Piezosurgery for the Lingual Split Technique in Lingual Positioned Impacted Mandibular Third Molar Removal

A Retrospective Study

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Abstract: The aim of this study was to evaluate the effect and safety of lingual split technique using piezosurgery for the extraction of lingual positioned impacted mandibular 3rd molars with the goal of proposing a more minimally invasive choice for this common surgery. Eighty-nine consecutive patients with 110 lingual positioned impacted mandibular 3rd molars requiring extraction were performed the lingual split technique using piezosurgery. One sagittal osteotomy line and 2 transverse osteotomy lines were designed for lingual and occlusal bone removal. The success rate, operative time, postoperative outcome, and major complications (including nerve injury, mandible fracture, severe hematoma or edema, and severe pyogenic infection) were documented and analyzed.

All impacted mandibular 3rd molars were successfully removed (110/110). The average time of operation was 14.6 minutes (ranged from 7 to 28 minutes). One hundred and seven extraction sites (97.3%) were primary healing. Pain, mouth opening, swelling, and PoSSe scores on postoperative 7-day were 0.34/C6, 2.4 ± 0.2 cm), and 23.7 ± 5.9, respectively. There were 6 cases (5.5%) had lingual nerve disturbance and 3 cases (2.7%) developed inferior alveolar nerve impairment, and achieved full recovery within 2 months by neurotrophic drug treatment.

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2015. To be included in the study sample, patients must have at least 1 mandibular 3rd molar which is classified as lingual position\(^6\) (the impacted tooth is located at the lingual side of the mandible body, according to buccal-lingual classification) and level C impaction pattern\(^7\) (the impacted tooth is below the cervical line of the adjacent 2nd molar, according to Pell-Gregory classification) (Figure 1).

Patients were excluded as study subjects if they had a history of uncontrolled diabetes, blood dyscrasias, alcoholism, drug abuse and heavy smoking, or if they had acute infections such as pericoronitis, acute alveolar abscess, or oral submucous fibrosis at the time of operation.

**Study Variables**

The predictor variable was the extraction technique. All patients were informed about the procedure, the post-operative recovery time, possible complications, and signed a detailed consent form. After a detailed medical and dental history was obtained, orthopantomogram and cone-beam computed tomography (CBCT) of the site were taken, and treatment started. The retrospective study followed the tenets of the Declaration of Helsinki for research involving human subjects, informed consent was obtained from all participants, and the study was critically reviewed and approved by the institutional review board of the Ninth People’s Hospital (Shanghai, China).

The methods were carried out in accordance with the approved guidelines of MEDICINE.

**Surgical Procedure**

All patients were operated by the same surgeon under local anesthesia with 2% lidocaine. A mouth prop was put into the patient’s mouth on the other side to ensure the mandible was adequately supported. The flap involved a sulcular incision from the mesial aspect of the 2nd mandibular molar and a distal relieving incision along the external oblique ridge to the anterior border of the ramus.\(^8\) For fully impacted teeth, the incision was extended to the 1st molar for greater access. After a full thickness flap was elevated, a piezosurgical device (Silfradent, Italy) was used to cut a precisely defined bony window. Cutting of bone and tooth was continuously accompanied by copious irrigation with chilled saline solution. When cutting and loosening of the alveolar bone, a curved periosteal elevator was placed on the lingual bone to improve exposure of the surgical field, to protect the lingual nerve, and to prevent the 3rd molar slipping accidentally into the lingual soft tissue\(^4\) (Figure 2). After the alveolar bone was removed by a periosteal detacher, the tooth was exposed and delivered in distolingual direction by inserting a straight elevator (Figure 3). No drainage was adopted in any cases. The extraction socket was debrided and filled with colloidal silver (Gelatamp, Germany). All extraction sockets

**FIGURE 1.** Cone-beam computed tomography (CBCT) image of axial view, paraxial view, and sagittal view of a lingual positioned fully impacted mandibular 3rd molar.
were closed by interrupted 4/0 absorbable silk (Covidien, US) sutures.

The osteotomy line was designed in the following pattern: 1 oblique sagittal line was made just parallel with the lateral side of the 3rd molar, stretching from the molar’s mesial point to distal point (Figure 4); 2 transverse lines, including the mesial one and the distal one, were made from the oblique sagittal line to the lingual plate (Figure 5). There is no sagittal osteotomy line on the lingual plate in this technique, the lingual plate would break at its weakest point where the 3rd molar is nearest to the lingual cortex bone. During the procedure, gentle irrigation within the osteotomy permitted visualization of the lingual nerve (Figure 6).

Outcome Variables and Their Assessment

The primary outcome variables were success rate, operating time (from the 1st incision to the last suture), and the incidence of major complications. The secondary outcome variables were pain, swelling, restricted mouth opening, and the postoperative symptom severity (PoSSe) score at the postoperative 7-day. Major complications include mandibular 2nd molar injury, permanent sensory impairment of lingual and inferior alveolar nerve (IAN), tooth pieces slipping into pterygomandibular space, mandibular fracture, temporomandibular joint injury, excessive hemorrhage, severe pharyngeal space swelling, and severe pyogenic infection. Sensory deficit lasting longer than 6 months is deemed to be permanent.

Patients were recalled on postoperative 7-day and examined for wound healing, nerve function, postoperative assessment, and major postoperative complications. Potential neurosensory disturbances of the lip, chin, and tongue were assessed before surgery and the postoperative 1 week recall, additional examinations were made at 1, 3, and 6 months postoperatively if any alteration of the sensation was noted. The postoperative outcome assessment included evaluation of pain, trismus, swelling, and the PoSSe score at recall 7-day. Pain was assessed with a visual analog scale of 10 units in combination with a graphic rating scale. On the visual analog scale, the leftmost end represented absence of pain (score of 0) and the rightmost end indicated the most severe pain (score of 10). Trismus was evaluated by measuring the interincisal distance at maximum mouth opening (cm) with a ruler. The preoperative measurement was the baseline value. Swelling was measured using standard calipers from the lingual aspect of the crown of the mandibular 1st molar to the tangent of the skin of the cheek, according to previous studies. Patient also completes the PoSSe scale at postoperative 7-day. This questionnaire was designed to assess the patient’s perception of adverse effects in 7 subscales: eating, speech, sensation, appearance, pain, sickness, and interference with daily activities. A score was assigned to the possible responses to each forced question. The scores of the responses to each question were summed. The outcome variables would be compared with data from previously published studies to evaluate the effect and safety of the lingual split technique using piezosurgery.

The demographic data included age, gender, and anatomic position of wisdom tooth. Anatomic position of wisdom tooth was assessed regarding to the following items: the status of eruption, the relationship with ramus, and the relationship with mandibular canal (MC). Data Analysis

Data were entered into a spreadsheet (Excel; Microsoft Inc, Redmond, WA) over the course of the study and analyzed using a statistical software package (SPSS, version17.0, Chicago). Quantitative data were presented as mean ± SD. Paired t-test was used to compare patients’ mouth opening scores at baseline and 7-day postoperatively, and a value of $P \leq 0.05$ was considered statistically significant. Demographic data and parametric data (such as success rate, operative time, and major complication rate) were analyzed using descriptive statistics.

RESULTS

In total, 89 patients fulfilled the eligibility criteria and 110 surgeries were performed. There were 46 males and 43 females, aged from 22 to 56 years (mean age of 33.2 years). Sixty-two of the 3rd molars were on the right side and 48 of the 3rd molars on the left. Forty-seven molars (42.7%) were deeply impacted while 63 molars (57.3%) were fully impacted. According to Pell–Gregory classification, 50 molars (45.4%) were class 1, 41 molars (37.3%) were class 2, and 19 molars (17.3%) were class 3. With regard to the radiographical relationship between dental apices and MC, 25 molars (22.7%) were not contacting the MC,
47 molars (42.7%) were contacting the MC, and 38 molars (34.6%) were constricting or penetrating the MC.

All impacted mandibular 3rd molars were successfully removed, the success rate was 100%. The average time of operation was 14.6 minutes (ranged from 7 to 28 minutes). No major intraoperative complication occurred during the operation. There were 6 cases (5.5%) had lingual nerve disturbance and 3 cases (2.7%) developed IAN impairment on the
recall 7 days. Further reassessment showed that the 9 cases achieved full recovery within the 1st postoperative 2 months by neurotrophic drug treatment. A total of 107 sites (97.3%) were primary healing. Three cases (2.7%) developed postoperative infection, and recovered by draining and antibiotic administration within 1 week.

The demographic data, operation time, parameters evaluated preoperatively, and postoperatively are summarized and shown in the Table 1. The interincisal distance in this study was significantly reduced at postoperative 7-day. Table 1 also showed the relevant data of previous studies on bony impacted mandibular 3rd molar extraction performed by piezosurgery.

**DISCUSSION**

The purpose of this study was to describe lingual split technique using piezosurgery for the extraction of lingual positioned impacted mandibular 3rd molar. The authors hypothesized that the unique extraction technique can remove lingual positioned impacted mandibular 3rd molar successfully. The specific aim of the study was to evaluate its success rate, operative time, postoperative outcome, and incidence of major complication. The hypothesis that the lingual split technique using piezosurgery could be used to remove lingual positioned impacted mandibular 3rd molars was accepted.

In this study, the authors proposed lingual split technique using piezosurgery after reviewing their 2-year experience of clinical applications. The indications for this technique were lingual positioned and level C impacted mandibular 3rd molars. The results indicated that the lingual split technique using piezosurgery has high efficiency for lingual positioned mandibular 3rd molar’s extraction. Generally, the piezosurgery device was deemed less efficient than conventional saw.20,21 However, the mean time taken to complete the whole operation procedures was shorter than that of previous studies using piezoelectric osteotomy technique (Table 1), and even slightly shorter than that of previous studies using the conventional rotatory instruments.9,22–24 The occlusal and lingual resistant alveolar bone was removed adequately by this osteotomy method, thus allowed easier and faster tooth luxation and extraction in lingual direction, reduced the surgical difficulty (coronal sectioning or root sectioning) and saved operation time, and avoided adjacent second molar injury. As the buccal plate is much more thicker than lingual plate in the lingual positioned impacted mandibular 3rd molar,6 applying conventional buccal technique would cause larger surgical trauma and longer operation time than lingual osteotomy. Furthermore, buccal access could have put the lingual cortex at risk of fracture during tooth luxation, with higher risk of lingual nerve injury and tooth displacement. Finally, because less bone was removed compared with the buccal approach, a better healing process could be expected.

Our results revealed that lingual split technique using piezosurgery could minimize the drawbacks of conventional lingual split technique. Although lingual split technique has prominent advantages over conventional buccal approach, it was not wildly accepted because of the high incidence of

![Figure 6](image)

**FIGURE 6.** 3D reconstruction showed the relationship among inferior alveolar nerve, lingual nerve, and osteotomy line. (A) Lingual view: deep osteotomy should be avoided in case of inferior alveolar nerve injury. (B) Overlook: lingual nerve contacted the lingual plate of the third molar.

**TABLE 1.** Comparison Between Present Study and Previous Reports of 3rd Molar Extraction Performed by Piezosurgery on Postoperative Outcome Assessment

| Investigator | Present Study | Sortino et al17 2008 | Barone et al14 2010 | Goyal et al18 2012 | Piersanti et al12 2014 | Rullo et al19 2013 |
|--------------|--------------|---------------------|-------------------|-------------------|---------------------|-------------------|
| Patients     | 89           | 50                  | 13                | 20                | 10                  | 52                |
| Male, %      | 46(51.7%)    | 23 (46.0%)          | 7 (53.8%)         | 12 (60.0%)        | 4 (40.0%)           | 20 (38.5%)        |
| Female, %    | 43 (48.3%)   | 27 (54.0%)          | 6 (46.2%)         | 8 (40.0%)         | 6 (40.0%)           | 32 (61.5%)        |
| Age, year    | 33.2 ± 5.8   | 23.26 ± 6.62        | 32.2 ± 6.7        | 34.3 ± 7.4        | 29                  | 22.4 ± 2.3        |
| Operation time, minutes | 14.6 ± 6.4 | 22.92 ± 8.88 | 32.2 ± 6.7 | 45 ± 16 | 0.0 ± 0.7 | 36.8 ± 10.6 |
| Mouth opening preoperation | 4.24 ± 0.47 | 44.5 ± 3.9 | 4.75 ± 0.76 | 38.5 ± 3.7 | 4.48 ± 0.81 | 2.7 ± 0.2 |
| Swelling     | 2.4 ± 0.2    |                    |                   |                   |                     |                   |
hemorrhage and lingual nerve injury. The incidence of hemorrhage and temporary lingual nerve disturbance in this study were 0% and 5.5%, respectively, and no permanent lingual nerve injury was observed. A systematic review reported that temporary lingual nerve disturbance due to the lingual split technique was ranging between 6.64% and 19.80%, and for permanent disturbance between 0% and 1.02%. Unintended iatrogenic injury to the lingual nerve is due to its anatomical proximity, the nerve was found at the level of the alveolar crest or higher, horizontally contacted the lingual plate of the 3rd molar, separated from the cortex of the 3rd molar region only by the periosteum. The reasons of the lingual nerve damage during 3rd molar surgery include raising and retracting a lingual mucoperiosteal flap, lingual flap trauma during osteotomy or tooth sectioning, and lingual plate perforation and supra-crestal incision. Association of depth of impaction with lingual nerve damage was rare. To prevent postoperative hemorrhage, it is critical to raise and retract lingual flap and protect lingual nerve. The elevation of the lingual flap may be the most important surgical factor contributing to temporary lingual nerve disturbance in this study. The lingual nerve injured by retraction has a considerable potential for spontaneous recovery, so permanent nerve damage was rare. To prevent postoperative hemorrhage, it is also very important to infiltrate lidocaine with 1:10,000 epinephrine into the lingual soft tissue for the vaso-constrictive effect before making the incision and osteotomy.

The results of this study also demonstrated that lingual split technique might reduce the incidence of IAN injury. IAN injury can cause paresthesia to complete numbness and/or pain in the region of the skin of the mental area, the lower lip, mucous membranes, and the gingiva as far posteriorly as the 2nd premolar. Furthermore, IAN injury commonly interferes with speech, eating, kissing, make-up application, shaving, and drinking. The incidence of IAN damage has been reported as 1.2% to 5.5% of the lingual split technique, no statistically significant difference compare to the conventional buccal approach. IAN injury occurs in approximately 11% to 30% of the cases where a contact relationship is observed between the MC and the 3rd molar. Eighty-five (77.3%) molars had intimate relationship with MC in this study, while the relatively low rate of temporary nerve injury (2.7%) indicated that this technique might impose less trauma than conventional technique. The 3 cases in this study that developed temporary IAN injury might be due to their roots were penetrating into the MC. When performing the distal transverse osteotomy, the depth of the cutting tip should always be within the distance from the alveolar crest to the MC, which is estimated from the CBCT images. CBCT is indispensable for optimal risk assessment and adequate surgical planning as it provides a 3-dimensional view of the 3rd molar and the adjacent anatomical structures.

Our results concerning postoperative outcome (pain, trismus, swelling, and the PoSSe score) were comparable to those from other reports of mandibular 3rd molar extraction completed with piezosurgery (Tables 1 and 2). The short-term outcomes of 3rd molar operations differ depending on preoperative index of difficulty. According to the Parant scale, surgical difficulty of extraction need osteotomy is level II or higher. This study was homogeneous with other such studies in terms of surgical difficulty indicated that the lingual split technique would not increase patients’ discomfort. Furthermore, 5 subscales (eating, speech, appearance, pain, and interference with daily life) and total PoSSe score in this study were lower than those of previous studies using rotatory instruments (Table 2). This finding is consistent with a meta-analysis, which revealed patients undergoing piezosurgery have less swelling, less pain, and trismus. Noticeably, the score of sickness in this study was slightly higher than that of other studies (Table 2), which suggests lingual flap retraction and lingual plate osteotomy increase the trauma to the lingual soft tissue. All in all, the benefits of the lingual split technique using
piezosurgery overwhelmed its disadvantages as long as the indication was carefully selected.

The piezoelectric device was indispensable for the application of lingual split technique in this study. The conventional lingual split technique requires the operator have a very good tactile sense and take precautions to control the chisel and hammer, thus prevent the chisel from penetrating soft tissue. Piezosurgery, as a part of minimal invasive surgery, has prominent advantages over conventional osteotomy instruments, including precise cutting, soft tissue protection, and flexibility in complex anatomic areas. The lingual split technique in this study could not be executed effectively and safely without the piezosurgical device. Also, a great difference was observed in the recovery of bone tissues treated by bur and piezoelectric device, as bur induces degeneration of cellular elements along the edges with reduced vitality of osteoblasts and osteoclasts. This side effect was minor in the ones treated with scalpel or ultrasonic instrument techniques. This is due to the osteotomies were done with a relative low temperature, and marginal osteonecrosis was occurred as a result of thermal injury. In addition, the oscillating tip drives the irrigation solution and evacuates debris in the operating field, which allows the lingual split technique can be executed with better visibility and safety.

As a retrospective study, the limitation of potential referral bias cannot be overlooked: the conclusion drawn from its data compared with those in previously published articles is not adequate. A further research, designed as a prospective randomized controlled trial to compare the lingual split technique using piezoeosurgery and conventional buccal technique, may be a worthwhile exercise. In addition, the choice of the lingual route for surgical access should always be reached through a careful clinical and radiographic diagnosis in which all parameters are evaluated in relation to the morphology of the tooth, its location, and relationship with adjacent anatomical structures.

CONCLUSIONS

From the results of the study, it can be concluded that the lingual split technique using piezosurgery is an effective and minimally invasive approach for lingual positioned bony impacted mandibular third molars’ extraction. As lingual position type occupies the largest proportion in deeply or fully impacted mandibular third molars, this technique can be widely applied.

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