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# Comparison of a piezoelectric and a standard surgical handpiece in third molar surgery

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## Abstract

**Aim:** The aim was to compare the use of a piezoelectric handpiece versus a standard surgical handpiece in removal of impacted third molars under general anaesthesia.

**Materials and methods:** Thirty patients undergoing routine third molar removal were included in the study. Panoramic radiographs were used to assess the positioning of the impacted third molars. The patients were randomly subdivided and the split mouth technique was used in which each side (left or right) of the mouth was randomly assigned to two treatment groups. Hence each patient served as their own control. In one group, a piezoelectric handpiece was used, while a conventional handpiece was used for the second group.

All aspects of preoperative care, general anaesthesia, surgery and post-operative care were standardised for the two groups. The following parameters were recorded; time of surgery, bleeding during surgery, post-operative swelling, post-operative pain, associated complications and post-operative nerve injury.

**Results:** No statistically significant difference was found between the groups in terms of pain and swelling. There was less bleeding with the use of the piezoelectric device as compared with the standard surgical handpiece; however, the surgical time was longer. There were no reports of trauma to the lips or intra-oral soft tissue. There were two incidences (6.7%) of post-operative paraesthesia in the standard surgical handpiece group.

**Conclusions:** The use of a piezoelectric device is an acceptable alternative to the standard surgical handpiece in third molar surgery. Its use is advocated in difficult cases especially where there is inferior alveolar nerve approximation.

## Clinical relevance

### Scientific rationale for study

To compare piezoelectric handpiece with a standard surgical handpiece in removal of impacted third molars in terms of post-operative pain, swelling, bleeding and nerve injuries.

### Principal findings

Both modalities showed similar post-operative pain and swelling. Intraoperative bleeding was less in the piezoelectric device; however, the surgical time was longer. There was no post-operative paraesthesia in the piezoelectric group while 6.7% incidence in the standard handpiece group.

### Practical implications

Piezoelectric handpiece is best reserved for difficult and deeply impacted third molars with nerve approximation otherwise standard surgical handpiece remains the gold standard.

## Introduction

Impacted third molars are directly or indirectly the underlying cause of numerous disorders in the mouth, jaw and facial regions. According to Sortino *et al.*[1] impacted third molars in the mandible may have several consequences. These include pericoronitis and regional pain, abscess, trismus, distal caries and periodontal pocket of the second molar, development of follicular cysts and crowding of lower incisors[2]. As a result their removal is often necessary, and their surgical removal is the most frequently undertaken oral surgical procedure[3].

Some of the most frequent complaints following third molar surgery are pain and trismus[4]. Fisher *et al.*[5] in 1988, showed that trismus and swelling are closely associated with acute inflammation following third molar surgery. Inferior alveolar nerve injury is also a well-documented complication following third molar surgery[6]. Susarla and Dodson[7] stated that the percentage of nerve damage ranges from 1 to 22% and it has become a common cause of litigation. Several therapeutic protocols have thus been evaluated to support improvements in the post-operative period.

Piezoelectric surgery techniques have opened up a new age for osteotomy, osteoplasy and exodontia in maxillofacial and oral surgery. The micrometric cuts have maximum surgical precision and are selective, resulting in minimal damage to soft tissue. The cavitation effect provides maximum intraoperative visibility and a blood free surgical site.

Thus, the aim of this study was to compare the use of a piezoelectric (Surgybone®) device with the standard surgical handpiece, in third molar surgery, in an analytical prospective case series of selected patients undergoing routine third molar removal.

## Materials and methods

### Selection criteria

The study included 30 consecutive patients attending the Maxillofacial and Oral Surgery outpatient clinic at the Faculty of Dentistry, University of the Western Cape who were scheduled to undergo third molar removal under general anaesthesia. The study was registered and approved by the Senate Research Ethics committee at the University of the Western Cape. All patients gave written informed consent for the procedure and partaking in the study and received an information leaflet in their preferred language.

Selection criteria included that patients were 18 years of age and older, of any sex or race with four impacted third molars that were mirror images of each other (assessed by pantomographic radiographs). All surgical procedures were performed under general anaesthesia. Visually and mentally challenged patients, and those with haemostasis abnormalities and immune-compromised were excluded. Patients with third molar infections (pain and swelling) and those on antibiotics, non-steroid anti-inflammatory or herbal drugs were also excluded.

To determine whether there was any radiographic signs of a close relationship between the lower third molar and the mandibular canal the classification of Monaco *et al.*[8]

### Anaesthetic technique

An anaesthetic administered a standardised general anaesthesia procedure. Nasotracheal intubation was performed after intravenous induction with propofol, (2 mg/kg) and alcuronium, (0.3 mg/kg). General anaesthesia was maintained by isoflurane, nitrous oxide and 35% oxygen. Cardiac function was monitored with electrocardiography and the blood pressure was monitored by an intermittent automated sphygmomanometer. Respiratory function was monitored by capnography and pulse oximetry.

### Surgical procedure

The split mouth technique was used; therefore two impacted third molars (on one side) were removed using a conventional handpiece coupled to a surgical bur, and the other two (on the other side), a piezoelectric device in an analytical prospective case series. A flip of a coin determined which device was to be used for which side.

The surgical procedures were all performed by the same operator. An envelope mucoperiosteal flap was raised exposing the third molar. Bone was removed under constant sterile 0.9% saline irrigation on the buccal and distal aspect of the third molar with a number eight surgical burr in one group and a piezoelectric device (Surgybone®) using the SB P0610 –

120° sharp lance for extraction and removal of teeth, with prescribed settings *pwr ult* : 46(power), *vibra* :100 (frequency) and p045 (water), in the other group.

Crown amputation, root division was done with the respective devices in the two different groups. Tooth elevation as required was done with Warwick James or Coupland elevators. After removal of the tooth, the surgical field was meticulously rinsed with sterile 0.9% saline. The wound was closed by placing 3-0 interrupted chromic sutures.

### Post-operative care

All patients received the same pre- and post-operative medication. 1000 mg of paracetamol and 400 mg of ibuprofen, 6 hourly, was prescribed for pain and swelling. 500 mg of amoxicillin was given 8 hourly for 2 days as prophylaxis. 10–15 mL of chlorhexidine gluconate (0.2%) mouthwash was prescribed for 5 days to be used after meals.

### Parameters measured

Data capture sheets were used to record all patient information and all surgical parameters including the time of surgery in minutes from the start of incision to the end of suturing, bleeding intraoperatively by means of a verbal rating scale, swelling 24 h post-operatively by means of a verbal rating scale (Table 1), and pain 24 h post-operatively by means of a verbal rating scale (Table 2).

The presence of complications such as trauma to soft tissues intra-orally and lip were assessed at the end of surgery. The presence of paraesthesia was assessed 24 h post-operatively. Statistical analysis was performed by Theodata® using the Microsoft Excel® software package.

**Table 1** Verbal rating scale to evaluate swelling

| | | |
|---|---|---|
| 0 | No swelling | The patient does not detect the slightest swelling |
| 1 | Slight swelling | The patient detects a slight swelling but it is not very noticeable |
| 2 | Mild swelling | The swelling is noticeable but does not interfere with normal swallowing and mastication |
| 3 | Severe swelling | The swelling is evident and hinders normal mastication |
| 4 | Very severe swelling | The swelling is marked. Mastication is hindered but there is no reduction in mouth opening |
| 5 | Extremely severe swelling | The swelling is evident and mouth opening is reduced |

**Table 2** Verbal rating scale to evaluate pain

| | | |
|---|---|---|
| 0 | No pain | The patient feels well |
| 1 | Slight pain | If the patient is distracted, he or she does not feel the pain |
| 2 | Mild pain | The patient feels the pain even when concentrating on some activity |
| 3 | Severe pain | The patient is very disturbed but nonetheless can continue with normal activities |
| 4 | Very severe pain | The patient is forced to abandon normal activities |
| 5 | Extremely severe pain | The patient must abandon every type of activity and feels the need to lie down |

## Results

A total of 30 patients were operated with a total operating time of 805 minutes, averaging 26 minutes per case. The average time of surgery on the right was 13.33 min and on the left 13.5 min. A summary of the times taken on the respective sides using the piezoelectric device (Surgybone®) and drill is shown in Figure 1.

The average time taken to remove third molars with piezoelectric device was longer (14.97 min) compared to the drill coupled to handpiece (11.87 min). This finding was statistically significant ($P = 0.001$) with a sample standard deviation of 4.6338 with a sample mean of −3.1 (Table 3).

Pivot tables were used to evaluate swelling based on patient responses on a verbal rating scale 24 h post-operatively. It was noticed that using a drill coupled to handpiece caused more swelling post-operatively than when using piezoelectric device. This finding, however, was not statistically significant ($P = 0.1239$; significance = 0.2478).

Pivot tables were also used to evaluate pain based on patient responses on a verbal rating scale 24 h post-operatively. It was also noticed that using a drill

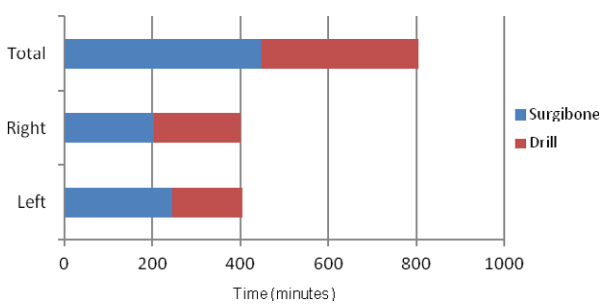


**Figure 1** Graph showing total time taken to remove third molars in 30 patients using piezoelectric device versus surgical handpiece on the left and right sides.

**Table 3** Time in minutes taken using piezoelectric device versus surgical handpiece per case

| Case no | Time for handpiece (min) | Time for piezoelectric device (min) |
|---|---|---|
| 1 | 5.5 | 6.5 |
| 2 | 7 | 15 |
| 3 | 8.5 | 12.5 |
| 4 | 12.5 | 11.5 |
| 5 | 6 | 10 |
| 6 | 7.5 | 5 |
| 7 | 15.5 | 23.5 |
| 8 | 13.5 | 25 |
| 9 | 16.5 | 32.5 |
| 10 | 5 | 10 |
| 11 | 8.5 | 7.5 |
| 12 | 19 | 15.5 |
| 13 | 11.5 | 16.5 |
| 14 | 28 | 31 |
| 15 | 14.5 | 23.5 |
| 16 | 8 | 14 |
| 17 | 7.5 | 6.5 |
| 18 | 9.5 | 7.5 |
| 19 | 10 | 9 |
| 20 | 22.5 | 23.5 |
| 21 | 10.5 | 13.5 |
| 22 | 18 | 24 |
| 23 | 20.5 | 20.5 |
| 24 | 8.5 | 8.5 |
| 25 | 13.5 | 15 |
| 26 | 8.5 | 4.5 |
| 27 | 15.5 | 19.5 |
| 28 | 7 | 10 |
| 29 | 4 | 4 |
| 30 | 13.5 | 23.5 |
| Average | 11.87 | 14.97 |

coupled to handpiece caused more pain than using piezoelectric device (Surgybone®). However, this was also not statistically significant ($P = 0.2617$; significance = 0.5235).

Bleeding was evaluated intraoperatively by a single operator and compared by means of a verbal rating scale. In 22 cases (73%), the bleeding was the same for both surgical modalities. In one case (3%), piezoelectric device (Surgybone®) caused more bleeding than the drill. In seven cases (24%), the drill caused more bleeding than the piezoelectric device (Surgybone®). Therefore, significantly less bleeding occurred with the use of piezoelectric device compared to using standard handpiece ($P = 0.007$).

In 20 of the sides (i.e. L or R), the inferior alveolar nerve was considered to be in close approximation to the lower third molar using the classification by Monaco et al.[8]. Of those, two cases reported paraesthesia of the lower lip 24 h post-operatively, both these cases were caused by using the drill coupled to handpiece. There were no incidences of any damage to teeth, lip trauma or intra-oral soft tissue.

## Discussion

This study aimed to compare the use of a piezoelectric and a standard surgical handpiece in the removal of third molars in terms of surgical cutting time, intraoperative bleeding, and post-operative soft tissue injuries, swelling, pain and paraesthesia. Although a few similar studies on the subject are available in the literature, to our knowledge, this is one of the first few studies to use the split mouth technique to compare the two treatment modalities. This allows for the same patient to be their own control, hence providing more accurate results when comparing the two techniques.

The results of the comparison in our study showed that the piezoelectric device reduced post-operative swelling and pain, although increasing the time of surgery, but allowing a more comfortable post-operative time compared with rotary techniques. These findings were also concluded by a few other studies on the same subject. Piersanti *et al.*[9] showed that piezoelectric devices significantly reduced post-operative symptoms when compared with the standard rotating handpiece. Furthermore, post-operative swelling 1 week following surgery was significantly reduced when using piezoelectric devices.

In a study carried out by Sortino *et al.*[1], post-operative outcome was compared in mandibular third molars treated by piezoelectric surgery or by rotary osteotomy technique. The authors were able to demonstrate that the piezoelectric osteotomy technique produced a reduced amount of facial swelling and trismus 24 h after surgery, but required a longer time when compared with the rotary osteotomy technique.

In this study, the split mouth technique was used on 30 patients to compare the outcomes of the two different techniques. With regards to swelling and time, our findings correspond with the findings of Sortino *et al.*[1] even though we opted to perform the odontotomy with the respective devices. Although more time-consuming, the Surgybone® performed the task adequately.

The average time taken with the Surgybone® per case was 14.97 min and the drill was 11.87 min. In some cases, there was a marked difference in operating time with the two devices. This can be attributed to the level of difficulty of surgery requiring extensive bone removal and multiple tooth sectioning, in which the drill had superior

performance than the Surgybone®. This finding was also concurred by Rullo *et al.*[10] The same authors also recommended use of piezoelectric devices for extraction of 'difficult' third molars so as to significantly reduce post-operative pain experienced by the patient. Mantovani *et al.*[11] also showed that piezoelectric devices took significantly longer time in third molar removals than standard handpiece.

With regards to intraoperative bleeding, the two sides were compared and recorded by the operator on a verbal rating scale. In 73% of the cases, the bleeding was found to be the same, with more bleeding caused by the drill in 24% and the piezoelectric device in 3% of cases. Measurement of the actual blood loss could be included in a subsequent study. Goyal *et al.*[12] also noted that blood loss is more when using standard handpiece as compared to piezoelectric device.

The piezoelectric device caused less pain and swelling when compared to standard handpiece, although this was not statistically significant finding. Goyal *et al.*[12] also reported that a larger number of patients complained of pain when a standard handpiece was used, required more analgesics, and developed trismus more frequently than when the piezoelectric devices were used. The authors also noted that there was significantly more post-operative swelling when the standard handpiece was used. Physical measurement of the swelling could also be included in a subsequent study.

In conclusion, both conventional rotary handpiece and piezoelectric devices have their inherent advantages and disadvantages. Rotary handpiece reduce operative time and have superior cutting ability; however, they cause more pain, swelling and increase risk of injury to adjacent tissues. On the other hand, piezoelectric devices are safer to use and cause reduced bleeding, pain and swelling though more time-consuming and expensive. Selection of the device should depend on difficulty of osteotomy, risk of damage to adjacent tissue and post-operative outcomes. Hence, piezoelectric devices are an acceptable alternative to the standard rotary handpiece in third molar surgery. Its use is advocated in difficult cases especially where there is inferior alveolar nerve approximation.

## Conflict of interest

The authors have no financial interests to disclose. This study had no funding sources.

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