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APPLICATION OF PIEZOSURGERY IN EXTRACTION OF IMPACTED THIRD MOLARS

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Abstract

Removal of impacted permanent third molars is considered to be one of the most common and routine oral surgical procedures. This intervention is usually performed in the classical way with the use of rotatory instruments and burs. As an alternative to this classical approach, piezosurgery can be used, which is an osteotomy technique based on ultrasonic vibrations. The crucial advantage of piezosurgery is that it is inert to soft tissues.

The aim of this study was to compare piezosurgery with the rotatory osteotomy technique, with particular reference to the time required to perform the intervention and the intensity of postoperative sequelae: pain, swelling, and trismus.

This paper summarizes published experiences and knowledge of piezosurgery, with special regard to the extraction of mandibular third molars. For the purposes of this research, an automatic detailed search was performed on the electronic database PubMed for the period 2012-2022. Keywords used in the search were: piezosurgery, impacted third molars.

The initial filtration resulted in 47 scientific papers, 17 of which met the selection criteria. Of particular interest were papers such as Meta-analyzes and systematic reviews.

A review of the literature indicates that although patients undergoing piezosurgery required longer operating times, they had less postoperative pain, swelling, and trismus.

Keywords: impacted molar, piezosurgery.

Introduction

Piezosurgery is a quite new and effective method of bone removal and soft tissue sparing, based on the principle of piezoelectric vibrations [1]. The term "piezo" comes from the Greek word "piezein" which means "presses hard, squeezes" [2].

The piezoelectric effect was introduced by Pierre and Marie Curie in 1880, first used in dentistry in the late 1970s by Horton and later by the Italian maxillofacial surgeon Tomaso Vercellotti in 1988. The primary purpose is to modify conventional ultrasound technology to overcome the limitations encountered during traditional osteotomy performed with rotary instruments. It is well known that the traditional protocol where the bone is removed by rotatory drills and burs shows certain weaknesses such as generating heating with a potential danger of thermal osteonecrosis, the need of applying greater force while working and the possibility of injury of the anatomical soft tissues in the surrounding.

Piezosurgery minimizes these problems of the conventional technique and it is used in all surgical branches where osteotomy is done - oral surgery and implantology, traumatology, orthopedics, otorhinolaryngology, neurosurgery, and other disciplines. In addition to the clinical efficacy, histological and histomorphometric analyzes of wounds, as well as new bone formation in experimental animal models, shows more favorable results when using piezosurgery in relation to bone damage with conventional technique [3].

As an additional benefit, piezoelectric vibrations a fluid environment also help in reducing the number of bacteria in the operative field, providing a disinfecting effect [4].

Expectations go in the direction of controlled bone loss and minimization of soft tissue damage because the used frequency of the electro-sound waves ranges between 25-30 kHz, and the created micro-movements with an amplitude of 60-210 μm do not affect the surrounding soft tissue structures [5].

Literature review

The piezoelectric device is about 3 times more powerful than a conventional ultrasonic dental device (16 Watts vs. 5 Watts) which enables the cutting of highly mineralized cortical bone [4].

The already mentioned author Walsh states that piezosurgery allows the bone to be cut selectively and atraumatically and that ultrasonic waves in the fluid environment help to reduce the number of bacteria, providing a disinfecting effect. Bone, which is rigid, is easily cut by the high-frequency micro-vibrations of the piezoelectric extension, while soft tissues are soft and pliable, meaning they are not injured when in contact with the piezoelectric device. Advantages of piezoelectric surgery compared to conventional surgery are the following: better healing and fewer postoperative sequelae, less possibility of injury to surrounding soft tissue, less intraoperative bleeding, less possibility of bone necrosis, better visibility through the phenomenon of cavitation, built-in system of intraoperative cooling, as well as removal of debris and greater patient comfort due to the absence of macrovibrations that are present in the conventional method [6].

Other authors also mention additional advantages - easier access to hard-to-reach places enabled by the different angles of the piezoelectric extensions [7], greater precision [8], less stress due to microvibrations compared to macrovibrations in the conventional technique, less noise [9].

Disadvantages are longer duration of the operative procedure, higher price and longer time necessary for perfecting this technique [6]. Use in patients with a pacemaker is contraindicated.

A relatively large number of papers and researches have been done to verify and confirm the above advantages of piezosurgery.

Beziat et al.[10], in one of the most comprehensive scientific papers to date on piezosurgery, conclude that with this technique very precise bone cutting is possible, the use of an osteotome is avoided, and soft tissue structures such as the brain, meninges, palatine mucosa, sinus membrane, inferior alveolar nerve, are protected from injury; the duration of the osteotomy increases, but not the total operative time because there is no need to protect or repair potential complications from soft tissue injuries. According to them, the lesser power of piezosurgery compared to traditional rotatory instruments, as well as the longer time required to perform the intervention, are minor problems compared to the benefits of its use.

Blus [11] indicates that bone cut by piezosurgery heals initially more efficiently during osseointegration of titanium implants.

According to Valente et al. [12] using the piezo surgical technique, the microscopic anatomy of the bone is preserved, guaranteeing a high cutting precision without altering the natural trabecular structure, and the bone samples obtained with piezo surgery demonstrate significantly faster cell proliferation. Piezo surgery generates less noise but longer bone cutting time.

Abella et al. [13] in the review paper say that cystectomy done by piezosurgery can be performed in hard-to-reach areas with much less risk for injuring the vital structures, less chance of bleeding, epithelial perforation, and postoperative complications.

Regarding interventions on impacted third molars, the study by Chang et al. [14] concluded that in the experimental group in which piezosurgery was used to perform the intervention, patients had a significantly higher comfort level than in the control group when the classic technique with rotating instruments was used. In the experimental group, patients had less pain and facial edema, but greater limitation of mouth opening on the first postoperative day, with no significant difference.

Material and Methods

For preparation of this paper, an automatic detailed search of the Internet database PubMed was carried out for the period of the last 10 years (2012-2022).

The used search keywords were: piezosurgery, impacted third molars. In addition to already published papers, the search also included reports that have been reviewed and accepted for publication, but not yet printed. On the other hand, we excluded articles that were expert reports, as well as those that were not in English language or were not performed on human subjects. Of particular interest were clinical studies, prospective and retrospective studies, and systematic reviews and meta-analyses.

The following inclusion criteria were used to confirm whether the study was eligible to be included in our analysis: patients with impacted mandibular third molars, patients who underwent a piezosurgical technique, studies where conventional rotatory surgical technique was used in the control group, and studies where postoperative complications were analyzed.

Ethical approval was not required for the preparation of this paper, as it was based on previously published information.

Results

The initial filtering under the set criteria, we identified 47 scientific papers. After the initial analysis of these papers, 17 papers met the selection criteria. Five of these were meta-analyses and systematic reviews [15,16,17,18,19] investigating the effectiveness of piezosurgery versus conventional surgery, while the remaining articles were randomized controlled trials and prospective clinical studies. We particularly focused on studies of the type of meta-analyses and systematic reviews because they are considered to be the most relevant studies and of the highest scientific value for certain selected topic.

In the meta-analysis by Jiang et al [15], 305 studies were analyzed, 7 of which met the criteria for acceptability and their conclusion is that patients have significantly less swelling after piezosurgical intervention, and there is a trend of less pain and trismus.

A meta-analysis by Liu [16] included 402 patients with results showing less pain, trismus, and facial edema in the piezo group. Both meta-analyses state that more multicentric studies are needed in order to obtain more conclusive results.

In the systematic literature review and meta-analysis by Badenoch-Jones [17], 15 studies evaluating postoperative sequelae and neurological complications were analyzed. The obtained results reveal that the patients who underwent osteotomy with a piezoelectric device have significantly less swelling, trismus and pain on the 1st postoperative day, less swelling and a lower risk of neurological complications on the 7th day. Trismus and pain on postoperative day 7 did not differ significantly.

These findings support the better clinical response to osteotomy performed with piezo surgery compared to those performed with conventional rotatory instruments for surgical removal of impacted mandibular third molars.

Al Moraissi et al. [18] emphasize that there is a significantly lower incidence of postoperative sequelae with the piezoelectric surgical technique compared to the conventional one. According to them, it is a result of less bone injury and better hemostasis, which reduces the risk of edema. The meta-analysis shows that pain, swelling, trismus, and the quantity of analgesics are significantly reduced using piezosurgery, but significantly longer operative time compared to conventional impacted mandibular third molars surgery.

Ciccio et al. [19] in an analysis of 929 scientific papers, seven of which met their inclusion criteria, set the thesis that piezoelectric bone surgery prolongs the time required to perform the intervention compared to conventional surgery. They state that evidence and results suggesting that postoperative pain and trismus are reduced with piezosurgery are not numerous. Data were insufficient to statistically determine whether piezosurgery reduces postoperative neurologic complications and postoperative swelling compared with rotatory handpiece and drills.

Conclusion

There are certain advantages in performing extraction of impacted mandibular third molars using piezosurgical technique compared to the conventional rotatory instruments. The available data highlight the possibility of improved healing in cases where piezosurgery is used, but with a prolonged operative time. More multicentric studies are needed in order to obtain more conclusive results.

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