# CLINICAL STUDY ON THE EFFECTIVENESS OF PIEZOSURGICAL TECHNIQUES VERSUS TRADITIONAL TECHNIQUES IN RECONSTRUCTION OF PERIIMPLANT BONE DEFECTS

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***Keywords:*** *piezosurgical techniques, bone reconstructions, traditional techniques, bone grafting, bone augmentation*

***Abstract:*** *There are already more than 2 decades since ultrasound instruments are being used for osteotomy and osteoplasty in our health system. The cutting of hard tissue with ultrasonic vibrations that are formed by the piezoelectric effect was first described by Catuna in 1953 and then by Volkov and Shepelevam in 1974.(1,2) Purpose and methods: A particular emphasis has been placed on evaluating interventions using minimally invasive piezosurgical device, which allowed solving critical situations of bone resorption up to 2.5 mm width, and which through classical techniques would have created serious problems of osteotomy and immediate insertion of implants. I have insisted on how to resolve the delicate situation in which, both very small width of the bone ridge and proximity of the sinus cavity could lead to intraoperative accidents unless intervened with piezosurgical technique. The results obtained from the various surgical techniques applied were evaluated by analyzing specific accidents and complications, reinterventions and the average duration of healing. Discussions: The success rate of implants and prosthetic restoration waiting time (in months) were set as dependent variables for the statistical analysis. Success rate was calculated for each osteotomy surgical technique using the formula: number of implants inserted / number of implants lost. The main variable which determines the other parameters is represented in the analysis by means of the implant. The variables were: origin of the graft (lateral wall of the maxillary sinus, the combination of autogenous bone and xenogenous bovine bone), smoking habits (smoker / non-smoker), associated comorbidity (periodontal disease, systemic disease) and implant insertion (immediate or delayed). Conclusions: Piezoelectric technique achieves a higher success rate than was possible with any other method of surgical implantology. These significant advances enable a surgical technique that reduces accidents during operative time and also patient's morbidity.*

## INTRODUCTION

In periimplantar bone defect reconstruction, a decision must be taken regarding surgical techniques to be applied for modifying and optimizing periimplantar bone crest. Applied surgical procedures and techniques depend on the objective to be achieved: fixed restorations with support exclusively on implants, overdenture, or mixed support.(3)

Piezoelectric device or piezosurgery device was originally developed for the atraumatic cutting of bone by way of ultrasonic vibrations and as an alternative to the mechanical and electrical instruments that are used in conventional oral surgery.(4)

Motorized devices (classical) that make rotary, reciprocal or oscillatory movements have certain drawbacks that include: tissue necrosis due to the overheating of bone; loss of fine touch sensitivity due to the requirement of pressure on the hand piece; difficulty in the determination of cutting depth; iatrogenic impairment in undesired areas due to a failure in the accurate adjustment of the speed of a rotating head or saw; and the risk of soft tissue injury to important anatomical structures, such as the inferior alveolar nerve or maxillary sinus.(5)

Applications of piezosurgery in oral and maxillofacial surgery:(6,7,8) in dento-alveolar procedures; separating the tooth roots; hemi-section, root amputation; periodontal surgery; apical resection and endodontic treatments. In dental implantology: Implant socket preparation; alveolar ridge splitting and expansion; re-contouring of alveolar crest.

In maxillary sinus bone grafting surgery: preparation of bone window with lateral approach; atraumatic dissection of sinus mucosa; internal sinus floor elevation.

In maxillofacial bone surgery: harvesting of autogenous bone grafts; alveolar decortication and corticotomy; orthognathic surgery; alveolar distraction; removal of cystic and tumour-like lesions; orthodontic micro-surgery; temporomandibular joint ankylosis resection. In other surgical disciplines: craniofacial surgery; plastic and reconstructive surgery; head and neck surgery; neurosurgery; ophthalmology; traumatology; orthopaedics.

The use of piezosurgery has advantages in procedures that require a meticulous preparation of a small bone or a piece of a tooth: for example, tooth sectioning or the removal of a piece of a broken wisdom tooth that has a close relation with an important anatomical structure. In working around the mandibular canal or maxillary sinus, piezosurgery may prevent nerve damage; even in the case of accidental contact with the working insert tips. Piezosurgery also allows planning of the root surfaces and the removal of inflammatory tissue in periodontal operations.(9)

## PURPOSE

The aim of this study was to implement piezosurgical technique in surgical procedures for bone splitting, sinus floor augmentation, and its assessment compared to conventional techniques of bone osteotomy.

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## MATERIALS AND METHODS

This paper is a **prospective** study conducted over a period of 5 years from 2010 until present. The study is mostly conducted on old edentulous patients, expanded or reduced, both maxillary and mandibulary, with an initial width of the bone crest ranged between 2.5 and 5.5 mm, averaging 4.15 mm, and with high resorption in maxillary sinus in Clinical Ambulatory of Dental and Oral Implantology Military Hospital "Alexandru Augustin" in Sibiu. There were 150 patients who received bone reconstructions with piezosurgical and classic techniques pursuing the benefits and efficiency of modern piezosurgical technology. Surgeries were performed by piezoelectric device (Mectron, Genoa, Italy) and USBs device (Italy Medica, Milan, Italy) but also with conventional instruments. Piezoelectric device works within 24 to 29 kHz and a power ranging between 5 and 16 W (Robiony et al. 2004). USBs work within 20 to 32 kHz with a maximum power of 90W.

The prospective study was based on direct tracking of patients before surgery so by conducting tests and analyzes (BT, CT) having the agreement of the general practitioner or of the patient's doctor (where the case may be), and their enrolment in a protocol for diagnosis and treatment. They were imagistically diagnosed with orthopantomography (OPT), retroalveolary radiographs, and computed tomography (CT). Surgical treatment was followed by medical treatment with antibiotic (Augmentin or Amoxiklav 3 grams per day for 5 days), and anti-inflammatory (Ibuprofen forte or Ketonal).

In the study, the following parameters were evaluated:

- width of the alveolar bone crest before and after the intervention;
- height of alveolar bone crest before and after the intervention (by panoramic radiography and CT scan inspection);
- smoking habits (smoker / non-smoker);
- comorbidity (periodontal disease, systemic diseases);
- type of anaesthesia (general or local);
- type of bone graft (anterior / posterior iliac crest, maxillary tuberosity, lateral wall of the sinus, xenogenous bovine bone combined with autogenous bone);
- the number of implants inserted;
- implant placement (immediate or delayed);
- type of the prosthetic rehabilitation which was used (fixed implant or implant-mucosal mixed support).

The success rate of implants and prosthetic restoration waiting time (in months) were set as dependent variables for our statistical analysis. Success rate was calculated for each surgical technique of osteotomy using the formula: number of implants inserted / number of implants lost.

**Stages of external sinus lifting technique performed by classical techniques and piezosurgery.**

Assessment of bone atrophy degree, and choosing an augmentation technique corresponding to each case were based almost entirely on laboratory tests (CT, OPT) and also on the clinic.

**Figures no. 1, 2. Formation of the sinusal window with conventional techniques for the sinusal opening**

**Figure no. 3. Sinus augmentation with external sinus technique**

**Figure no. 4. Crestal bone splitting with classical techniques**

**Figures no. 5 a, b, c. Bone splitting with piezosurgical technique in case of advanced alveolar crestal bone resorption**

a b c

## RESULTS AND DISCUSSIONS

Monitoring was carried out at 2, 14, 30 and 90 days after surgery. During this time, no occurrence of complications was observed. At 6 months after this first surgical stage, the second phase of discovering the surgical implants and their prosthetic loading was initiated. All cases were evaluated 6 months later using OPT examination and then annually assessing the degree of bone resorption and of bone integration of the implants. After bone reconstruction interventions, most accidents occurred during classical techniques such interventions:

*Vestibular wall fracturing during splitting osteotomy of the edentulous bone ridge.*

This occurred when the bone splitting technique was classical, using cutters and chisels. Usually, the vestibular cortical which is thinner will be fractured. Also, vestibular wall fracture was more common in the maxillary frontal area where bone resorption had a stronger orientation toward the apex (figure no. 6). Treatment has consisted in its immobilization using osteosynthesis principles by applying a plate of osteosynthesis.

**Figure no. 6. Fracture of the alveolar walls after the bone splitting using chisels**

*Sinus membrane perforation.*

Accidents occurred during the process of external or internal sinus lifting (figure no. 7) or while performing the new socket for the implant that was to be inserted. Sinus membrane perforation occurred mainly:

1. while performing bone milling to achieve the required bone window in external sinus lifting.
2. when the sinus mucosa is being taken off carelessly using conventional tools.

**Figure no. 7. Clinical appearance: sinus membrane perforation**

## CONCLUSIONS

Addressing the bone by classical methods involve an increased intraoperative risk. Using traditional procedures, soft tissues such as tongue, cheek or lips may be affected during bone preparation. The access near teeth is difficult. Moreover, with the techniques mentioned above, achieving unloading incisions require much effort and circumspection. In dense bone (DI and DII), piezosurgical technique was used. Using this technique, a bone penetration up to 10 mm was able - literature data offers even 12 mm depth with piezoelectric device - without risk of overheating the bone.

Surgical protocol that uses piezo instruments radically reduced the danger of membrane perforation (without perforation in more than 98.8% of cases, perforation occurring in 1.2% of the cases during membrane take-off).

Cavitation effect cleans the work area offering increased visibility. In narrow crestal bone (2.5 to 4 mm) simultaneous implant placement was only possible using piezosurgery without creating dehiscence or fenestration which can damage implant osseointegration due to technique's precision without risking damaging the vestibular wall of the crestal bone.

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