

## Placement of Denti implants using a piezosurgery device

### Introduction

The widespread use of modern piezosurgery methods in dental and oral surgery, and dental implantology, can be dated to the last decade.

Earlier, between 1960 and 1981, only 5 publications dealt with bone preparation performed by the use of an ultrasonic device. These studies do not recommend this preparation method because the low cutting efficiency is accompanied by a longer healing period, when compared with the conventional osteotomy methods.

In 1998, *Torella et al.* published (2) a paper on sinus window preparation with the help of an ultrasonic elevator. The difficulty of the technique they use is that because of the low cutting efficiency and performance, only a thin and pointed handpiece could be used for the osteotomy. Because of this, the sinus membrane could be easily injured by the handpiece during the surgery, and the risk of burning the bone is too high in case of a bone wall thicker than 1 mm.

In 2000, *T. Velcelotti* published a case report (4) on his new piezoelectric jawbone-splitting technique, now performed with due efficiency and safety during bone preparation with the “Piezosurgery 1” device manufactured by Mectron Medical Technology (Italy).

Since then, the piezosurgery device has gained a widespread use in dental and oral surgery and implantology because of the following advantages:

- **Precise cutting:** the precision of the cutting depends on the micro-oscillations of the handpiece (20 to 80 micrometers). Thus, in case of an appropriately thin handpiece, the cutting width may range between 60 and 200 micrometers, which is considerably smaller than the width achievable with rotary instruments.
- **Selective cutting:** the oscillation range of about 30 kHz of the handpieces ensures the effective cutting of the mineralized bone tissue and the protection of the soft tissues (3), because a frequency of at least 50 kHz would be needed to injure these latter. The most obvious advantage of selective cutting shows itself in the preparation of the sinus membrane during open sinus lift. The use of the device provides even for a less experienced surgeon a considerably more successful and more

complication-free surgical result (8). This property can also be beneficial for the preparation of the inferior alveolar nerve, e.g. when obtaining a bone block, removing an impacted third molar or relocating the nerve.

- **Greater control of the surgical device:** controlling the surgical instrument during the operation, precisely at the preparation site of fine, thin bone parts or near the margin of other structures (sinus membrane, inferior alveolar nerve), is indispensable for the success of the procedure. To achieve the desired efficiency, conventional drills must be loaded with a force of 2 to 3 kg, whereas the piezosurgical handpiece reaches its highest efficiency when applying a load of 0.5 kg.
- **A large selection of handpieces:** it enables the surgeon to use the most appropriate handpiece for the patient anatomy and his/her own experience, contributing to the success of the procedure.
- **Bleeding-free surgery site:** ensures excellent overview during the surgery because the bleeding during the osteotomy is minimal. The reason for this is that, as a result of the oscillation of the instrument and the ultrasonic velocity, steam bubbles emerge from the physiological salt solution, and these lead to microcoagulation (5). Bleeding restarts when the cutting is over.
- **Faster bone healing:** histological and biomolecular studies have proven that tissues heal significantly faster after a piezosurgical osteotomy than after the use of rotary instruments (1, 6). It has been shown with histomorphological studies that there are significantly less inflammatory cells in the prepared implant cavity if compared with the cases where preparation is performed with conventional drills (7).

Taking these advantages into account, we present three cases below, during which the preparation of the beds of the Denti<sup>®</sup> root-form implants and the open sinus lift were performed with the help of a technique slightly different from the conventional preparation: using a piezosurgery device.

During the procedures, we used the “Piezosurgery 3” device manufactured by Mectron Medical

Technology (Italy). The handpiece is connected to the central electrical unit with a cable; the desired operating mode (root extraction, bone preparation, implant bed preparation) can be set on the central unit. The sterile cooling fluid, similarly to other surgical motor units, can be connected via a silicone tube, and can be sterilized completely.

The wide selection of headpieces allows us to choose the most appropriate one for the procedure and the patient's anatomy. Some of the headpieces have diamond coating. We can use them for four main purposes: bone preparation, osteoplasty, root extraction and implant bed preparation.

The device uses two different oscillations. The oscillations have the same direction but different frequencies, ensuring this way the optimal energy level for osteotomy, while minimizing heat production and tissue damage at the same time. The frequency of the oscillation fluctuates between 24 and 29 kHz. Besides the appropriate operating mode, the intensity of the cooling fluid can also be adjusted, optimizing the cooling of the headpieces for the different preparations. In case of bone preparation, the cutting width depends on the used headpieces ranging between 60 and 200 micrometers, which is considerably smaller than the width achievable with rotary instruments.

### Case Reports

In the following I will demonstrate through 3 cases the methods I use in my everyday dental practice for the placement of dental implants, using the piezosurgery device mentioned above. With this method, I have placed about 30 Denti<sup>®</sup> root-form implants in the past 2 years. No implants have been lost so far.

#### Case 1

Class 2 tooth loss, placement of Denti<sup>®</sup> root-form implants, early loading, with half-open, half-closed surgical technique. We were planning a delayed implantation in the lower right quadrant of a 70-year-old female patient (*Figure 1a*). Because of the planned early loading, we performed the preparation of the root-form implants with a piezosurgery device. Histological and biomolecular studies have shown that if the implant bed is prepared using an ultrasonic device, the healing of the bone is significantly faster than preparing the implant bed with conventional rotary instruments. As a result, if the implant has a good primary stability, early loading may have a significantly greater success rate. The surgery was performed using a half-open, half-closed surgical technique. The first step is to create the pre-bore with

the IM1 headpiece. The maximum diameter of this instrument is 2 mm; then we check the axis alignment. This is followed by the expansion of the bed with an IM2 headpiece of 2 mm in diameter (*Figure 1b-c*). During the preparation, the feeling of cutting the cortical bone is again well distinguishable from that of cutting the spongy bone. In case of thick mineralized cortical bone, the next step is to expand the bed in the cortex with an OT4 headpiece (of 2.4 mm in diameter), which has a cylindrical shape and diamond coating. At this step, we still have the possibility to correct the axis alignment. After this, with an IM3 headpiece, we expand the implant bed further to its lower 2/3 because of the root form. The final shaping of the cortical bone is also performed with a diamond-coated, conical headpiece, until reaching the desired diameter (*Figure 1d*). Then we cut the thread and screw the implant into its bed (*Figure 1e-f*).





*Figure 1*

- a) Pre-operative orthopantomogram with measurement sphere.*
- b) Making the pre-bore with an IM1 headpiece, after incision.*
- c) Expanding the implant bed with an IM3p headpiece.*
- d) The prepared implant beds.*
- e) The placed Denti® root-form implants.*
- f) The finished zirconium-ceramic prosthesis*

*Case 2*

We were planning the placement of a Denti® two-piece zirconium dioxide (DCR) implant in the lower left second premolar position of a 50-year-old female patient, with immediate surgery (*Figure 2a*). The first step was the preparation around the root, with an EX1 headpiece, in extraction-perio operating mode, protecting the bone wall (*Figure 2b*). If required, we can reach the root apex during the preparation. Because of the cooling, it is recommended to advance towards the apex preparing a wide area. The second step is to “wobble out” the root in “endo” mode, releasing the still existing ligament bonds. Then, we carefully luxate the root, which, if we have worked well, “snaps out” from the alveolus (*Figure 2c-d*).

If the root is more difficult to remove, the technique is changed: we cut the root through transversally, luxate its fragment inward (while protecting the bone wall), and then remove the remaining root as well. Then we expanded the implant bed to the desired size (as described in the previous case) watching not to hurt the inferior alveolar nerve during the preparation, and after cutting the thread, we screwed the two-piece Denti® zirconium implant into its bed (*Figure 2e*). The peri-implant bone loss was replaced using GBR technique. We should take special care to create the implant bed for the two-piece zirconium implants precisely: we must be able to screw in the DCR implant to the desired level in one attempt. If it gets stuck, screwing it out may be risky, especially in case of smaller-diameter implants (*Figure 2f*).



*Figure 2.*  
a) *Pre-operative orthopantomogram with measurement sphere.*  
b) *The thin buccal bone wall.*  
c) *Preparation around the root with an EX1 headpiece.*  
d) *When luxated, the root “snaps out” from the alveolus.*  
e) *The placed two-piece zirconium implant.*  
f) *The one-year check-up orthopantomogram.*

### Case 3

We were planning an open sinus lift with two-stage surgery to replace the Class 2 tooth loss with an implant in the posterior area of the maxilla of a 36-year-old male patient (*Figure 3a*). The selective cutting property of the device shows itself well during the preparation around the sinus membrane. This surgical method allows even a less experienced surgeon to achieve a higher success rate. This is partly due to the frequency of 30 kHz – a frequency of 50 kHz would be required to hurt the soft tissues –, and partly because of the use of blunt instruments.

The surgical method is as follows: after incision, we thin the bone wall to a thickness of about 0.5 mm at the planned site of the bone window (*Figure 3b*). We add the bone debris obtained this way to the artificial bone substitute material. Then we prepare the bone window using a diamond-coated, spherical, blunt headpiece (*Figure 3c-d*). During the process, the membrane usually “kicks off” the remaining thin bone wall, which has already been slightly detached from the margin of the prepared window. After that we detach the sinus membrane from around the bone wall with an EL1 headpiece, and then lift the membrane off the bone wall either with a conventional sinus rasp or with a piezo headpiece designed for this purpose. Then we prepare the implant bed at the planned site with the appropriate piezo handpieces – similarly to the cases described above (*Figure 3e-f*). According to literature data, significantly better primary stability can be achieved if the preparation is performed using a piezosurgery device, even in the case of a thin sinus wall. If conventional rotary instruments are used, the thin bone wall may crack or break off, whereas with this surgical method, a single-session bone replacement or implantation can be successful even in the case of a thin bone wall. We filled the cavity of the maxillary sinus with a mixture of the bone chips from the retromandibular region and the wall of the sinus window, and Ossyresorb bone substitute granules (SziKKTi Ltd., Budapest, Hungary), and then screwed in the Denti® root-form implants, and closed the surgical site with interrupted sutures (*Figure 3g-h*).

### Discussion

The piezosurgery device, with its greater cutting precision and selective cutting, makes the work of dentists performing implantation considerably easier both when extracting ankyrotic roots and when performing preparations around the sinus membrane. In addition, it provides greater safety when cutting bone in the vicinity of the inferior alveolar nerve, or removing autologous bone. It provides a practical help in obtaining the patient’s own bone chips, for example from the retromandibular region. The creation of the

implant bed is a new area of use of the device, and taking the above advantages into consideration, it should be considered for certain indications. The disadvantage of the procedure is the need for an undoubtedly larger investment and the increased operation time required for the preparation of the bone tissue.

To summarize our own experience gained in the past two years, the use of piezosurgery devices for dental and oral surgical procedures and dental implantation has numerous advantages. Since more severe complications can be prevented with a more precise, although sometimes slower, work, the use of the device and the procedures in the everyday dental practice should be considered.





**Figure 3.**

- a) Pre-operative calibrated image.
- b) Thinning the buccal wall of the sinus.
- c) Preparing the window with a diamond-coated, spherical headpiece.
- d) Detaching the membrane from the bone wall with an ELI headpiece.
- e) Preparing the pre-bore of the implant.
- f) Creating the implant beds with an IM2 headpiece.
- g) Expanding the cortical part to the desired size with a conical, diamond-coated headpiece.
- h) Filling the cavity with the patient's own bone-Ossyresorb mixture, and placing the implants.
- i) Check-up orthopantomogram at the end of the third month after loading

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