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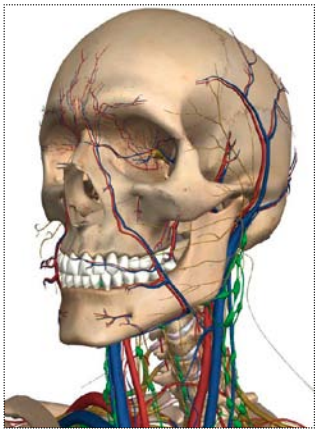
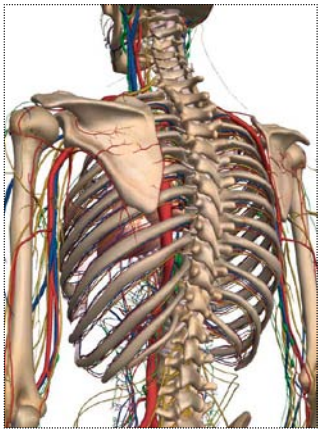
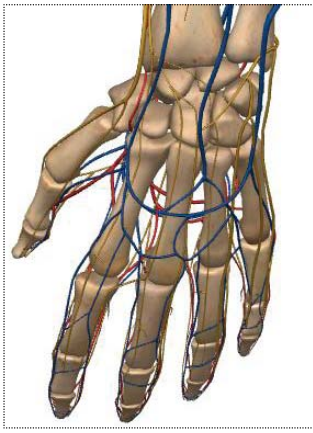
Scientific Abstracts

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PIEZOSURGERY® TECHNOLOGY – HISTOLOGICAL RESULTS

Stoetzer M., Felgenträger D., Kampmann A., Schumann P., Rücker M., Gellrich N.C., von See C.

Effects of a new piezoelectric device on periosteal microcirculation after subperiosteal preparation.

ENGLISH

Microvasc Res. 2014 Jul;94:114-8. doi: 10.1016/j.mvr.2014.06.003. Epub 2014 Jun 14.

■ **Abstract**

Introduction: Subperiosteal preparation using a periosteal elevator leads to disturbances of local periosteal microcirculation. Soft-tissue damage can usually be considerably reduced using piezoelectric technology. For this reason, we investigated the effects of a novel piezoelectric device on local periosteal microcirculation and compared this approach with the conventional preparation of the periosteum using a periosteal elevator.

Material and methods: A total of 20 Lewis rats were randomly assigned to one of two groups. Subperiosteal preparation was performed using either a piezoelectric device or a periosteal elevator. Intravital microscopy was performed immediately after the procedure as well as three and eight days postoperatively. Statistical analysis of microcirculatory parameters was performed offline using analysis of variance (ANOVA) on ranks ($p<0.05$).

Results: At all time points investigated, intravital microscopy demonstrated significantly higher levels of periosteal perfusion in the group of rats that underwent piezosurgery than in the group of rats that underwent treatment with a periosteal elevator.

Conclusion: The use of a piezoelectric device for subperiosteal preparation is associated with better periosteal microcirculation than the use of a conventional periosteal elevator. As a result, piezoelectric devices can be expected to have a positive effect on bone metabolism.

Ma L., Mattheos N., Sun Y., Liu X.L., Yip Chui Y., Lang N.P.

Wound healing of osteotomy defects prepared with piezo or conventional surgical instruments: a pilot study in rabbits.

ENGLISH

J Investig Clin Dent. 2014 May 22. doi: 10.1111/jicd.12097. [Epub ahead of print]

■ **Abstract**

Aim: The aim of the present study was to evaluate and compare the wound-healing process following osteotomies performed with either conventional rotary burs or piezoelectric surgery in a rabbit model.

Methods: Two types of osteotomy window defects of the nasal cavities were prepared on the nasal bone of 16 adult New Zealand white rabbits with either a conventional rotary bur or piezo surgery. The defects were covered with a resorbable membrane. Four animals were killed at 1, 2, 3, and 5 weeks after the surgical procedure, respectively. Histological and morphometric evaluations were performed to assess the volumetric density of various tissue components: the blood clot, vascularized structures, provisional matrix, osteoid, mineralized bone, bone debris, residual tissue, and old bone.

Results: Significantly more bone debris was found at 1 week in the conventionally-prepared defects compared to the piezo surgically-prepared defects. At 2 and 3 weeks, a newly-formed hard tissue bridge, mainly composed of woven bone, was seen; however, no statistically-significant differences were observed. At 5 weeks, the defects were completely filled with newly-formed bone.

Conclusions: The defects prepared by piezo surgery showed a significantly decreased proportion of bone debris at 1 week, compared to conventional rotary bur defect.

Ma L., Stübinger S., Liu X.L., Schneider U.A., Lang N.P.

Healing of osteotomy sites applying either piezosurgery or two conventional saw blades: a pilot study in rabbits.

ENGLISH

Int Orthop. 2013 Aug;37(8):1597-603. doi: 10.1007/s00264-013-1908-3. Epub 2013 Jun 22.

■ **Abstract**

Purpose: The purpose of this study was to compare bone healing of experimental osteotomies applying either piezosurgery or two different oscillating saw blades in a rabbit model.

Methods: The 16 rabbits were randomly assigned into four groups to comply with observation periods of one, two, three and five weeks. In all animals, four osteotomy lines were performed on the left and right nasal bone using a conventional saw blade, a novel saw blade and piezosurgery.
Results: All three osteotomy techniques revealed an advanced gap healing starting after one week. The most pronounced new bone formation took place between two and three weeks, whereby piezoelectric surgery revealed a tendency to faster bone formation and remodelling. Yet, there were no significant differences between the three modalities.
Conclusions: The use of a novel as well as the piezoelectric bone-cutting instrument revealed advanced bone healing with a favourable surgical performance compared to a traditional saw.

Rashad A., Sadr-Eshkevari P., Weuster M., Schmitz I., Prochnow N., Maurer P.

Material attrition and bone micromorphology after conventional and ultrasonic implant site preparation.

ENGLISH

Clin Oral Implants Res. 2013 Aug;24 Suppl A100:110-4. doi: 10.1111/j.1600-0501.2011.02389.x. Epub 2012 Jan 17.

■ **Abstract**
Objective: Little is known about the recently introduced ultrasonic implant site preparation. The purpose of this study was to compare material attrition and micromorphological changes after ultrasonic and conventional implant site preparations.
Material and methods: Implant site preparations were performed on fresh bovine ribs using one conventional (Straumann, Freiburg, Germany) and two ultrasonic (Piezosurgery; Mectron Medical Technology, Carasco, Italy and Variosurg; NSK, Tochigi, Japan) systems with sufficient saline irrigation. Sections were examined by environmental scanning electron microscopy (ESEM). Energy-dispersive X-ray spectroscopy (EDX) was performed to evaluate the metal attrition within the bone and the irrigation fluid.
Results: ESEM: After conventional osteotomy, partially destroyed trabecular structures of the cancellous bone that were loaded with debris were observed, whereas after ultrasonic implant site preparations, the anatomic structures were preserved. EDX: None of the implant site preparation methods resulted in metal deposits in the adjacent bone structures. However, within the irrigation liquid, there was significantly higher metal attrition with ultrasonic osteotomy ($P < 0.0001$ and $P < 0.0001$ for Mectron and NSK, respectively). Whereas for Straumann system used, 15.5% of the SEM/EDX findings were drill-origin metals, this percentage increased to 37.3% and 37.9% with the application of Mectron and NSK, respectively.
Conclusion: Ultrasonic implant site preparation is associated with the preservation of bone microarchitecture and with the increased attrition of metal particles. Therefore, copious irrigation seems to be even more essential for ultrasonic implant site preparation than for the conventional method.

Gülnahar Y., Hüseyin Kösger H., Tutar Y.

A comparison of piezosurgery and conventional surgery by heat shock protein 70 expression.

ENGLISH

Int J Oral Maxillofac Surg. 2013 Apr;42(4):508-10. doi: 10.1016/j.ijom.2012.10.027. Epub 2012 Nov 26.

■ **Abstract**
The effects of mechanical instruments on the viability of cells are essential in terms of regeneration. There is considerable interest in cell repair following damage mediated by dental surgical procedures. Cells can tolerate stress by expressing heat shock protein 70 (Hsp70). During and after surgical tooth removal, oxidative stress can activate Hsp70 expression proportional to the intensity of the stress signal stimulus to cope with stress. This study examined the expression of Hsp70 as a potential biomarker of immediate postoperative stress in patients undergoing two different surgical procedures of different severity. Expression of Hsp70 both at mRNA and at protein level in the conventional group was two-fold higher than that of the piezo group. This suggests that tooth movement by the piezo method causes relatively lower stress in the alveolar bone. Piezosurgery provides relatively low stress to the patients and this may help cell repair after the surgical procedure. Patients undergoing more aggressive surgery using conventional methods showed a significant increase in Hsp70 in the immediate postoperative period. Therefore, Hsp70 induction can be a potential tool as a prognostic surgical marker.

Claire S., Lea S.C., Walmsley A.D.

Characterisation of bone following ultrasonic cutting.

ENGLISH

Clin Oral Investig. 2013 Apr;17(3):905-12. doi: 10.1007/s00784-012-0754-9. Epub 2012 May 26.

■ **Abstract**

Objectives: Ultrasonic surgery is an increasingly popular technique for cutting bone, but little research has investigated how the ultrasonic tip oscillations may affect the cuts they produce in bone. The aim of this investigation was to evaluate the oscillation and cutting characteristics of an ultrasonic surgical device.

Materials and methods: A Piezosurgery 3 (Mectron, Carasco, Italy) ultrasonic cutting system was utilised with an OP3 style tip. The system was operated with the tip in contact with porcine bone samples (loads of 50 to 200 g) mounted at 45° to the vertical insert tip and with a water flow of 57 ml/min. Tip oscillation amplitude was determined using scanning laser vibrometry. Bone surfaces defects were characterised using laser profilometry and scanning electron microscopy.

Results: A positive relationship was observed between the magnitude of tip oscillations and the dimensions of defects cut into the bone surface. Overloading the tip led to a reduction in oscillation and hence in the defect produced. A contact load of 150 g provided the greatest depth of cut. Defects produced in the bone came from two clear phases of cutting.

Conclusions: The structure of the bone was found to be an important factor in the cut characteristics following piezosurgery.

Clinical relevance: Cutting of bone with ultrasonics is influenced by the load applied and the setting used. Care must be used to prevent the tip from sliding over the bone at low loadings.

Stacchi C., Vercellotti T., Torelli L., Furlan F., Di Lenarda R.

Changes in Implant Stability Using Different Site Preparation Techniques: Twist Drills versus Piezosurgery. A Single-Blinded, Randomized, Controlled Clinical Trial.

ENGLISH

Clin Implant Dent Relat Res. 2013 Apr;15(2):188-97. doi: 10.1111/j.1708-8208.2011.00341.x. Epub 2011 Apr 19.

■ **Abstract**

Purpose: The objective of the present investigation was to longitudinally monitor stability changes of implants inserted using traditional rotary instruments or piezoelectric inserts, and to follow their variations during the first 90 days of healing.

Materials and methods: A randomized, controlled trial was conducted on 20 patients. Each patient received two identical, adjacent implants in the upper premolar area: the test site was prepared with piezosurgery, and the control site was prepared using twist drills. Resonance frequency analysis measurements were taken by a blinded operator on the day of surgery and after 7, 14, 21, 28, 42, 56, and 90 days.

Results: At 90 days, 39 out of 40 implants were osseointegrated (one failure in the control group). Both groups showed an initial decrease in mean implant stability quotient (ISQ) values: a shift in implant stability to increasing ISQ values occurred after 14 days in the test group and after 21 days in the control group. The lowest mean ISQ value was recorded at 14 days for test implants (97.3% of the primary stability) and at 21 days for the control implants (90.8% of the primary stability). ISQ variations with respect to primary stability differed significantly between the two groups during the entire period of observation: from day 14 to day 42, in particular, the differences were extremely significant ($p < .0001$). All 39 implants were in function successfully at the visit scheduled 1 year after insertion.

Conclusions: The findings from this study suggest that ultrasonic implant site preparation results in a limited decrease of ISQ values and in an earlier shifting from a decreasing to an increasing stability pattern, when compared with the traditional drilling technique. From a clinical point of view, implants inserted with the piezoelectric technique demonstrated a short-term clinical success similar to those inserted using twist drills.

Birkenfeld F., Becker M.E., Harder S., Lucius R., Kern M.

Increased intraosseous temperature caused by ultrasonic devices during bone surgery and the influences of working pressure and cooling irrigation.

ENGLISH Int J Oral Maxillofac Implants. 2012 Nov-Dec;27(6):1382-8.

■ **Abstract**

Purpose: The purpose of this study was to investigate the increases in intraosseous temperature generated by a modern ultrasonic device for bone surgery (UDBS) and the influences of working pressure and cooling irrigation on this temperature.

Material and methods: Twenty human mandibular bone specimens (20x15x5 to 7 mm) were used; three vertical cuts were performed for a duration of 12 seconds per cut. Each bone specimen was machined with a different combination of working pressure (1.5, 2.0, 3.0, 4.0, or 6.0 N) and cooling irrigation (0, 30, 60, or 90 mL/min), and intraosseous temperatures were measured. Harmful temperature development was defined as an increase of more than 10°C for the 75th percentile and/or a maximum increase of more than 15°C. Cutting performance was also measured.

Results: Harmless intraosseous temperature development was identified for working pressures of 1.5 N and 2.0 N with cooling irrigations of 30, 60, and 90 mL/min and for 3.0 N at 90 mL/min. The maximum temperature observed was 72°C (6.0 N with 60 mL/min). The mean cutting performance values were 0.21±0.02 mm/s for 6.0 N, 0.21±0.06 mm/s for 3.0 N, 0.20±0.01 mm/s for 4.0 N, 0.11±0.05 mm/s for 1.5 N, and 0.08±0.03 mm/s for 2.0 N.

Conclusion: To prevent tissue damage in dental bone surgery, a minimum coolant amount of 30 mL/min is recommended. The working pressure should be chosen with great care because of its significant influence on intraosseous temperature. Doubling of the working pressure from 1.5 to 3.0 N requires a tripling of the coolant (30 to 90 mL/min) to prevent tissue damage. A working pressure above 3.0 N did not result in improved cutting performance.

Schütz S., Egger J., Kühl S., Filippi A., Lambrecht J.T.

Intraosseous temperature changes during the use of piezosurgical inserts in vitro.

ENGLISH Int J Oral Maxillofac Surg. 2012 Nov;41(11):1338-43. doi: 10.1016/j.ijom.2012.06.007. Epub 2012 Aug 17.

■ **Abstract**

This study concerns intraosseous temperature changes during the use of piezosurgical inserts. On six fresh pig jaws heated to body temperature (36°C), osteotomies and osteoplasties were performed in vitro with the Piezosurgery® 3 device (Mectron, Carasco, Italy) and various inserts. The intraosseous temperature increases were measured at a depth of 3 mm and at a distance of 1 mm from the working site using nickel–chromium/nickel temperature sensors. 20°C Ringer's solution was used for cooling in an initial test series and 10°C Ringer's in a second series. The processed bone was examined using digital volume tomography images to determine the ratio of cortical to cancellous bone thickness. Mean temperature increases of 4.4–10.9°C were found; maximum temperature peaks were over 47°C for an average of only 8.5 s. The type of piezosurgical insert had a marked influence on intraosseous temperature generation ($p = 0.026$); the thickness of the cortical bone and the temperature of the coolant did not. Coolant temperature had an influence on the bone cooling time ($p = 0.013$). The results show that correct use of the piezosurgery device does not give rise to prolonged temperature increases over 47°C and hence does not cause any irreversible thermal damage in the bone.

Hollstein S., Hoffmann E., Vogel J., Heyroth F., Prochnow N., Maurer P.

Micromorphometrical analyses of five different ultrasonic osteotomy devices at the rabbit skull.

ENGLISH Clin. Oral Impl. Res 2012 Jun;23(6):713-8. doi: 10.1111/j.1600-0501.2011.02185.x. Epub 2011 Apr 13.

■ **Abstract**

Objectives: The recently introduced ultrasonic osteotome procedure is an alternative to conventional methods of osteotomy. The aim of the present study was to establish the differences between five recently introduced ultrasonic osteotomes and to

perform micromorphological and quantitative roughness analyses of osteotomized bone surfaces.
Materials and methods: Fresh, standard-sized bony samples were taken from a rabbit skull using the following ultrasonic osteotomes: the Piezosurgery® 3 with insert tip OT7, Piezosurgery® Medical with insert tip MT1-10, Piezon Master Surgery® with insert tip SL1, VarioSurg® with inert tip SG1, and Piezotome 2 with insert tip BS1 II. The required duration of time for each osteotomy was recorded. The prepared surfaces were examined via light microscopy, environmental surface electron microscopy (ESEM), and confocal laser scanning microscopy (CLSM).
Results: All of the investigated piezoelectric osteotomes preserved the anatomical structure of bone. The mean roughness values of the osteotomized bone edge obtained using the investigated piezoelectric osteotomes were as follows: 2.47 µm (Piezosurgery® 3), 9.79 µm (Piezosurgery® Medical), 4.66 µm (Piezon Master Surgery®), 6.38 µm (VarioSurg®), and 6.06 µm (Piezotome 2). Significantly higher roughness values were observed when using the Piezosurgery® Medical in comparison with those achieved by the Piezosurgery® 3 (P<0.0001) and Piezon Master Surgery® (P=0.002). Different osteotomy durations were achieved using the different piezoelectric osteotomes: 144 s (Piezosurgery® 3), 126 s (Piezosurgery® Medical), 142 s (Piezon Master Surgery®), 149 s (VarioSurg®), and 137 s (Piezotome 2).
Conclusions: In the present study, micromorphological differences following the use of various ultrasonic devices were clearly identified. According to this study, it can be concluded that the power and the composition of the teeth of the insert tip might impact procedure duration and cutting qualities.

Baker J.A., Vora S., Bairam L., Kim H.I., Davis E.L., Andreana S.

Piezosurgery vs. conventional implant site preparation: ex vivo implant primary stability.

ENGLISH

Clin Oral Implants Res. 2012 Apr;23(4):433-7. doi: 10.1111/j.1600-0501.2011.02286.x. Epub 2011 Sep 15.

■ **Abstract**
Objectives: This study aims to determine differences in primary stability between implants placed in cortical bone following Piezoelectric or conventional site preparation, as assessed by resonance frequency analysis (RFA) and reverse torque testing (RTT).
Material and methods: Four fresh bovine ribs were acquired and surgical guides fabricated with five sites per rib (n = 20), for proper site preparation. Implant sites were prepared via conventional drilling technique as per manufacturer's instruction (Implantium) or via Piezoelectric (Mectron) implant site preparation using the Implant Prep kit. Twenty 10 mm long, 3.6 mm diameter Implantium implants were placed with 35 Ncm torque; 10 implants per preparation method. RFA was assessed via the Osstell Mentor. Five values were taken per implant. All implants where subjected to a reverse torque in increasing increments of 5 until 50 Ncm force was reached.
Results: The five RFA values per site were averaged and plotted by placement technique. A paired t-test statistical analysis was run. The average RFA values showed no statistical significance between the 10 test (RFA = 69.04 ± 5.11) and 10 control (RFA = 70.94 ± 6.41) sites (P > 0.05). All implants in both groups withstood RTT up to 50 Ncm force without movement and thus showed no statistical differences.
Conclusion: Results of this ex vivo study imply that the Piezoelectric implant site preparation affords similar primary implant stability in comparison to conventional rotary instrumentation in cortical bone.

von See C., Gellrich N.C, Rücker M., Kokemüller H., Kober H., Stöver E.

Investigation of perfusion in osseous vessels in close vicinity to piezoelectric bone cutting.

ENGLISH

Br J Oral Maxillofac Surg 2012 Apr;50(3):251-5. doi: 10.1016/j.bjoms.2011.04.069. Epub 2011 May 18.

■ **Abstract**
Cutting bones by piezosurgery leads to failure of perfusion at the site of the osteotomy, the cause of which cannot be identified immediately. Among other things the formation of vascular thrombi by the transmission of oscillations from the piezoelectric unit to the bone may be responsible. We used three output levels of oscillation that were predefined by the system. The outer cortical bone of the calvaria of rats (n = 24) was removed horizontally and the intraosseous vessels exposed at the surface of the osteotomy. The blood flow was then examined repeatedly using intravital fluorescence microscopy. To calculate the transmission of oscillations to the bone, the spatial oscillation frequency of each calvarium and the contact pressure during removal of bone in vitro (n = 18) were also examined. After removal of the bone there was constant blood flow at all three levels of oscillation output. In no case did an individual vessel seem to be occluded.

The excitation oscillation of the bone was established at 2000 Hz in all spatial directions, irrespective of the predefined oscillation output. The application of piezosurgery does not cause the formation of vascular thrombi in the bone. This probably results from the oscillation damping properties of bone.

Pavlíková G., Foltán R., Burian M., Horká E., Adámek S., Hejcl A., Hanzelka T., Sedý J.

Piezosurgery prevents brain tissue damage: an experimental study on a new rat model.

ENGLISH

Int. J. Oral Maxillofac. Surg. 2011 Aug;40(8):840-4. doi: 10.1016/j.ijom.2011.05.008. Epub 2011 Jun 15.

■ **Abstract**

Piezosurgery is a promising meticulous system for bone cutting, based on ultrasound microvibrations. It is thought that the impact of piezosurgery on the integrity of soft tissue is generally low, but it has not been examined critically. The authors undertook an experimental study to evaluate the brain tissue response to skull bone removal using piezosurgery compared with a conventional drilling method. In Wistar male rats, a circular bone window was drilled to the parietal bone using piezosurgery on one side and a conventional bone drill on the other side. The behavioural performance of animals was evaluated using the motor BBB test and sensory plantar test. The brains of animals were evaluated by magnetic resonance imaging (MRI) and histology. The results of MRI showed significantly increased depth and width of the brain lesion in the region of conventional drilling compared with the region where piezosurgery was used. Cresylviolet and NF 160 staining confirmed these findings. There was no significant difference in any of the behavioural tests between the two groups. In conclusion, piezosurgery is a safe method for the performance of osteotomy in close relation to soft tissue, including an extremely injury-sensitive tissue such as brain.

Salami A., Mora R., Crippa B., Gentile R., Dellepiane M., Guastini L.

Potential nerve damage following contact with a piezoelectric device.

ENGLISH

Ann Otol Rhinol Laryngol. 2011 Apr;120(4):249-54.

■ **Abstract**

Objectives: The aim of the study was to assess the extent of the potential nerve damage following prolonged contact with a piezoelectric device.

Methods: The study was conducted with 30 patients; all of the patients had cervical metastatic lymph nodes at levels II, III, and IV (N2b) and a negative evaluation for metastatic disease (M0). The patients underwent radical neck dissection. After its skeletonization,the spinal nerve was exposed directly to ultrasonic activation with a piezoelectric device for various times (5, 10, and 20 seconds) and with different inserts (OP3 insert and OT7 insert). The axonal damage was graded from 0 to 3 as follows: 0, no damage; 1, minor axonal damage; 2, severe axonal damage but not covering the entirety of the nerve fascicles; 3, severe axonal damage covering the entirety of the nerve fascicles.

Results: Histologic examination showed no evidence of damage to the perineurium and axons after 5 and 10 seconds of exposure to ultrasonic activation with each insert.

Conclusions: Our histologic data highlight the selective action of the piezoelectric device, which reduces the risk of acidental nerve damage in otolaryngological bone surgery.

von See C., Rücker M., Kampmann A., Kokemüller H., Bormann K.H., Gellrich N.C.

Comparison of different harvesting methods from the flat and long bones of rats.

ENGLISH

Br J Oral Maxillofac Surg. 2010 Dec;48(8):607-12. doi: 10.1016/j.bjoms.2009.09.012. Epub 2009 Nov 3.

■ **Abstract**

Different harvesting methods have been developed for bony augmentation before implantation. The aim of the present study was to assess the viability of endochondral (femoral) and membranous (mandibular) bone cells harvested by different methods under standard conditions in an animal model, and to investigate the surface of the bone in the harvested area. Samples of mandibular and femoral bone were harvested using a drilling burr, a piezoelectrical device, or a Safescraper®. Blocks of bone that had been harvested with cutting forceps were used as controls. The size of the samples was measured

and they were examined by conventional microscopy and immunohistochemical analysis; osteoblast-like cells were also cultured. The surface of the harvested area was analysed with scanning and conventional microscopy. There was no significant difference between mandibular and femoral bone in the size of particles harvested, but bone chips were significantly smaller when a drilling device had been used in both harvesting areas. Viability of cells in these smaller particles was significantly less than among cells harvested with a piezoelectrical device or Safescraper®. Scanning microscopy showed a smooth bony surface where a drilling burr or piezoelectrical device had been used, whereas small disruptions were observed after the Safescraper® had been used. Harvesting of particulate bone is feasible using a drilling burr, piezoelectrical device, or Safescraper® from mandibular and femoral bone. The piezoelectrical device and the Safescraper® gave comparable results concerning the viability of osteoblast-like cells, and so are preferred to a drilling burr.

Di Alberti L., Donnini F., Di Alberti C., Camerino M.

A comparative study of bone densitometry during osseointegration: piezoelectric surgery versus rotary protocols.

ENGLISH

Quintessence Int (Berl) 41(8):639-44 (2010) PMID 20657852.

■ **Abstract**

Objectives: To date, there have been no studies on the outcome of osseointegration of alveolar bone around dental implants inserted with piezoelectric osteotomy versus conventional osteotomy. The aim of this study was to compare the radiographic differences, through evaluation of peri-implant bone density, between implant insertion using traditional surgical technique and piezoelectric technique.

Method and materials: Forty patients were selected whose treatment consisted of a minimum of two implants placed in non-pathologic native bone. A single type of implant surface (SLA) was chosen. The implants were placed following the manufacturer protocol for traditional surgical technique and piezoelectric technique. Radiographs were taken following surgery and 30, 60 and 90 days after surgery. The bone density was studied with the densitometry application.

Results and conclusion: All patients completed the study period with success. Despite a limited number of treated patients, the results of this pilot study demostrated that *(1)* piezoelectric implant site preparation promotes better bone density and osteogenesis, and *(2)* the piezoelectric technique is predictable, with a 100% success rate in this study.

Maurer P., Kriwalsky M.S., Block Veras R., Vogel J., Syrowatka F., Heiss C.

Micromorphometrical analysis of conventional osteotomy techniques and ultrasonic osteotomy at the rabbit skull.

ENGLISH

Clin Oral Implants Res. 2008 Jun;19(6):570-5. doi: 10.1111/j.1600-0501.2007.01516.x.

■ **Abstract**

Objectives: The ultrasonic osteotome, which was recently introduced, is an alternative to conventional methods of osteotomy. The aim of the present study was to establish the differences between three osteotomy techniques and to perform a quantitative roughness analysis of the osteotomized bone surface.

Materials and methods: Fresh bony samples of standardized size were taken from the rabbit skull. The techniques used were as follows: reciprocate micro-saw, Lindemann bur, ultrasonic osteatome with the two insert tips OT6 (rough) and OT7 (fine). The prepared surfaces were examined by light microscopy, environmental surface electron microscopy (ESEM) and by confocal laser scanning microscopy (CLSM).

Results: It was difficult to distinguish between cortical and cancellous bone after using the conventional osteotomy technique. The ultrasonic technique preserved the original structure of the bone. The values observed for superficial roughness were as follows: 3.97 µm (micro·saw), 5.7 µm (Lindemann bur). 2.48 µm (OT7) and 3 µm (OT6). There were statistical diffeences between the values of the bur and insert tip OT6 (P= 0.01 5) as well as between the bur and insert tip OT7 (P= 0.003).

Conclusions: In the present study micromorphological differences after using various osteotomy techniques could be clearly identified.

Grauvogel J., Scheiwe C., Kaminsky J.

Use of Piezosurgery for removal of retrovertebral body osteophytes in anterior cervical discectomy.

ENGLISH

Spine J. 2014 Apr;14(4):628-36. doi: 10.1016/j.spinee.2013.06.085. Epub 2013 Dec 4.

■ **Abstract**

Background context: The relatively new technique of Piezosurgery is based on microvibrations, generated by the piezoelectrical effect, which results in selective bone cutting with preservation of adjacent soft tissue.

Purpose: To study the applicability of Piezosurgery in anterior cervical discectomy with fusion (ACDF) surgery.

Study design/setting: Prospective clinical study at the neurosurgical department of the University of Freiburg, Germany.

Patient sample: Nine patients with cervical disc herniation and retrovertebral osteophytes who underwent ACDF surgery.

Outcome measures: Piezosurgery was evaluated with respect to practicability, safety, preciseness of bone cutting, and preservation of adjacent neurovascular tissue. Pre- and postoperative clinical and radiological data were assessed.

Methods: Piezosurgery was supportively used in ACDF in nine patients with either radiculopathy or myelopathy from disc herniation or ventral osteophytes. After discectomy, osteophytes were removed with Piezosurgery to decompress the spinal canal and the foramina. Angled inserts were used, allowing for cutting even retrovertebral osteophytes.

Results: In all nine cases, Piezosurgery cut bone selectively with no damage to nerve roots, dura, or posterior longitudinal ligament. None of the patients experienced any new neurological deficit after the operation. The handling of the instrument was safe and the cut precise. Osteophytic spurs, even retrovertebral ones that generally only can be approached via corpectomies, could be safely removed because of the angled inserts through the disc space. Currently, a slightly prolonged operation time was observed for Piezosurgery. Furthermore, the design of the handpiece could be further improved to facilitate the intraoperative handling in ACDF.

Conclusions: Piezosurgery proved to be a useful and safe technique for selective bone cutting and removal of osteophytes with preservation of neuronal and soft tissue in ACDF. In particular, the angled inserts were effective in cutting bone spurs behind the adjacent vertebra which cannot be reached with conventional rotating burs.

Grauvogel J., Grauvogel T.D., Kaminsky J.

Piezosurgical lateral suboccipital craniectomy and opening of the internal auditory canal in the rat.

ENGLISH

J Neurosurg Sci. 2014 Mar;58(1):17-22.

■ **Abstract**

Aim: Rotating burs (RB), routinely used in skull base and cerebellopontine angle (CPA) surgery for craniotomy and opening of the internal auditory canal (IAC) carry some risks for neurovascular tissue due to their rotating power. This paper describes the use of piezosurgery (PS), which selectively cuts bone with preservation of soft tissue, in lateral suboccipital craniectomy and opening of the IAC in the rat.

Methods: A lateral suboccipital craniectomy and opening of the bony IAC were performed with the Mectron® piezosurgical device under microsurgical conditions in the anesthezised rat. The piezosurgical device was evaluated with respect to practicability, safety, preciseness of craniectomy and IAC opening, and preservation of adjacent neurovascular tissue. The operation procedure is described in detail.

Results: The present work shows that PS allows easy, safe and precise bone cutting with no injury to neurovascular tissue, such as dura, transverse or signoid sinus, brain, and cranial nerves. No complications were noted during the procedure. Due to the adsence of rotating power near neurovascular structures the drilling process was easy and confortable for the surgeon.

Conclusion: PS proved to be a safe, precise and easy to handle tool to perform suboccipital craniectomy and opening of IAC in the rat. Since PS makes the drilling process safer and more confortable compared to a rotating bur it may be used instead of rotating burs in all scientific applications in animal models where a safe removal of bone near delicate nervous or soft tissue structures is essential.

Farrell M., Solano M.A., Fitzpatrick N., Jovanovik J.

Use of an ex vivo canine ventral slot model to test the efficacy of a piezoelectric cutting tool for decompressive spinal surgery.

ENGLISH Vet Surg. 2013 Oct;42(7):832-9. doi: 10.1111/j.1532-950X.2013.12051.x. Epub 2013 Aug 5.

■ **Abstract**

Objective: To test the efficacy of a piezoelectric instrument (PI) for bone removal during ventral slot surgery.

Study design: *Ex vivo* feasibility study.

Sample population: Cadaveric canine cervical spinal specimens (n=3; C1–7; C1–T1; C2–T1).

Methods: The spinal cord of each explanted spinal unit was replaced with a saline-filled latex condom. In 8 disc spaces, ventral slot surgery was performed using a previously reported technique. Bone removal was achieved using a motorized burr (MB). In 8 disc spaces, bone was removed via en bloc ostectomy with a PI that selectively cuts mineralized tissue. Surgical duration and operating field visibility were recorded. Rupture of the fluid filled condom was used as a measure of iatrogenic collateral trauma. Computed tomography was used to measure ventral slot morphometry.

Results: Mean surgical duration for PI (23.4 minutes) was significantly shorter than for MB (34.1 minutes; *P=.049*). Using a 4 point Likert scale (4=excellent, 3=good, 2=fair, 1=poor), median visibility score was significantly higher for PI (2) than for MB (1; *P=.03*). The condom burst twice (1MB, 1PI) during elevation of the dorsal longitudinal ligament; there was no significant difference between techniques for incidence of collateral trauma (*P=.99)*. Regardless of surgical technique, there was a bias in slot deviation towards the right (i.e., the surgeon's left; *P=.021*).

Conclusions: The PI allowed completion of ventral slots in a significantly shorter time, without an increased incidence of iatrogenic trauma. The right-handed surgeon showed a left-sided aiming bias, regardless of surgical technique.

Jayawardene J., Choy D., Kuthubutheen J., Rajan G. P.

Piezosurgery Applications in Skull Base Surgery.

ENGLISH J Neurol Surg B 2012; 73 - A429 DOI: 10.1055/s-0032-1314338.

■ **Abstract**

Background: Skull base surgery involves frequent dissection of the bony skull base around critical neurovascular structures. Current tools for bone dissection such as the drill or saw are dangerous as they can cause significant collateral damage to these structures, thus potentially altering functional outcomes after skull base surgery. Piezosurgery, due to its soft tissue sparing and hemostatic effects, enables safe, precise and atraumatic bone dissection with the potential of expanding the capabilities of skull base surgery and reducing the associated functional morbidity. We demonstrate the various applications of piezosurgery in different skull base regions.

Methods: Retrospective case series of three skull base cases in the anterior, middle, and posterior cranial fossa using piezosurgery. An anterolateral skull base approach, a middle cranial fossa approach, and a translabyrinthine approach were performed; piezosurgery was used to dissect or expose dural and neurovascular structures under nerve monitoring. Operation time, macroscopic preservation, and functional preservation were monitored and correlated with postoperative function. Any complications were correlated with the different phases of surgery and the instruments used.

Results: Operation times were comparable to conventional procedures. Dural integrity was maintained, and the extent of bone removal was increased by piezosurgery. Dissection and exposure of neurovascular structures was achieved with macroscopic preservation and no functional irritation of neural structures. No surgical complications occurred.

Conclusion: Piezosurgery increases the extent and radicality of bone removal possible through anatomic and integrity-preserving dissection of critical neurovascular structures in the bony skull base. This enhances exposure and access in various skull base regions.

Grauvogel J., Scheiwe C., Kaminsky J.

Use of piezosurgery for internal auditory canal drilling in acoustic neuroma surgery.

ENGLISH Acta Neurochir (Wien). 2011 Oct;153(10):1941-7; discussion 1947. Epub 2011 Jul 27.

■ **Abstract**

Background: Piezosurgery is based on microvibrations generated by the piezoelectrical effect and has a selective

bone-cutting ability with preservation of soft tissue. This study examined the applicability of Piezosurgery compared to rotating drills (RD) for internal auditory canal (IAC) opening in acoustic neuroma (AN) surgery.
Materials and methods: Piezosurgery was used in eight patients for IAC drilling in AN surgery. After exposition of the IAC and tumor, the posterior wall of the IAC was drilled using Piezosurgery instead of RD. Piezosurgery was evaluated with respect to practicability, safety, preciseness of bone cutting, preservation of cranial nerves, influences on neurophysiological monitoring, and facial nerve and hearing outcome.
Results: Piezosurgery was successfully used for selective bone cutting, while cranial nerves were structurally and functionally preserved, which could be measured by means of neuromonitoring. Piezosurgery guaranteed a safe and precise cut by removing bone layer by layer in a shaping way. Compared to RD, limited influence on neurophysiological monitoring attributable to Piezosurgery was noted, allowing for continuous neuromonitoring. No disadvantage due to microvivrations was noticed concerning hearing function. The angled tip showed better handling in right-sided than in left-sided tumors in the hands of a right-handed surgeon. The short, thick handpiece may be improved for more convenient handling.
Conclusion: Piezosurgery is a safe tool for selective bone cutting for opening of the IAC with preservation of facial nerve and hearing function in AN surgery. Piezosurgery has the potential to replace RD for this indication because of its safe and precise bone-cutting properties.

Sham M.E., Sai Kiran

Efficacy of Piezo-Electric Surgery for Optic Canal Unroofing: Our Experience with Two Cases.

ENGLISH

The Open Neurosurgery Journal, 2011, 4, 24-27.

■ **Abstract**
Ultrasonic vibrations have been used to cut tissues for two decades. However, it is only in the last five years that experimental applications have been used routinely for standard clinical applications in many different fields of surgery. Surgically decompressing optic nerve, with the use of conventional drills is associated with greater risk of damage to the optic nerve itself. Developing new & precession bound safer techniques would certainly be beneficial to accomplish this task. Ultrasonic piezo bone surgery is a highly sophisticated device designed specifically for high end precession osseous surgery. In this article we describe our experience in using this device for extradural unroofing of the optic canal.

Jung S.H., Ferrer A.D., Vela J.S., Granados F.A.

Spheno-Orbital Meningioma Resection and Reconstruction: The Role of Piezosurgery and Premolded Titanium Mesh.

ENGLISH

Craniomaxillofac Trauma Reconstr. 2011 December; 4(4): 193–200. doi: 10.1055/s-0031-1286113.

■ **Abstract**
We present the clinical case of a patient with a spheno-orbital meningioma. Literature review of the treatment options, including the application of piezoelectric or ultrasound surgery and orbital reconstruction after meningioma resection, is also presented. Complete resection was performed by means of a frontotemporal craniotomy and an orbitozygomatic approach. Piezoelectric osteotomy was used around the optic nerve canal and the superior orbital fissure to minimize the damage to soft tissues. Orbital wall reconstruction was done using a titanium mesh previously premolded using a skull model. The superior orbital rim was reconstructed with calvarial bone grafts, and the sphenotemporal bone defect was covered with a titanium mesh cranioplasty. Ultrasonic vibrations to perform osteotomies in craniofacial surgery provide an interesting tool to reduce damage to surrounding soft tissues. Reconstruction of the roof and lateral orbital wall with premolded titanium meshes with a skull model is a safe and easy method to achieve a good orbital reconstruction and to avoid secondary sequelae.

Mancini G., Buonaccorsi S., Reale G., Tedaldi M.

Application of piezoelectric device in endoscopic sinus surgery.

ENGLISH

J Craniofac Surg. 2012 Nov;23(6):1736-40. doi: 10.1097/SCS.ob013e318270fa16.

■ **Abstract**

New applications of piezoelectric device have been already documented from otologic and ophthalmic endoscopic studies. The authors describe a first experience in endoscopic sinus surgery with piezosurgery to approach the paranasal sinus. Patients involved in this study presented for rhinogenous headache, rhinorrhea, nasal obstruction, and sinusitis. Radiological studies such as computed tomography of paranasal sinus and a correct clinical examination with a rigid endoscope 0 degrees were carried out, to exclude from the procedure patients with polyposis or other soft-tissue diseases. In fact, because of piezosurgery properties of micrometric and selected cutting on mineralized tissues, it has been used only to treat bone or cartilage anomalies of nasal sinus. The main advantages of the technique include soft-tissue protection and optimal visibility in the surgical field with decreased blood loss. From this preliminary report, the stability of mucous membrane previously cut has been documented by endoscopic follow-up, and the resolution of the main symptom of headache was referred. The main indications for piezosurgery shown in literature are in oral surgery, such as sinus lift, bone graft harvesting, osteogenic distraction, ridge expansion, endodontic surgery, and periodontal surgery. Other applications have been shown in otology, neurosurgery, ophthalmology, and orthopedics. Authors describe as a promising technique the piezoelectric device use in functional endoscopic paranasal sinus surgery in selected cases, with a minimal mucosal approach and thus the preservation of ventilation.

Pirodda A., Raimondi M.C., Ferri G.G.

Piezosurgery in otology: a promising device but not always the treatment of choice.

ENGLISH

Eur Arch Otorhinolaryngol. 2012 Mar;269(3):1059. doi: 10.1007/s00405-011-1841-2. Epub 2011 Nov 22.

■ **Letter to the editor**

Dear Editor,

An interesting paper by Crippa et al. [1] was recently published on the European Archives of Otorhinolaryngology, concerning the favourable effects of piezoelectric surgery on the postoperative pain as compared to microdrill in otology. Actually, even in our much more limited experience the minimal postoperative pain appears remarkable; in the same direction, the first impression about the rapidity of recovery appears noteworthy: it results in a reduced necessity of postoperative medications, due to a lesser production of granulation tissue and, consequently, to the possibility to better foresee the stabilized result with important anatomical and functional implications. On the other hand, a better control of the inflammatory processes was already reported in oral surgery [2] and appears reliable according to the observations about the bone formation subsequent to the surgical trauma reported [1]. The minimum patient discomfort derived from the employment of piezoelectric device is a further advantage in addition to its safety in ear surgery due to the capability to spare soft tissues that has been extensively documented [3]. These considerations render piezoelectric device a very promising and interesting tool, in routine tympanic and mastoid surgery as well as in selected cases when the need of respecting delicate soft tissues is prominent (e.g., particular anatomical conditions, extended processes reaching vascular and nervous structures, transmastoid surgery of the superior semicircular canal dehiscence). Nevertheless, some aspects, to date, need to be perfected: first of all, the velocity of the device appears not competitive with micro-drill yet, and needs to be improved; at the moment, a possible solution could consist in making an initial gross bone demolition by means of the traditional tool and refine the remnant bone with piezoelectric device, thus achieving the advantages of the latter in terms of a less inflammatory attitude; a second aspect is represented by the irrigation, that should in our opinion permit to choose a different regulation in order to afford a better vision of the limited operatory field: this should be an easily resolvable technical detail; finally, the width of the hand-piece makes it difficult to use it in a pure transmeatal approach when the space is particularly restricted. Taken together, these limits are not absolute but suggest the need of a further development of this important tool, that anyhow already represents an enrichment in the field of instruments for otologic surgery and seems to yield a real contribution in terms of safety and comfort.

Crippa B., Salzano F.A., Mora R., Dellepiane M., Salami A., Guastini L.

Comparison of postoperative pain: piezoelectric device versus microdrill.

ENGLISH

Eur Arch Otorhinolaryngol. 2011 Sep;268(9):1279-82. doi: 10.1007/s00405-011-1520-3. Epub 2011 Feb 16.

■ **Abstract**

Piezosurgery® is a recently developed system for cutting bone with microvibrations. The objective of this study was to compare the severity of pain over the first 10 postoperative days in a group of 70 patients who underwent intact canal wall mastoidectomy, with the piezoelectric device, and to compare the results with traditional method by means of microdrill (70 patients). The subjective perception of pain was evaluated on a scale from 0 to 10, such that 0 represented no pain and 10 represented maximum pain; the severity was recorded as null when the score was 0; slight, when it was 1–4; moderate, when it was 5–7; or severe, when it was 8–10. Compared with microdrill, the patients that underwent surgery with the piezoelectric device showed a significant ($P < 0.05$) lower postoperative pain on day 1 (52 vs. 26 patients presented a slight pain, 12 vs. 37 presented a moderate pain, and 6 vs. 7 presented a severe pain) and day 3 (68 vs. 44 patients presented a slight pain, 2 vs. 23 presented a moderate pain, and 0 vs. 3 presented a severe pain). These results highlight as the piezoelectric device is a safe and minimally invasive tool.

Salami A., Mora R., Dellepiane M., Crippa B., Santimauro V., Guastini L.

Piezosurgery versus microdrill in intact canal wall mastoidectomy.

ENGLISH

Eur Arch Otorhinolaryngol. 2010 Nov;267(11):1705-11. doi: 10.1007/s00405-010-1308-x. Epub 2010 Jun 25.

■ **Abstract**

Piezosurgery® is a recently developed system for cutting bone with microvibrations. The objectives of the present study were to report our experience with the piezoelectric device in the intact canal mastoidectomy, and to compare the results with traditional method by means of microdrill. A non-randomized controlled trial was undertaken on 60 intact canal wall mastoidectomy performed using the piezoelectric device (30 patients) or the microdrill (30 patients). Before 1 month and 1 year after surgery, all the patients underwent the following instrumental examinations: otomicroscopic evaluation of the tympanic membrane and external auditory duct, bone conduction threshold audiometry, tympanometry, transient-evoked otoacoustic emissions with linear click emission, distortion product otoacoustic emissions, auditory brainstem response (ABR) by MK 12-ABR screener with natus-ALGO2e (Amplifon, Milan, Italy), and electronystamographic recording. The piezoelectric device is proved to be effective in sclerotic and pneumatic mastoid, with an excellent control and without side effects on the adjacent structures of the middle and inner ear (lateral sinus, facial nerve, and/or dura mater). The operation time has been the same as compared with microdrill, and the average hospital stay was significantly ($p < 0.05$) shorter. Postoperatively, all patients had uneventful recovery with no evidence of audiovestibular deficit or side effects. Our experience highlights the safety of the piezoelectric device on the anatomic structures of the middle and inner ear, and demonstrates its efficiency in terms of cutting precision and healing process.

Salami A., Mora R., Dellepiane M., Guastini L.

Piezosurgery® for removal of symptomatic ear osteoma.

ENGLISH

Eur Arch Otorhinolaryngol. 2010 Oct;267(10):1527-30. doi: 10.1007/s00405-010-1289-9. Epub 2010 Jun 4.

■ **Abstract**

Piezosurgery is an ultrasound instrument (24.7-29.5 kHz) that is able to cut the bone without necrosis and nonmineralized tissue damage. The aim of this work has been to determine the applicability and efficiency of the piezoelectric device in the excision of symptomatic ear osteomas. 10 patients affected by osteoma of the external auditory canal (EAC) (6 right, 4 left) were enrolled. Patients underwent excision of the EAC osteoma through a transcanal approach, with the piezoelectric device. Before and 6 months after surgery, all the patients underwent pure-tone audiometry, tympanometry, transient-evoked otoacoustic emissions, distortion product otoacoustic emissions, auditory brainstem response, and electronystamographic recording. The piezoelectric device provided excellent control without side effects on the adjacent structures of the external, middle and inner ear. The piezoelectric device is a new bony scalpel using the microvibrations at ultrasonic frequency so that soft tissue (nerve, vessel, dura mater, skin, etc.) will not be damaged even on accidental contact with the cutting tip. A feature of the piezoelectric device is its good manageability, which makes it easy for a well-trained otologic surgeon to create a straight osteotomy line: this renders the piezoelectric device suitable for bone surgery and for removal osteomas of the EAC.

Salami A., Mora R., Dellepiane M., Crippa B., Guastini L.

Results of revision mastoidectomy with Piezosurgery®.

ENGLISH Acta Otolaryngol. 2010 Oct;130(10):1119-24. doi: 10.3109/00016481003716536.

■ **Abstract**

Conclusion: For otologic revision surgery, the advantage of the piezoelectric device appears real because it is possible to perform a 'blind' cutting of bone with fewer precautions necessary for soft tissues such as the facial nerve, lateral sinus, and dura mater.

Objectives: The aim of this study was to determine the efficiency of the piezoelectric device in revision surgery for chronic otitis media.

Methods: A total of 30 patients had revision mastoidectomy with previous canal wall up mastoidectomy. The piezoelectric device was used in all intraoperative steps. Before surgery and 1 month and 1 year after surgery, all the patients underwent the following instrumental examinations: pure-tone audiometry, tympanometry, transient-evoked otoacoustic emissions, distortion product otoacoustic emissions, auditory brainstem response, and electronystamographic recording.

Results: The piezoelectric device provided effective cutting, with excellent control and without side effects on the adjacent structures of the middle and inner ear (lateral sinus, facial nerve, and/or dura mater). Postoperatively, all patients had an uneventful recovery with no evidence of audiovestibular deficit or side effects. Among 30 cases followed for 1 year, 29 (97%) maintained a dry and safe ear. Intermittent otorrhea with perforation of the tympanic membrane occurred in one patient (3%).

Salami A., Dellepiane M., Proto E., Mora R.

Piezosurgery in otologic surgery: four years of experience.

ENGLISH Otolaryngol Head Neck Surg. 2009 Mar;140(3):412-8.

■ **Abstract**

Objective: Piezosurgery (Mectron Medical Technology, Genoa, Italy) is a new ultrasound instrument (24.7-29.5 kHz) that is able to cut the bone without necrosis and nonmineralized tissues damage. The aim of this work has been to report our experience with the piezoelectric device in otologic surgery.

Study design: We have used the piezoelectric device in 50 patients affected by otosclerosis, 50 by chronic otitis media, 20 by posttraumatic facial nerve palsy, 10 by type A glomus tympanicum tumor, and in three patients with a B-cell non-Hodgkin lymphoma.

Methods: Patients underwent platinotomy, mastoidectomy, antroatticotomy, posterior tympanotomy, facial nerve decompression, and excision of middle ear tumors. Before and 6 months after surgery, all the patients underwent the following instrumental examinations: pure-tone audiometry, tympanometry, transient-evoked otoacoustic emissions, distortion product otoacoustic emissions, auditory brainstem response, and electronystamographic recording.

Results: In each surgical technique, the piezoelectric device provided excellent control without side effects on the adjacent structures of the middle and inner ear.

Conclusions: The piezoelectric device is a new and revolutionary bony scalpel using the microvibrations at ultrasonic frequency so that soft tissue will not be damaged even on accidental contact with the cutting tip; this renders the piezoelectric device ideal for otologic bone surgery.

Robiony M., Casadei M., Sbuelz M., Della Pietra L., Politi M.

Ultrasonic aesthetic cranioplasty.

ENGLISH J Craniofac Surg. 2014 Jul;25(4):1448-50. doi: 10.1097/SCS.0000000000000793.

■ **Abstract**

The management of frontal bone injury is an important issue, and inappropriate management of such injuries may give rise to serious complications. Piezosurgery is a technique used to perform safe and effective osteotomies using piezoelectric ultrasonic vibrations. This instrument allows a safe method for osteotomy of the cranial vault in close proximity to extremely injury-sensitive tissue such as the brain. After a wide review of the literature, the authors present this technical report, introduce the use of piezosurgery to perform a safe "slim-osteotomies" for treatment of posttraumatic frontal bone deformities, and suggest the use of this instrument for aesthetic recontouring of the craniofacial skeleton.

Ponto K.A., Zwiener I., Al-Nawas B., Kahaly G.J., Otto A.F., Karbach J., Pfeiffer N., Pitz S.

Piezosurgery for orbital decompression surgery in thyroid associated orbitopathy.

ENGLISH J Craniomaxillofac Surg. 2014 Jun 26. pii: S1010-5182(14)00204-2. doi: 10.1016/j.jcms.2014.06.020. [Epub ahead of print]

■ **Abstract**

The purpose of this study was to assess a piezosurgical device as a novel tool for bony orbital decompression surgery. At a multidisciplinary orbital center, 62 surgeries were performed in 40 patients with thyroid associated orbitopathy (TAO). Within this retrospective case-series, we analyzed the medical records of these consecutive unselected patients. The reduction of proptosis was the main outcome measure. Indications for a two (n = 27, 44%) or three wall (35, 56%) decompression surgery were proptosis (n = 50 orbits, 81%) and optic neuropathy (n = 12, 19%). Piezosurgery enabled precise bone cuts without intraoperative complications. Proptosis decreased from 23.6 ± 2.8 mm (SD) by 3 mm (95% CI: - 3.6 to - 2.5 mm) after surgery and stayed stable at 3 months (- 3 mm, 95% CI: - 3.61 to - 2.5 mm, $p < 0.001$, respectively). The effect was higher in those with preoperatively higher values (> 24 mm versus ≤ 24 mm: - 3.4 mm versus - 2.81 mm before discharge from hospital and - 4.1 mm versus - 2.1 mm at 3 months: $p < 0.001$, respectively). After a mean long-term follow-up period of 14.6 ± 10.4 months proptosis decreased by further - 0.7 ± 2.0 mm ($p < 0.001$). Signs of optic nerve compression improved after surgery. Infraorbital hypesthesia was present in 11 of 21 (52%) orbits 3 months after surgery. The piezosurgical device is a useful tool for orbital decompression surgery in TAO. By cutting bone selectively, it is precise and reduces the invasiveness of surgery. Nevertheless, no improvement in outcome or reduction in morbidity over conventional techniques has been shown so far.

Robiony M., Costa F., Politi M.

Ultrasound endoscopic bone cutting for rapid maxillary expansion.

ENGLISH J Oral Maxillofac Surg. 2014 May;72(5):980-90. doi: 10.1016/j.joms.2013.10.004. Epub 2013 Oct 16.

■ **Abstract**

Purpose: This study evaluated the feasibility and morbidity of ultrasound endoscopic rapid maxillary expansion.

Patients and methods: Thirteen consecutive patients (7 women and 6 men; mean age at time of surgery, 22 yr 10 months; range, 15 yr 4 months to 26 yr 3 months) who required surgically assisted rapid palatal expansion were included in this study. Eight patients had Class III malocclusion and 5 had Class II malocclusion. All osteotomies were performed using ultrasound bone-cutting instruments under direct visualization with a rigid 30° 2.7-mm-diameter endoscope connected to a video system, with access through 3 small vertical incisions.

Results: Satisfactory maxillary expansion was achieved in all patients, with minimal postsurgical sequelae. The average operative time for the 13 cases was 74 minutes (standard deviation, 11 minutes) and was not dependent on the quality of bone. Postoperative pain was measured using a visual analog scale ranging from 0 to 10 and was found to be 1.5 ± 0.8 on the first postoperative day, which decreased to 0.9 ± 0.4 on the second day. Mucosal healing was excellent and none of the patients had excessive edema, hematoma formation, or nerve injury.

Conclusion: The procedure described is minimally invasive and has advantages over the usual technique in providing direct vision, creation of a precise and safe osteotomy, minimal bleeding risk, and decreased dissection.

Chiarini L., Albanese M., Anesi A., Galzignato P.F., Mortellaro C., Nocini P., Bertossi D.

Surgical treatment of unilateral condylar hyperplasia with piezosurgery.

ENGLISH

J Craniofac Surg. 2014 May;25(3):808-10. doi: 10.1097/SCS.0000000000000699.

■ **Abstract**

Introduction: Unilateral condylar hyperplasia (UCH) is a disorder of unknown etiology mainly seen in growing patients, which results in facial asymmetry. High condylectomy alone or in association with orthognathic surgery can improve the occlusion and the facial aesthetics.

Materials and methods: Between 2005 and 2012, a total of 5 patients underwent high condylectomy for UCH using a piezoelectric cutting device. All patients were treated postoperatively with functional rehabilitation.

Results: The long-term follow-up showed that all patients had a satisfactory temporomandibular joint articular function associated with stable occlusion without any recurrence of further condylar growth.

Conclusions: High condylectomy in the surgical treatment of unilateral UCH seems to be the procedure of choice in growing patients. The use of a piezoelectric cutting device allows a safe and less invasive high condylectomy.

Bertossi D., Albanese M., Chiarini L., Corega C., Mortellaro C., Nocini P.

Eagle syndrome surgical treatment with piezosurgery.

ENGLISH

J Craniofac Surg. 2014 May;25(3):811-3. doi: 10.1097/SCS.0000000000000700.

■ **Abstract**

Introduction: Eagle syndrome (ES) is an uncommon complication of styloid process elongation with stylohyoideal complex symptomatic calcification. It is an uncommon condition (4% of the population) that is symptomatic in only 4% of the cases. Eagle syndrome is usually an acquired condition that can be related to tonsillectomy or to a neck trauma. A type of ES is the styloid-carotid syndrome, a consequence of the irritation of pericarotid sympathetic fibers and compression on the carotid artery. Clinical manifestations are found most frequently after head turning and neck compression. Although conservative treatment (analgesics, anticonvulsants, antidepressants, local infiltration with steroids, or anesthetic agents) have been used, surgical treatment is often the only effective treatment in symptomatic cases.

Materials and methods: We present the case of a 55-year-old patient, successfully treated under endotracheal anesthesia. The cranial portion of the calcified styloid process was shortened through an external approach, using a piezoelectric cutting device (Piezosurgery Medical II; Mectron Medical Technology, Carasco, Italy) with MT1-10 insert, pump level 4, vibration level 7.

Results: No major postoperative complications such as nerve damage, hematoma, or wound dehiscence occurred. After 6 months, the patient was completely recovered. Two years after the surgery, the patient did not refer any symptoms related to ES.

Conclusions: The transcervical surgical approach in patients with ES seems to be safe and effective, despite the remarkable risk for transient marginal mandibular nerve palsy. This risk can be decreased by the use of the piezoelectric device for its distinctive characteristics—such as precision, selective cut action, and bloodless cut.

Spinelli G., Lazzeri D., Conti M., Agostini T., Mannelli G.

Comparison of piezosurgery and traditional saw in bimaxillary orthognathic surgery.

ENGLISH

J Craniomaxillofac Surg. 2014 Mar 20. pii: S1010-5182(14)00080-8. doi: 10.1016/j.jcms.2014.02.011. [Epub ahead of print]

■ **Abstract**

Purpose: Investigators have hypothesised that piezoelectric surgical device could permanently replace traditional saws in conventional orthognathic surgery.

Methods: Twelve consecutive patients who underwent bimaxillary procedures were involved in the study. In six patients the right maxillary and mandible osteotomies were performed using traditional saw, whilst the left osteotomies by piezoosteotomy; in the remaining six patients, the surgical procedures were reversed. Intraoperative blood loss, procedure duration time, incision precision, postoperative swelling and haematoma, and nerve impairment were evaluated to compare the outcomes and costs of these two procedures.

Results: Compare to traditional mechanical surgery, piezoosteotomy showed a significant intraoperative blood loss reduction of 25% ($p = 0.0367$), but the mean surgical procedure duration was longer by 35% ($p = 0.0018$). Moreover, the use of

piezoosteotomy for mandible procedure required more time than for the maxillary surgery (p = 0.0003). There was a lower incidence of postoperative haematoma and swelling following piezoosteotomy, and a statistically significant reduction in postoperative nerve impairment (p = 0.003).
Conclusions: We believe that piezoelectric device allows surgeons to achieve better results compared to a traditional surgical saw, especially in terms of intraoperative blood loss, postoperative swelling and nerve impairment. This device represents a less aggressive and safer method to perform invasive surgical procedures such as a Le Fort I osteotomy. However, we recommend the use of traditional saw in mandible surgery because it provides more foreseeable outcomes and well-controlled osteotomy. Further studies are needed to analyse whether piezoosteotomy could prevent relapse and promote bony union in larger advancements.

Iacoangeli M., Rienzo A.D., Nocchi N., Balercia P., Lupi E., Regnicolo L., Somma L.G., Alvaro L., Scerrati M.

Piezosurgery as a Further Technical Adjunct in Minimally Invasive Supraorbital Keyhole Approach and Lateral Orbitotomy.

ENGLISH

J Neurol Surg A Cent Eur Neurosurg. 2014 Feb 19. [Epub ahead of print]

■ **Abstract**
Objective: One of the problems in neurosurgery is how to perform rapid and effective craniotomies that minimize the risk of injury to underlying eloquent structures. The traditional high-powered pneumatic tools and saws are efficient in terms of speed and penetration, but they can provoke bone necrosis and sometimes damage neurovascular structures. As an alternative, we evaluated the piezoelectric bone scalpel (piezosurgery), a device that potentially allows thinner and more precise bone cutting without lesioning neighboring delicate structures, even in the case of accidental contact.
Material and methods: From January 2009 to December 2011, 20 patients (8 men and 12 women), 19 to 72 years of age (mean: 49.3 years) were treated using piezosurgery. Surgery was performed for the removal of anterior cranial fossa meningiomas, orbital tumors, and sinonasal lesions with intracranial extension.
Results: The time required to perform craniotomy using piezosurgery is a few minutes longer than with traditional drills. No damage was observed using the piezoelectric device. Follow-up clinical and neuroradiologic evaluation showed a faster and better ossification of the bone flap with good esthetic results.
Conclusions: Piezosurgery is a new promising technique for selective bone cutting with soft tissue preservation. This instrument seems suitable to perform precise thin osteotomies while limiting damage to the bone itself and to the underlying delicate structures even in the case of unintentional contact. These advantages make the piezoelectric bone scalpel a particularly attractive instrument in neurosurgery.

Ghassemi A., Prescher A., Talebzadeh M., Hölzle F., Modabber A.

Osteotomy of the nasal wall using a newly designed piezo scalpel - a cadaver study.

ENGLISH

J Oral Maxillofac Surg. 2013 Dec;71(12):2155.e1-6. doi: 10.1016/j.joms.2013.07.028. Epub 2013 Sep 25.

■ **Abstract**
Purpose: Achieving the desired outcome in rhinoplasty depends on many factors. Osteotomy and adjustment of the lateral nasal wall are important steps that necessitate careful planning and execution. A cadaver study was performed to evaluate the osteotomy result obtained with a newly designed piezoelectric-based scalpel.
Materials and methods: Twenty lateral osteotomies of the nasal wall were performed in 10 human cadaver noses. The osteotomies were conducted in 6 female and 4 male cadavers (age range, 65 to 83 yr; mean age, 74.8 yr). A specially designed Piezosurgery-based scalpel was used endonasally to perform the lateral osteotomy. Cutting of the bony nasal wall was performed subperiostally along the planned osteotomy route under tactile control. Digital infracturing was accomplished by applying gentle pressure. After completing the osteotomy, the osteotomy line and nasal mucosa were examined endoscopically. The skin cover was removed to examine the lateral bony nasal wall for the shape and amount of bone fragments, the osteotomy path, and mucosa involvement.
Results: Using the Piezosurgery-based scalpel required a learning curve, but the handling was easy. It allowed an exact performance of the osteotomy and caused no mucosal tearing. If excessive force was used, the piezo tip stopped working. There was no comminuted fracture pattern and the lateral nasal wall remained in 1 piece. The duration of the osteotomy was

5 to 10 minutes on each side.
Conclusion: The piezoelectric-based scalpel is a useful tool, which can be used to perform osteotomy of the nasal wall. In addition, this specifically designed tool tip allows an endonasal approach, is easy to handle, and allows effective irrigation of the osteotomy region.

Bertossi D., Lucchese A., Albanese M., Turra M., Faccioni F., Nocini P., Rodriguez Y Baena R.

Piezosurgery versus conventional osteotomy in orthognathic surgery: a paradigm shift in treatment.

ENGLISH J Craniofac Surg. 2013 Sep;24(5):1763-6. doi: 10.1097/SCS.0b013e31828f1aa8.

■ **Abstract**
The aim of the study was to compare in a randomized controlled clinical trial the use of the piezoelectric osteotomy as an alternative to the conventional approach in terms of surgery time, intraoperative blood loss, cut quality, nerve injury, and costs. One hundred ten patients who had orthognathic surgery procedures with bimaxillary osteotomy were divided into 2 groups: group A was treated with a piezosurgery device, and group B, with a reciprocating saw and bur. The piezosurgical bone osteotomy permitted individualized cut designs. The surgical time in group A was reduced, with a mean for the mandibular osteotomy (1 side) between 3 minutes 31 seconds and 5 minutes 2 seconds, whereas in group B, the surgical time was between 7 minutes 23 seconds and 10 minutes 22 seconds. The surgical time in group A for the Le Fort I osteotomy was between 5 minutes 17 seconds and 7 minutes 55 seconds in group A and between 8 minutes 38 seconds and 15 minutes 11 seconds in group B. All patients in group A had a low blood loss (<300 mL) versus patients of group B who had a medium to high blood loss (medium loss: 400 mL, high loss: >500 mL). Inferior alveolar nerve sensation was retained in 98.2% of group A versus 92.7% in group B at 6 months postoperative testing. Piezoelectric osteotomy reduced surgical time, blood loss, and inferior alveolar nerve injury in bimaxillary osteotomy. Absence of macrovibrations makes the instrument more manageable and easy to use and allows greater intraoperative control with higher safety in cutting in difficult anatomical regions.

Gennaro P., Chisci G., Aboh I.V., Iannetti G.

Inferior alveolar nerve lateralization: a dual technique.

ENGLISH Int J Oral Maxillofac Surg. 2013 Jun;42(6):796-7. doi: 10.1016/j.ijom.2013.02.015. Epub 2013 Apr 2.

■ **Letter to the editor**
Dear Editor
We read the article 'Rehabilitation of edentulous posterior atrophic mandible: inferior alveolar nerve lateralization by piezotome and immediate implant placement' by Fernández Díaz & Naval Gías with great interest, and we congratulate the authors for their review of inferior alveolar nerve lateralization (IANL) and for describing the challenges in re-using an updated technique. The use of piezosurgery is an appealing concept in maxillofacial surgery due to the frequent proximity of the bone surgical site to the nerve and/or vascular tissues; many studies have suggested this application in implant surgery, and have reported satisfactory in vivo and in vitro results compared with the bur technique. In the discussion section, Fernández Díaz and Naval Gías refer to the common habit of the surgeon to choose techniques based on their own experience. We partially agree with this concept, as young surgeons and researchers often introduce new techniques or use validated theories from other medical disciplines to find better postoperative outcomes; hence this appears to be a related condition, more due to the specific personal characteristics of some surgeons than to a common habit. Fernández Díaz and Naval Gías discuss mandibular atrophy, a common case in prosthetic dentistry, and refer to the occurrence of vertical bone resorption and postoperative infections due to wound dehiscence as complications in mandibular bone grafts that could suggest the use of IANL to obtain the needed vertical bone instead. They also relate the use of a sandwich technique as a key factor in decreasing the occurrence of such situations. With the evidence of many studies, we think that the type and origin of the bone graft have a strong influence on graft resorption, and in recent years many authors have reported better outcomes with calvarial grafts compared with iliac crest grafts in the rehabilitation of mandibular atrophy. ITURRIAGA and RUIZ determined a crestal height reduction of 1.5–2.5 mm in 6% of 233 dental implants inserted on calvarial grafts in 58 patients. Hence mandibular grafts are still a matter of interest in maxillofacial surgery, and the indication for and choice between IANL and graft appears to be the target to focus on, rather than the techniques themselves, which have both been shown to be reliable. We recently used the IANL for a different reason: a 48-year-old man was referred due to IAN hypoesthesia after implant surgery on the posterior mandible. We used the preoperative and postoperative trigeminal evoked potential to assess neurosensory function. After a panoramic radiograph and computed tomography (CT) scan, it was discovered that the implant fixture interrupted the IAN. A simple implant removal with counter-torque ratchet technique or high speed bur could have caused further damage to the

nerve during implant removal, due to the spiral shape of the implant. Hence IANL was performed under general anesthesia to obtain a correct lateralization of the IAN during implant removal. Differently to Fernández Díaz and Naval Gías, we achieved a bevel shape on the contours of the osteotomy section to obtain an improved direct view of the mandibular nerve and to better place the cortical outer bone after IANL. Postoperative visits showed a gradual recovery of the neuronal lesion, and the trigeminal evoked potential after 6 months showed recovery of neuronal function.-Many patients are referred to our Department of Maxillofacial Surgery in Siena for surgical treatment of iatrogenic problems. We believe that IANL performed with piezosurgery is a useful technique for all conditions requiring a surgical intervention in maxillofacial and implant surgery. We used IANL for the treatment of complications after implant dentistry, while Fernández Díaz and Naval Gías have shown IANL with the piezotome to be a reliable technique in implant dentistry. Our results regarding the recovery of the neuronal disturbance after surgical intervention, along with the evidence in the literature, suggest IANL to be a dual technique, useful for both implant removal and prosthetic surgery.

Hoffmann E., Räder C., Fuhrmann H., Maurer P.

Styloid-carotid artery syndrome treated surgically with Piezosurgery: A case report and literature review.

ENGLISH

J Craniomaxillofac Surg. 2013 Mar;41(2):162-6. doi: 10.1016/j.jcms.2012.07.004. Epub 2012 Aug 16.

■ **Abstract**

Styloid-carotid artery syndrome was first described by Eagle and is associated with cervical and facial pain caused by head movement resulting from mechanical compression of the carotid nerve plexus due to an elongated styloid process. The case of a 49-year-old man with persistent cervical pain, neurological symptoms and an elongated styloid process of 7.5 cm is reported here; this patient was successfully treated using Piezosurgery. In addition, a literature review is included.

Rana M., Gellrich N.C., Rana M., Piffkó J., Kater W.

Evaluation of surgically assisted rapid maxillary expansion with piezosurgery versus oscillating saw and chisel osteotomy – a randomized prospective trial.

ENGLISH

Trials. 2013 Feb 17;14:49. doi: 10.1186/1745-6215-14-49.

■ **Abstract**

Background: Ultrasonic bone-cutting surgery has been introduced as a feasible alternative to the conventional sharp instruments used in craniomaxillofacial surgery because of its precision and safety. The piezosurgery medical device allows the efficient cutting of mineralized tissues with minimal trauma to soft tissues. Piezoelectric osteotome has found its role in surgically assisted rapid maxillary expansion (SARME), a procedure well established to correct transverse maxillary discrepancies. The advantages include minimal risk to critical anatomic structures. The purpose of this clinical comparative study (CIS 2007-237-M) was to present the advantages of the piezoelectric cut as a minimally invasive device in surgically assisted, rapid maxillary expansion by protecting the maxillary sinus mucosal lining.

Methods: Thirty patients (18 females and 12 males) at the age of 18 to 54 underwent a surgically assisted palatal expansion of the maxilla with a combined orthodontic and surgical approach. The patients were randomly divided into two separate treatment groups. While Group 1 received conventional surgery using an oscillating saw, Group 2 was treated with piezosurgery. The following parameters were examined: blood pressure, blood values, required medication, bleeding level in the maxillary sinus, duration of inpatient stay, duration of surgery and height of body temperature.

Results: The results displayed no statistically significant differences between the two groups regarding laboratory blood values and inpatient stay. The duration of surgery revealed a significant discrepancy. Deploying piezosurgery took the surgeon an average of 10 minutes longer than working with a conventional-saw technique. However, the observation of the bleeding level in the paranasal sinus presented a major and statistically significant advantage of piezosurgery: on average the bleeding level was one category above the one of the remaining patients.

Conclusion: This method of piezoelectric surgery with all its advantages is going to replace many conventional operating procedures in oral and maxillofacial surgery.

Ochiai S., Kuroyanagi N., Sakuma H., Sakuma H., Miyachi H., Shimozato K.

Endoscopic-assisted resection of peripheral osteoma using piezosurgery.

ENGLISH

Oral Surg Oral Med Oral Pathol Oral Radiol. 2013 Jan;115(1):e16-20. doi: 10.1016/j.oooo.2011.09.032. Epub 2012 May 10.

■ **Abstract**

Endoscopic-assisted surgery has gained widespread popularity as a minimally invasive procedure, particularly in the field of maxillofacial surgery. Because the surgical field around the mandibular angle is extremely narrow, the surrounding tissues may get caught in sharp rotary cutting instruments. In piezosurgery, bone tissues are selectively cut. This technique has various applications because minimal damage is caused by the rotary cutting instruments when they briefly come in contact with soft tissues. We report the case of a 33-year-old man who underwent resection of an osteoma in the region of the mandibular angle region via an intraoral approach. During surgery, the complete surgical field was within the view of the endoscope, thereby enabling the surgeon to easily resection the osteoma with the piezosurgery device. Considering that piezosurgery limits the extent of surgical invasion, this is an excellent low-risk technique that can be used in the field of maxillofacial surgery.

Iacoangeli M., Neri P., Balercia P., Lupi E., Di Rienzo A., Nocchi N., Alvaroa L., Scerrati M.

Piezosurgery for osteotomies in orbital surgery: Our experience and review of the literature.

ENGLISH

Int J Surg Case Rep. 2013;4(2):188-91. doi: 10.1016/j.ijscr.2012.11.006. Epub 2012 Nov 17.

■ **Abstract**

Introduction: Piezoelectric bone surgery, simply known as Piezosurgery®, is a new promising technique for bone cutting based on ultrasonic microvibrations that allows to perform precise and thin osteotomies with soft tissue sparing.

Presentation of case: A 45-years-old woman presenting with progressive left ocular pain, diplopia on the lateral left gaze, and visible exophthalmos was admitted to our department. CT scan and MRI images documented a left supero-lateral orbital lesion. A left lateral orbitotomy using the piezoelectric scalpel was performed. The tumour (lacrimal gland lymphoma) was completely removed with no injuries to the orbital structures and with a perfect realignment of the bone stumps.

Discussion: High powered pneumatic osteotome are commonly used to perform craniotomies. Large bone cutting groove and high temperatures developing at the contact site could produce an uneasy bone healing. The use of a piezoelectric scalpel allows to realize precise and thin osteotomies, facilitating craniotomy's borders ossification and avoiding injuries to non-osseous structures.

Conclusion: Widely used in Oral and Maxillofacial Surgery, Piezosurgery® can also be useful in neurosurgical approaches in order to obtain a faster bone flap re-ossification, a better aesthetic result, and a lower risks of dural layer and soft tissue damage.

Itro A., Lupo G., Carotenuto A., Filipi M., Cocozza E., Fiengo G., Marra A.

Management of temporomandibular joint ankylosis: a case report of joint replacement with piezoelectric surgery.

ENGLISH

Minerva Stomatol. 2012 Jul-Aug;61(7-8):329-35.

■ **Abstract**

Aim: Temporomandibular joint (TMJ) ankylosis is a joint disorder which refers to bone or fibrous adhesion of the anatomic joint components and the ensuing loss of function. This report describes the management of a case of bilateral TMJ ankylosis in a 20-year-old patient with prosthetic replacement with the aid of a piezoelectric instrument (MECTRON (R).

Methods: The right ankylotic mass was surgically removed and replaced by a custom-made prosthesis based on data obtained from three-dimensional computed tomography (CT) reconstruction of the skull of the patient using a stereolithography model.

Results: At six months postoperative, the opening of the mouth was stable at 36 mm and imaging studies (CT and magnetic resonance imaging [MRI]) showed a great condylar prosthesis and surrounding tissues in addition to partial remodeling of

the left TMJ.
Conclusion: In this patient, despite the bilateral ankylosis, it was sufficient to intervene only on the right TMJ, which presented a serious bone block, with mobilization since surgery gradually restored the anatomical and functional conditions of the left TMJ compatible with normal activities of mastication and speech.

Itro A., Lupo G., Carotenuto A., Filipi M., Cocozza E., Marra A.

Benefits of piezoelectric surgery in oral and maxillofacial surgery. Review of literature.

ENGLISH

Minerva Stomatol. 2012 May;61(5):213-24.

■ **Abstract**
Piezoelectric surgery is based on the use of ultrasound for the cutting of bones. It represents an innovative technique, as it offers the maxillofacial surgeon the opportunity of making precise bone cuts without damaging any soft tissue, minimizing the invasiveness of surgical procedure, and the opportunity of working in a field which is almost totally blood-free. It reduces the impact on soft tissues (vessels and nerves) which lie adjacent to the areas of treatment. Compared to traditional methods, it enables optimal healing because it reduces the postsurgery swelling and discomfort. In this article the authors realized a review of the literature.

Rougeot A., Koppe M., Gleizal A.

The use of Piezosurgery™ for external dacryocystorhinostomy.

ENGLISH

Br J Oral Maxillofac Surg. 2012 Apr 17. [Epub ahead of print]

■ **No Abstract available**

Nusrath M.A., Postlethwaite K.R.

Use of piezosurgery in calvarial bone grafts and for release of the inferior alveolar nerve in sagittal split osteotomy: technical note.

ENGLISH

Br J Oral Maxillofac Surg 2011 Dec;49(8):668-9. doi: 10.1016/j.bjoms.2010.09.024. Epub 2011 Jan 7.

■ **No Abstract available**

Salgarelli A.C., Robiony M., Consolo U., Collini M., Bellini P.

Piezosurgery to perform hyoid bone osteotomies in thyroglossal duct cyst surgery.

ENGLISH

J Craniofac Surg. 2011 Nov;22(6):2272-4. doi: 10.1097/SCS.0b013e318232788e.

■ **Abstract**
Ultrasonic bone-cutting surgery has been introduced as a feasible alternative to the conventional sharp instruments used in craniomaxillofacial surgery because of its precision and safety. The device used is unique in that the cutting action occurs when the tool is used on mineralized tissues and stops on soft tissues. This work describes the use of piezosurgery for hyoid bone resection in thyroglossal duct cyst surgery, briefly reviews the literature on the surgical technique, and reports our experience with 12 cases.

Wagner M.E., Rana M., Traenkenschuh W., Kokemueller H., Eckardt A.M., Gellrich N.C.

Piezoelectric-assisted removal of a benign fibrous histiocytoma of the mandible: an innovative technique for prevention of dentoalveolar nerve injury.

ENGLISH

Head Face Med. 2011 Oct 31;7:20. doi: 10.1186/1746-160X-7-20.

■ **Abstract**

In this article, we present our experience with a piezoelectric-assisted surgical device by resection of a benign fibrous histiocytoma of the mandible. A 41 year-old male was admitted to our hospital because of slowly progressive right buccal swelling. After further radiographic diagnosis surgical removal of the yellowish-white mass was performed. Histologic analysis showed proliferating histiocytic cells with foamy, granular cytoplasm and no signs of malignancy. The tumor was positive for CD68 and vimentin in immunohistochemical staining. Therefore the tumor was diagnosed as primary benign fibrous histiocytoma. This work provides a new treatment device for benign mandibular tumour disease. By using a novel piezoelectric-assisted cutting device, protection of the dentoalveolar nerve could be achieved.

Nocini P.F., Turra M., Valsecchi S., Blandamura S., Bedogni A.

Microvascular Free Bone Flap Harvest With Piezosurgery.

ENGLISH

J Oral Maxillofac Surg. 2011 May;69(5):1485-1492. doi: 10.1016/j.joms.2009.10.016. Epub 2010 Jun 29.

■ **No Abstract available**

Robiony M., Polini F.

Piezosurgery: a safe method to perform osteotomies in young children affected by hemifacial microsomia.

ENGLISH

J Craniofac Surg. 2010 Nov;21(6):1813-5. doi: 10.1097/SCS.0b013e3181f43e03.

■ **Abstract**

Piezosurgery is a new innovating technique used to perform safe and effective osteotomies using piezoelectric ultrasonic vibrations. It was conceived by Tomaso Vercellotti, MD, DDS, and it was first reported for preprosthetic surgery, as alveolar crest expansion, sinus grafting, and, more recently, alveolar distraction. The purpose of this report was to introduce and justify the use of Piezosurgery to perform osteotomies during mandibular distraction in cases of hemifacial microsomia.

Laurentjoye M., Jeanniot P.Y., Beziat J.L., Gleizal A.

Piezoelectric osteotomies during fibula free flap harvesting.

ENGLISH

J Plast Reconstr Aesthet Surg. 2010 May;63(5):e495-6. Epub 2009 Oct 8.

■ **Correspondence and communication**

Piezosurgery is useful in a variety of oral cranio-maxillofacial and otologic surgical procedures. This new technique of osteotomy carries out precise and selective cut. Hard and soft tissues are cut at different frequencies. These are presented here the piezosurgical used during osteotomies of the useful fibula free flap. Disadvantages encountered with the fibula free flap have occurred when dissecting the pedicle as Collins described recently: risks of damage to the peroneal vessels during dissection and osteotomies. The good osteotomies placing are very difficult when contouring the fibula in mandibular reconstruction. Proximal and distal osteotomies are performed using ultrasonic bone cutting (Mectron, Piezosurgery). The ultrasonic device is composed of 16 W generator attached by a flexible cord. An automatic irrigation system is connected for cooling during osteotomies. One insert is used for cutting: OT7. All osteotomies are realised without protection of the pedicle on the deep surface of the fibula. Classiquely, osteotomies are performed using a sagittal oscillating saw with elevator on the postero-medial surface of the fibula to protect the pedicle. Subperiosteal dissection, necessary to put the elevator protecting the vessels, can cause pedicle lesions. Piezosurgery can be used for osteotomies without protections of the pedicle during flap harvesting or after when contouring the fibula for mandibular reconstruction. This technique decreases the risk of

pedicle damages during manipulations. Moreover, the piezoelectric bone surgery ensure a precise micrometric bone cutting action which facilitate ideal placement of osteotomies. Extra osteotomies when contouring fibula could be realised during harvesting while it is still attached to the leg. With piezosurgery, cutting a fixed bone is easier and faster than cutting a mobil bone. Moreover, this technique maintains a blood-free operative area secondary to the cavitation effect from the irrigation solution. The cost of a good ultrasonic device is about 8000 €. Piezoelectric osteotomies have also been described in cranio-maxillo-facial surgery for sectioning bone without damaging soft tissues.

Burghard P.

Piezosurgery-assisted sliding genioplasty: a method for reduction of complications. Review and case report.

ENGLISH

Eur J Plast Surg (2010) 33:183-187.

■ **Abstract**

The anterior mandible is generally considered a relatively safe surgical site for performing osteotomies. Nevertheless, the increasing rate of surgical interventions also has raised the reported complications. Careful preoperative planning and surgical approach are necessary to prevent damage to vital anatomic structures. The most frequent complications after genioplasties result from damage to neurovascular structures. The present article attempts to review the neurovascularization of the anterior mandible, taking account of typical anatomic variations and considering specific complications as well as therapeutic consequences. Piezosurgery is introduced as a safe and precise technique to reduce the complication rate and to improve the treatment outcomes of genioplasties. Conventional chin osteotomies are performed with bone drills, saws, and chisels. In comparison to these traditional instruments, the piezoelectric device is a lot easier to control and much less aggressive, creating only minimal damage to soft tissues. Accordingly, piezosurgery provides increase in the safety of osteotomies, especially concerning nerve and vessel injuries.

Bovi M., Manni A., Mavriqi L., Bianco G., Celletti R.

The use of piezosurgery to mobilize the mandibular alveolar nerve followed immediately by implant insertion: a case series evaluating neurosensory disturbance.

ENGLISH

Int J Periodontics Restorative Dent. 2010 Feb;30(1):73-81.

■ **Abstract**

One of the therapeutic options proposed for reconstruction of the atrophic posterior mandible is inferior alveolar nerve (IAN) mobilization with simultaneous implant placement. However, studies on the functionality of this neurovascular bundle after its mobilization have shown mixed results. This variability can be attributed both to the test methodology, which typically requires subjective answers from patients, and to the surgical procedure itself, which is highly dependent on operator technique. This article reports on a series of 10 cases of IAN mobilization using a device specifically engineered to simplify bone surgery. This device enables the oral surgeon to avoid overstretching the nerve by creating a smaller bone window and using an apicocoronal inclination of instruments to capture the neurovascular bundle. Evaluation by means of neurosurgery function tests over a 36-month period found that all patients had a return to normal sensation after a brief period of neurosensory disturbance. Subjective responses to a patient questionnaire confirmed these findings. The implant success rate was 100%.

Clauser L., Tieghi R.

New mini-osteotomy of the infraorbital nerve in bony decompression for endocrine orbitopathy.

ENGLISH

J Craniofac Surg. 2010 Jan;21(1):222-4. doi: 10.1097/SCS.0b013e3181c51123.

■ **Abstract**

Endocrine orbitopathy is a systemic complex disease that involves the orbital contents. The symptoms are exophthalmos and correlated. The surgical techniques used to correct this condition can be fat decompression by the Olivari technique, 3-wall bony decompression, or the combination of these 2 surgical strategies, the ancillary procedure. Fat decompression is indicated when the intraconal and extraconal fat tissue is increased, whereas bony decompression is used in the presence of extraocular muscle involvement, associated with a normal quantity of intraconal-extraconal fat. Surgical techniques include the transconjunctival approach and ostectomy of the medial wall (when possible through endoscopy), orbital floor, and lateral wall of the orbit. Complications of this type of intervention are often represented by sensitivity disorders of the second branch of the trigeminal nerve, compressed by the intraorbital contents when they prolapse into the sinus. Possible sensitivity disorders are paresthesia, anesthesia, hypoaesthesia, dysesthesia, and hyperesthesia. The innovation introduced by the first author in 2007 consists of a mini ostectomy around the infraorbital foramen with removal of bone fragment. This determines relaxation of the nerve and makes easier the descent toward the sinus, allowing a larger expansion of the orbit contents. The absence of compression significantly reduces the sensitive complications. After treatment of the basic disease, surgical indications should be given according to the Werner classification. Fat decompression with the coronal approach is almost entirely abandoned for the transconjunctival approach, which allows adequate exposure of the lower orbit. The use of mini ostectomy of the infraorbital foramen combined with a 3-wall bony expansion showed a significant reduction of sensitive complications that often cause patient discomfort.

Béziat J.L., Babic B., Ferreira S., Gleizal A.

[Justification for the mandibular-maxillary order in bimaxillary osteotomy].

FRANÇAIS

Rev Stomatol Chir Maxillofac. 2009 Dec;110(6):323-6. Epub 2009 Nov 25.

■ **Résumé**

Introduction: Le but de ce travail a été d'étudier la fiabilité respective du clivage sagittal et de l'ostéotomie Le Fort I pour essayer de juger objectivement de l'incidence de leur ordre sur le résultat final de l'ostéotomie maxillomandibulaire.

Patients et méthode: Nous avons chiffré les erreurs que génèrent le clivage sagittal et l'ostéotomie Le Fort I chez 50 patients en réalisant en peropératoire une empreinte de l'occlusion après chaque ostéotomie.

Résultants: Aprèe clivage sagittal, des variations dans le sens antéropostérieur ont été présentes dans 74 % des cas avec une amplitude moyenne de 0,32 mm. Dans le sens transversal, elles ont été de 54 % des cas avec une amplitude moyenne de 0,19 mm. Après ostéotomie Le Fort I, il n'y avait aucune différence dans le sens antéropostérieur dans 92 % des cas. L'erreur moyenne était de 0,02 mm. Aucune erreur n'a été ohservée dans le sens transversal.

Discussion: Le positionnement Le Fort I est remarquablement précis à la différence de celui du clivage sagittal. L'ordre ostéotomie Le Fort I en premier, clivage sagittal mandibulaire en second a l'inconvénient de pérenniser les erreurs du clivage sagittal. L'ordre inverse qui, en commençant par la mandibule, aboutit à gommer les petites erreurs du clivage lors du Le Fort I est plus logique et préférable.

■ **Abstract**

Introduction: Our aim was to study the reliability of sagittal split osteotomy and Le Fort I osteotomy respectively, and to try to judge objectively the impact of their order for the final result of bimaxillary osteotomy.

Patients and method: Fifty patients were included. For each we calculated the errors generated by sagittal split osteotomies on one hand and Le Fort I osteotomy on the other hand, by performing a peroperative splint after each osteotomy.

Results: After sagittal split osteotomies changes in the anteroposterior direction were present in 74% of cases with an average amplitude of 0.32 mm. They were less frequent in the transversal direction, 54% of cases, with a smaller amplitude (0.19 mm). After Le Fort I osteotomy, there was no difference in 92% of cases with an average error of 0.02 mm in the anteroposterior direction. No errors were observed in the transverse direction.

Discussion and conclusion: Le Fort I positioning is remarkably accurate contrary to the sagittal split. Using Le Fort I osteotomy first and mandibular sagittal split second has for drawback to perpetuate the errors of the sagittal split. The reverse order, beginning with the mandible, allows correction of sagittal split mistakes with the Le Fort I osteotomy. So it seems that the latter order is more logical and preferable.

Sortino F., Pedullà E., Masoli V.

The piezoelectric and rotatory osteotomy technique in impacted third molar surgery: comparison of postoperative recovery.

ENGLISH J Oral Maxillofac Surg. 2008 Dec;66(12):2444-8. doi: 10.1016/j.joms.2008.06.004.

■ **Abstract**

Purpose: The aim of this study was the comparison of postoperative outcome in mandibular impacted third molars treated by piezoelectric surgery or by rotatory osteotomy technique.

Patients and methods: One hundred patients with impacted mandibular third molars were included in the study. Fifty patients were treated by rotatory osteotomy technique (group A) and 50 patients were treated by piezoelectric osteotomy technique (group B). Therapeutic protocol was the same for both groups. Twenty-four hours after surgery, 2 different parameters, facial swelling and trismus, were evaluated in both groups. A pair of compasses were used for the evaluation of facial swelling and trismus was evaluated.

Results: The average surgery time was 17 minutes in group A, 23 minutes in group B; the mean facial swelling was 7.04 mm in group A, 4.22 mm in group B; trismus was 16.76 mm in group A, 12.52 mm in group B. Statistical analysis showed a significant reduction ($P < .05$) of postoperative facial swelling and trismus in group B; however, in this group, a statistically significant increased ($P < .05$ vs group A) surgery time was required.

Conclusion: The piezoelectric osteotomy technique produced a reduced amount of facial swelling and trismus 24 hours after surgery, but a longer surgery time was required when compared with the rotatory osteotomy technique.

Landes C.A., Stübinger S., Laudemann K., Rieger J., Sader R.

Bone harvesting at the anterior iliac crest using piezoosteotomy versus conventional open harvesting: a pilot study.

ENGLISH Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Mar;105(3):e19-28.

■ **Abstract**

Objective: The objective of this study was to evaluate piezoosteotomy for bone harvesting at the iliac crest in a pilot collective.

Study design: Thirteen patients underwent anterior iliac crest bone graft harvesting using piezoosteotomy. These patients were compared to an age- and sex-matched retrospective cohort of 13 patients who underwent bone graft harvesting at the anterior iliac crest using conventional chisels and saws in an otherwise identical protocol.

Results: Harvested bone volumes and operation times were comparable; hospitalization time was briefer and pain levels at the first 2 postoperative days less in the piezoosteotomy group; pain medication requirement was comparable. Spearman's-rho correlation showed a strong tie between pain medication requirement and harvested bone volume in the piezoosteotomy group and between harvested bone volume and operation time in the conventional surgery collective.

Conclusions: The correlation between required pain medication and harvested bone volume together with lower pain levels in the piezoosteotomy group indicate pain more exclusively related to local osseous damage than to correlated soft tissue lacerations. Conventional technique shows a correlation between operation time and harvested bone volume indicating a more time-effective procedure, although total operation time was comparable. Piezoosteotomy appears to have potential use in iliac crest bone harvesting.

Turra M., Bertossi D., Bissolotti G., Anesi A., Chiarini L., Nocini P.F.

Genioplasty with piezosurgery.

ENGLISH J Cranio-Maxillofac Surg. 2008; 36 (Suppl.1) Abstracts, EACMFS XIX Congress

■ **Abstract**

Aims: The chin is the most prominent and median sector of the lower third of the face giving harmony to nose and lips. We present the application of piezoelectric bone cutting device for the correction of different chin deformities. The distinctive characteristics of this device allows us to avoid or reduce the immediate genioplasty complications.

Methods: 25 cases of defective chin have been treated from January 2006 to April 2007. Intraoral chinplasty was performed during the correction of dentofacial dysmorphisms or associated to nasal surgery. We used a piezoelectric cutting device to perform different osteotomies and if necessary, different kind of interpositional grafts were used to stabilize bony segments.

Results: We observed a more precise and thin osteotomies (100% of cases), a reduced intraoperative bleeding (92%) with light degree of postoperative hematoma, no nervous injuries (100%, slight paresthesia 36%) and patients' satisfaction (96%). **Discussion:** Chinplasty represent one of the most common ancillary procedures and may be associated with corrective surgery of skeletal bases in dentofacial dysmorphisms. Mental nerve injuries, asymmetries, intraoperative bleeding are the main immediate complications of genioplasty. Distinctive characteristics of ultrasonic piezoelectric osteotomy are selective cutting of only mineralized structure with less risk of vascular and nervous damage (microvibrations), intraoperative precision (thin cutting scalpel and no macrovibrations), blood free site (cavitation effect). In our experience, piezoelectric cutting device, compared to saw and drill, enables us to reduce or avoid immediate complications of chin surgery, helping the surgeon to reach patients' satisfaction.

Gonzalez-Lagunas J., Mareque J.

Calvarial bone harvesting with piezoelectric device.

ENGLISH

J Craniofac Surg. 2007 Nov;18(6):1395-6.

■ **Abstract**

We introduce the use of a piezoelectric device in order to harvest calvarial bone grafts. The vibration frequency of the instrument allows for the efficient cutting of bone without the risk of accidentally damaging the dura.

■ ■ ■ ORTHOPEDIC SURGERY

Pamelin E., Zoccolan A., Spingardi O.

Corrective osteotomies of the hand using piezosurgery: Our experience.

ENGLISH

Chirurgie de la main, Volume 30, n° 6, pages 464-465 (décembre 2011) Doi : 10.1016/j.main.2011.10.123

■ **No Abstract available**

Hoigné D., Hug U., von Wartburg U.

Piezoelectric osteotomy in hand surgery: the autologous osteocartilage transplantation for joint reconstruction.

DEUTSCH

Handchir Mikrochir Plast Chir. 2011 Oct;43(5):319-20. Epub 2011 Sep 20.

■ **Zusammenfassung**

Die Anwendung des Piezosurgery® Device wird am Beispiel einer autologe osteokartilaginären Transplantation zur Defektrekonstruktion eines Fingergrundgliedkopfes durch einen Teil eines Zehengrundgliedkopfes dargestellt.

■ **Abstract**

This article demonstrates the use of this piezoelectricsurgical device during an autologous osteocartilage transplantation in which the head of the phalanx of a finger is reconstructed from part of the phalanx condyle of a toe.

Dagnino G., Dagnino G., Ruggeri R., Franchin F.

La piezosurgery dans la chirurgie de l'avant-pied (Piezosurgery in forefoot surgery).

FRANÇAIS

Médecine et Chirurgie du Pied Volume 27, Number 2, 57-60, DOI: 10.1007/s10243-011-0310-3

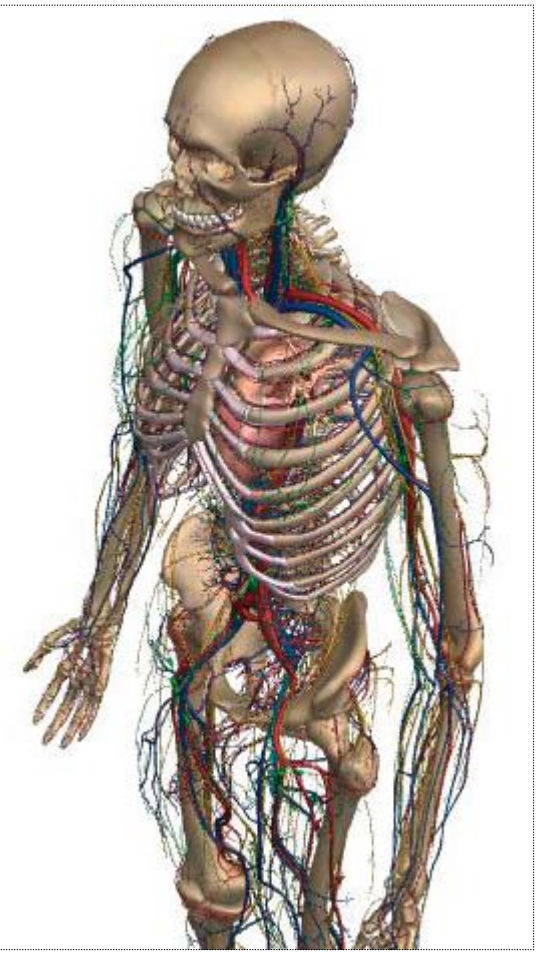
■ **Résumé**

La piezosurgery est une nouvelle technique de découpe ultrasonique initialement utilisée en chirurgie craniomaxillofaciale. Nous avons réalisé 22 interventions d'ostéotomie pour corriger les troubles fonctionnels de l'avant-pied. L'utilisation de l'appareil est un progrès considérable et a permis des découpes osseuses extrêmement précises avec respect des parties molles et diminution de la nécrose thermique du tissu osseux. Lors de la période d'apprentissage, le temps de réalisation des ostéotomies et le temps opératoire global du fait de la disparition des contraintes de protection de parties molles ont été identiques.

■ **Abstract**

Piezosurgery is a new surgical technique used in dentistry to section hard tissues without damaging the adjacent soft tissues. We made 22 osteotomy interventions to correct functional disorders of the forefoot. The use of the device is considered a progress and allows for extremely precise bone-cutting with respect to soft tissue and decreased bone tissue thermal necrosis. After the study period, it was seen that piezosurgery increased the time or bone-cutting but not the overall operative time, because of the absence of soft tissue protection.

PIEZOSURGERY®



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