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Systematic Review
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Does the piezoelectric surgical technique produce fewer postoperative sequelae after lower third molar surgery than conventional rotary instruments? A systematic review and meta analysis

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Abstract. A systematic review and meta-analysis was conducted to answer the clinical question ''Does the piezoelectric surgical technique produce fewer postoperative sequelae after lower third molar surgery than conventional rotary instruments?'' A systematic and electronic search of several databases with specific key words, a reference search, and a manual search were performed from respective dates of inception through November 2014. The inclusion criteria were clinical human studies, including randomized controlled trials (RCTs), controlled clinical trials (CCTs), and retrospective studies, with the aim of comparing the piezoelectric surgical osteotomy technique to the standard rotary instrument technique in lower third molar surgery. Postoperative sequelae (oedema, trismus, and pain), the total number of analgesics taken, and the duration of surgery were analyzed. A total of nine articles were included, six RCTs, two CCTs, and one retrospective study. Six studies had a low risk of bias and three had a moderate risk of bias. A statistically significant difference was found between piezoelectric surgery and conventional rotary instrument surgery for lower third molar extraction with regard to postoperative sequelae (oedema, trismus, and pain) and the total number of analgesics taken ($P = 0.0001$, $P = 0.0001$, $P < 0.00001$, and $P < 0.0001$, respectively). However, a statistically

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significant increased surgery time was required in the piezoelectric osteotomy group ($P < 0.00001$). The results of the meta-analysis showed that piezoelectric surgery significantly reduced the occurrence of postoperative sequelae (oedema, trismus, and pain) and the total number of analgesics taken compared to the conventional rotary instrument technique in lower third molar surgery, but required a longer surgery time.

Key words: piezoelectric surgery; conventional rotary osteotomy; lower third molar surgery; postoperative sequelae; meta-analysis.

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Third molar surgery is one of the most common procedures performed by oral and maxillofacial surgeons.[1] The extraction of a mandibular third molar can range from relatively easy to extremely difficult depending on its location, depth, and angulation, and on bone density.[2] One of the most critical phases during extraction is the osteotomy, for which many techniques are used; if these techniques are performed improperly, they can be dangerous.[3]

Piezoelectric surgery was introduced in 1988 and has since undergone improvements. The piezoelectric instrument produces a modulated ultrasonic frequency of 24–29 kHz and a microvibration amplitude between 60 and 200 mm/s. The amplitude of these microvibrations allows a clean, precise cut. Piezoelectric surgery is very efficient for osteotomy because it works selectively—the soft tissues, including nerves and blood vessels, are unaffected. This represents a significant advantage over the use of a bur. Microstreaming and the cavitation phenomenon are distinctive features of piezoelectric surgery. Microstreaming is generated by the continuous whirling movement of a fluid generated by a small vibrating insert that favours a mechanical action of debris removal. The cavitation phenomenon, caused by the implosion of gas bullae into blood vessels during osteotomy, produces an important haemostatic effect that optimizes intraoperative visibility.[4] Piezoelectric surgery is a new osteotomy technique utilizing the microvibrations of scalpels at ultrasonic frequency to perform safe and effective osteotomies.[4]

When used properly, piezoelectric surgery causes less damage at the structural and cellular levels when compared to other techniques; indeed the new bone formation is more rapid compared to that following surgery with a rotating drill.[5,6] However, several previous studies have demonstrated that the micrometric cutting action of piezoelectric surgery requires a longer surgery time when compared to the use of a bur, and as a result may potentially cause greater discomfort in the postoperative period.[7]

Furthermore, recent morphological analyses of bone samples have shown that a bur produces irregular surfaces and marginal osteonecrosis due to the high temperature generated during bone drilling.[5,8,9] The preservation of the bone structure observed after the use of the ultrasonic technique seems to improve cellular reactivity thus favouring the healing process of the traumatized mineralized tissues.[5,10,11]

The authors of the present study hypothesized that there is no difference between piezoelectric surgery and traditional rotary instruments used for the extraction of lower third molars with regard to postoperative sequelae. The aim of this study was to identify any significant differences in clinical outcomes between piezoelectric surgery and surgery performed with traditional rotary instruments for the extraction of lower third molars.

Materials and methods

Literature search strategy

An electronic search of the PubMed, Ovid MEDLINE, and Cochrane CENTRAL online databases was conducted from their respective dates of inception to November 2014. Free text words and medical subject heading (MeSH) terms were used. The heading sequence was (mandibular OR lower) AND (third molar OR wisdom) AND (Piezosurgery) AND (conventional OR standard OR traditional rotary osteotomy OR conventional handpiece). The low yield led to the use of another search term omitting the reference to piezoelectric surgery versus rotary bur: (mandibular OR lower) AND (third molar OR wisdom) AND (pain OR swelling OR trismus OR infection OR bleeding OR lingual OR inferior alveolar OR trigeminal OR labial OR lingual OR nerve OR the postoperative symptoms severity scale). The abstracts of the results yielded were reviewed and the full text obtained for those with apparent relevance. The references of the papers identified were cross-checked for unidentified articles. The individual databases of key subject journals were also searched using the same terms as above: the *Journal of Oral and Maxillofacial Surgery*, *International Journal of Oral and Maxillofacial Surgery*, *Journal of Oral Surgery*, and *British Journal of Oral and Maxillofacial Surgery*. The searches were limited to articles published in the English language. An attempt was made to identify unpublished material or to contact authors of published studies for further information. To complete the search, the references of each selected publication on piezoelectric surgery versus conventional surgery in the extraction of third molars were searched by hand.

Study eligibility

The inclusion criteria were developed using the PICOS guidelines. Population: patients had to be aged 18–25 years and require the removal of two impacted lower third molars with a mucoperiosteal flap and osteotomy, for orthodontic, prophylactic purposes. Intervention: surgical extraction of third molars using a piezoelectric device osteotomy technique. Comparator: surgical extraction of third molars using the conventional rotary bur osteotomy technique. Outcomes: the postoperative symptoms severity scales, facial swelling, pain assessed by visual analogue scale (VAS), trismus, number of analgesics taken, and duration of surgery. Study type: clinical human studies, including randomized controlled trials (RCTs), controlled clinical trials (CCTs), and retrospective studies with the aim of comparing clinical outcomes between piezoelectric surgery and the conventional rotary osteotomy technique in the surgical extraction of third molars, and reporting the incidence of postoperative complications.

Exclusion criteria

The following exclusion criteria were applied: case reports, technical reports, animal or in vitro studies, review papers, and uncontrolled clinical studies; studies in which patients were taking antibiotics for a current infection, or had acute pericoronitis or severe periodontal disease at the time of the operation; studies involving forceps extractions not requiring osteotomy; studies that did not report the data (mean and standard deviation) required to perform a meta-analysis.

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