust the working mode and injection speed according to specific needs, with subperiosteal, submucosal, and soft tissue anesthesia requiring adjustments in modes such as STA, Normal, and Turbo. Currently, painless anesthesia devices are widely used in the dental field. Guan Zeren et al. [18] stated that using a painless dental anesthesia device in conjunction with the ultrasonic bone knife improves intraoperative cooperation, reduces postoperative swelling and pain, and aids in the smooth completion of tooth extractions.

3.3 Surgical Scalpels

In ILTM extraction surgery, the use of traditional scalpels and electrocautery often increases blood loss and induces heat damage and other related side effects. In recent years, with deeper research into lasers, it has been found that hard lasers have distinct advantages when cutting gingival tissue. This is because lasers not only have a minimally invasive effect but also possess anti-inflammatory and antibacterial properties, with excellent hemostatic effects. Nd:YAG lasers, with a wavelength of 1064 nm, have a strong absorption capacity for hemoglobin, making them effective for hemostasis [19]. Additionally, Nd:YAG lasers enhance the surgical field of view, reducing the difficulty of the procedure. Furthermore, Nd:YAG lasers have enhanced bactericidal effects, thus reducing the risk of incision infections. Er:YAG lasers, with a wavelength of 2940 nm, have a weaker tissue penetration ability, resulting in cleaner-cut wounds with less heat damage [20].

4. Summary

With the deepening research on ILTM extraction methods and the advancement of technology, traditional tooth extraction techniques have been replaced by various new technologies, which help improve patient treatment and prognosis, laying the foundation for precise and individualized treatment. However, at present, ILTM extraction techniques are still limited in clinical application due to various influencing factors. Related research is still in the developmental stage, and further in-depth studies are needed to explore more minimally invasive, efficient, and safe treatment plans. These efforts will provide reference for clinical diagnosis and treatment, allowing patients to benefit fully.

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References

[1] Zhang Guangye, Xiong Jiwen, Yang Shiyi, et al. Application of concentrated growth factor in promoting wound healing and postoperative response after the extraction of mandibular impacted third molars [J]. Journal of Oral and Maxillofacial Surgery, 2024, 34(4):295-299.
[2] Yang Qingran, Xu Guangzhou. Natural course and impact on adjacent second molars after extraction of mandibular impacted third molars [J]. Chinese Journal of Oral and Maxillofacial Surgery, 2024, 22(04):365-372.
[3] Wang Mengmeng, Ma Yufeng. Application and current research on lasers in the extraction of impacted third molars [J]. Chinese Journal of Practical Oral Medicine, 2022, 15(05):625-628+633.
[4] Wu Yingfei, Huang Liao, Wen Shengtai, et al. Study on different methods of extracting mandibular impacted third molars and preventing inferior alveolar nerve injury [J]. Jilin Medical Journal, 2023, 44(07):1826-1829.
[5] Xu Li, Xiu Lijun, Zhu Guanglai. Comparative analysis of T-shaped crown sectioning method and three-segment method for extracting mesial or horizontally impacted mandibular third molars [J]. Chinese Journal of Clinical Medicine, 2023, 51(05):619-621.
[6] Lu Zhou, Lu Xufei, Zhao Yang, et al. Clinical effect comparison of three different crown sectioning methods for extracting mesial or horizontally impacted mandibular third molars [J]. Chinese Medical Journal, 2021, 56(09):1020-1023.
[7] Liu Jianwei, Wang Yifu, Wulijitu. Comparison of the effects of ultrasonic bone knife and horizontal T-shaped crown sectioning method in the extraction of horizontally impacted mandibular third molars [J]. Chinese Journal of Modern Medicine, 2023, 33(04):1-5.
[8] Wu Xingchen, Li Ying, Zhao Junjun. Application of crown-root stepwise removal method in the extraction of mandibular third molars potentially involving the inferior alveolar nerve [J]. Shanghai Journal of Oral Medicine, 2019, 28(01):85-88.
[9] Zhang Shuyin, Mo Jingzhen, Hu Kaijin. Comparison of two surgical methods for extracting horizontally impacted mandibular third molars [J]. Practical Oral Medicine Journal, 2023, 39(01):64-68.
[10] Ou Mingming, Zhao Yongchao, Li Guozheng, et al. Comparison of the effects of modified envelope flap and triangular flap in mandibular impacted third molar extraction surgery [J]. Clinical and Experimental Medicine Journal, 2024, 23(11):1226-1229.
[11] Yi Chen, Zhang Yadong, Dong Qian, et al. Efficacy observation of bone cover technique in extracting mandibular low-position bony impacted third molars [J]. Chinese Journal of Oral Medicine Research (Electronic Edition), 2023, 17(6):424-429.
[12] Li Xiufen, Yuan Wenwen, Li Shasha, et al. The effect of two gingival flap suturing techniques on the wound healing and postoperative complications in mandibular impacted third molar extraction [J]. Modern Practical Medicine, 2020, 32(12):1494-1496.
[13] Zhang Huihui. Observation of the efficacy of a new minimally invasive aesthetic gingival suturing technique in anterior crown lengthening surgery [J]. Journal of Oral Medicine Research, 2019, 35(2):147-150.
[14] Chen Dan, He Xiaoling, Tang Kunlun. Clinical efficacy of cone beam CT combined with ultrasonic bone knife in the treatment of pediatric maxillary impacted supernumerary teeth [J]. Clinical and Experimental Medicine Journal, 2024, 23(5):536-539.
[15] Cui Yanjun, Liu Xin, Xu Baojun. Comparison of the clinical effects of two micro-driven systems in the extraction of mandibular impacted teeth [J]. General Dentistry Electronic Journal, 2018, 5(33):73-75.
[16] Gui Chang. Clinical effect analysis of minimally invasive tooth extraction using high-speed turbine drills for mandibular impacted third molars [J]. Chinese Community Doctor, 2024, 40(34):52-54.
[17] Wang Q, Zhang T. Application of an ultrasonic bone knife combined with a dental electric motor in the extraction of mandibular middle and low impacted teeth. BMC Oral Health. 2024 Jan 4;24(1):18.
[18] Guan Zeren, Li Shuting, Liang Guojian, et al. Clinical application of painless dental anesthesia device combined with ultrasonic bone knife in third molar bud extraction surgery [J]. Guangdong Medical Journal, 2020, 41(10):1079-1081.
[19] Zhu Xiaoru, Pang Jianliang, Liu Bing, et al. Clinical efficacy analysis of Nd:YAG and Er:YAG lasers in adjunctive

treatment of chronic periodontitis with type 2 diabetes [J]. Practical Oral Medicine Journal, 2024, 40(3):430-433.
[20] Sun Shaoshan, Li Yang, Wang Hao. Er:YAG laser treatment of aggressive periodontitis and its effect on gingival Porphyromonas gingivalis [J]. Chinese Journal of Laser Medicine, 2023, 32(6):331-336.