Magneto-dynamic site preparation for zirconia implants: A dry, cold and minimally invasive protocol

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Today, dentistry is facing new challenges. Demanding and fragile patients who require quick, atraumatic and risk-free treatments are increasingly presenting to our dental clinics. These patients require immediately loaded implants even in local situations of bone atrophy and despite precarious health conditions such as diabetes, heart disease, osteoporosis and other chronic diseases. Furthermore, the COVID pandemic has made dental care increasingly complex regarding the management of operating times and the prevention of infections. The use of minimally invasive procedures in medicine and dentistry has increased exponentially for reduction in postoperative complications, lower consumption of analgesic and anti-inflammatory drugs, and shorter recovery time.

To cope with the changing demands and requirements, biomaterials technology has made significant progress in recent years. Today, we have zirconia implants that are very reliable in terms of biocompatibility and resistance. There are numerous types of dental implants on the market that allow the surgeon to rehabilitate in any clinical situation. However, the clinical results depend not only on the material used but also on the general condition of the patient, on the biological response of the tissue and on the operative technique.

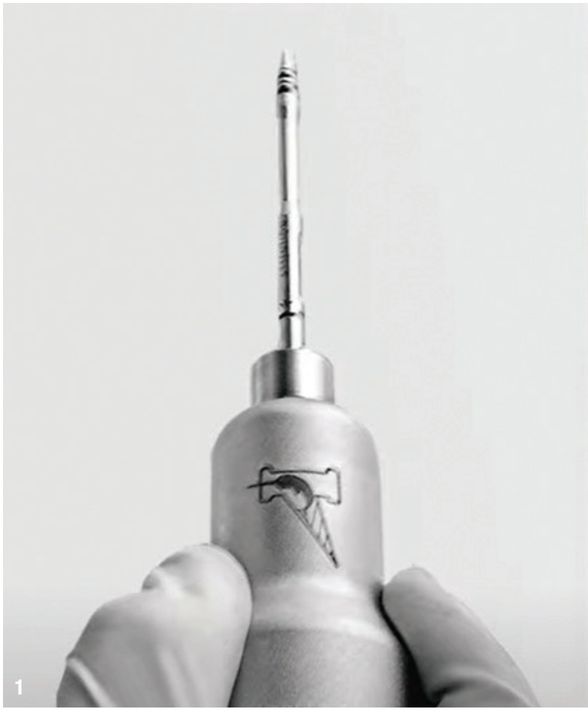

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Fig. 1: Correct grip of the Magnetic Mallet handle with one hand.

The patient's health can be improved through the correction of pathological conditions and the administration of nutraceuticals that improve the health of the tissue (vitamin D in high dosage, Lithothamnion calcareum, Ganoderma lucidum). The use of platelet growth factors in the form of membranes or liquids to be infiltrated makes it possible to reduce discomfort after surgery and stimulates the biological response.

For good implant osseointegration, however, the preparation of the implant site is essential for adequate immediate mechanical retention and stable biological integration over time. Unfortunately, the surgical technique for positioning implants has remained unchanged over time. Mucosal flaps are still raised and the implant site prepared using high-speed rotary drills and a water jet for cooling. The use of drills can lead to overheating of the tissue and tissue necrosis especially when using metallic materials that wear. The need for cooling of the rotating instruments exposes patients and operators to infectious contamination due to the aerosol cloud that is created during the operative sessions. Finally, preparation using drills alters the bone microstructure and removes tissue that is already very deficient in edentulous conditions.

In addition to traditional techniques, today it is possible to prepare the implant site using magneto-dynamic surgery with the Magnetic Mallet (Osseotouch), allowing the expansion of the alveolar crest without the use of water jets and without removing bone tissue. Magnetic dynamic technology is based on the concept of acceleration with a short impact time and high force of the pulse, thereby increasing effectiveness. Through this technology, it is possible, without the use of irrigation, to easily extract teeth (ankylosed), perform crestal sinus lift, expand thin alveolar ridges and prepare implant sites in low-density bone (Type D3 and D4).

The Magnetic Mallet surgical device is equipped with various inserts, such as for dental extraction, implant site preparation and regenerative surgery. The device applies greater force than conventional methods in short time on a focus point in the area being treated along a central axis moving up and down. An implant site can be prepared using only osteotome inserts of increasing diameter. Plastic bone deformation is facilitated by shock waves (130 daN in 80 μs) through their tips. The implant site is created by expanding bone tissue laterally and apically. No bone tissue is removed. Instead, the tissue is compacted, creating increased density and enabling greater primary stability.

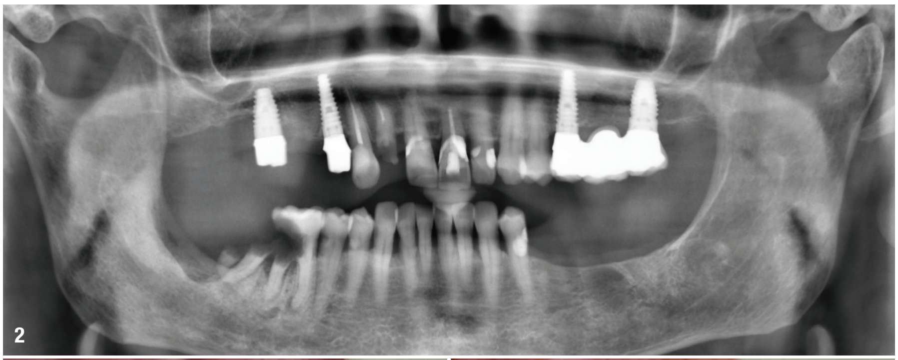
Magneto-dynamic surgery has several advantages. The force applied to the inserts is high and brief; therefore, the intervention is faster and more precise. The handpiece is operated with one hand (Fig. 1). The movement is only longitudinal; therefore, we will have better operative control and reduced operational risk. The absence of rotating instruments and lack of irrigation permit cold surgery without the risk of tissue overheating and infectious contamination.

The ZiBone implant system (COHO Biomedical Technology) has an ideal topography for placement using the magneto-dynamic technique. The standard ZiBone implant is made in one piece (endosseous and abutment portions) of highly pure and extremely resistant zirconia. The cylindrical body and apex's conical design allow the implant to achieve high primary stability. The thin threads on the implant collar increase the contact area and mechanical retention. The broad threads on the implant body improve primary stability and enhance osseointegration. The sandblasted intraosseous area gives to the implant a micro- and macro-roughness that favours better tissue integration. *In vivo* studies have demonstrated 60% bone–implant contact just eight weeks after implant placement.

Surgical protocol

In the case of an edentulous area with intact tissue, gingival access is created using a tissue punch mounted on a surgical handpiece rotated at 250 rpm (flapless technique) or by incision and raising of a flap with a zirconia scalpel. In the case of a compromised tooth, the root is first extracted using dedicated magneto-dynamic inserts (EXTR1, 2, 3, 4 and 5). After the cleaning and disinfection of the alveolus, the best site and inclination are sought for the preparation of the implant site according to the morphology of the alveolar crest and the condition of the residual bone.

The preparation of the site for the positioning of one-piece implants is achieved using the Black Ruby osteotomes owing to the excellent correspondence of shape and dimension. The Black Ruby inserts have a double





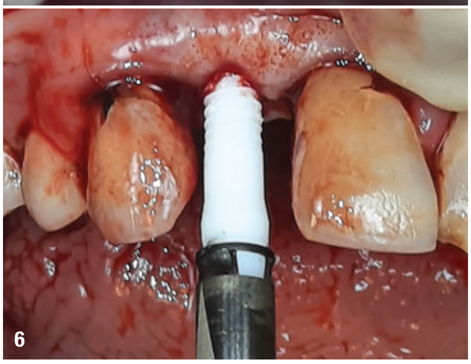


Fig. 2: Dental panoramic tomogram before surgery. **Fig. 3:** Initial clinical situation. **Fig. 4:** Gingival incision using a zirconia scalpel (ZiBone CST-B15). **Fig. 5:** Initial osteotomy preparation using a BLK-R1 osteotome. **Fig. 6:** Placement of the implant into the osteotomy.

taper, a rounded tip and a diamond-like carbon coating which decreases friction with the tissue and facilitates the sliding of the instrument into the bone being prepared.

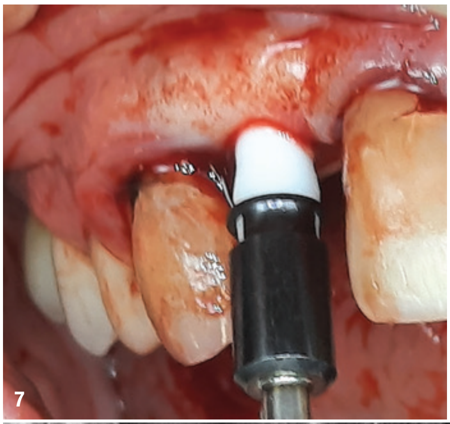
The penetration of the alveolar cortical bone is performed with the Black Ruby pointed osteotome (BLK-R1) with force Level 1. The implant site is created by expanding the bone tissue laterally and apically against the pre-existing bone. The instrument is slowly advanced through electromagnetic pulses and back and forth movements of the insert to allow the bone to adapt to the elastic stresses it has undergone. The osteotomy is progressively widened by means of a succession of inserts with progressive diameter (BLK-R2, BLK-R3, BLK-R4 and BLK-R5) until the dimensions compatible with the chosen implant are reached. The osteotomy is progressively expanded with the force distributed by the Magnetic Mallet osteotomes by 1 mm at each pulse. The final diameter of the osteotomy has to be between 0.5 mm and 1.2 mm under-prepared depending on the local bone density and the type of implant. In cases where sinus lift or adaptation of the osteotomy is required, standard flat-head inserts (200-F, 300-F and 330-F osteotomes) can be used. After preparation of the host site, the implant is first conditioned with the patient's platelet growth factors and subsequently positioned with a surgical handpiece or impacted with an adapter mounted on the Magnetic Mallet.

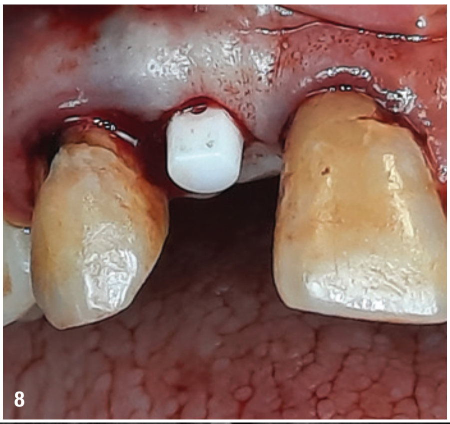
Case presentation

Case 1

A 79-year-old woman with psychiatric disorders, previous femoral fracture due to severe osteoporosis and sequelae of stroke presented for the replacement of a lost incisor. Considering the general condition of the patient and the lack of cooperation, it was decided to place the implant using a minimally invasive protocol (Figs. 2 & 3).

The gingival mucosa was incised using a zirconia scalpel, and a flap was raised (Fig. 4). The penetration of the alveolar cortical bone was performed using the BLK-R1 insert (Fig. 5). The instrument was made to advance to the desired depth through magneto-dynamic pulses of force Level 1 by rhythmic up and down and rotational movements. The implant was then mounted on a modified adapter and advanced into the prepared alveolus by the mechanical impulses delivered by the Magnetic Mallet (Fig. 6). The impact insertion allowed further expansion of the alveolar ridge and greater bone condensation essential for primary stability (Figs. 7–10). At the end of the treatment, autologous platelet growth factors were infiltrated via injectable platelet-rich fibrin (i-PRF) into the peri-implant tissue, which allowed a pain-free postoperative course; therefore, the patient did not need analgesics.





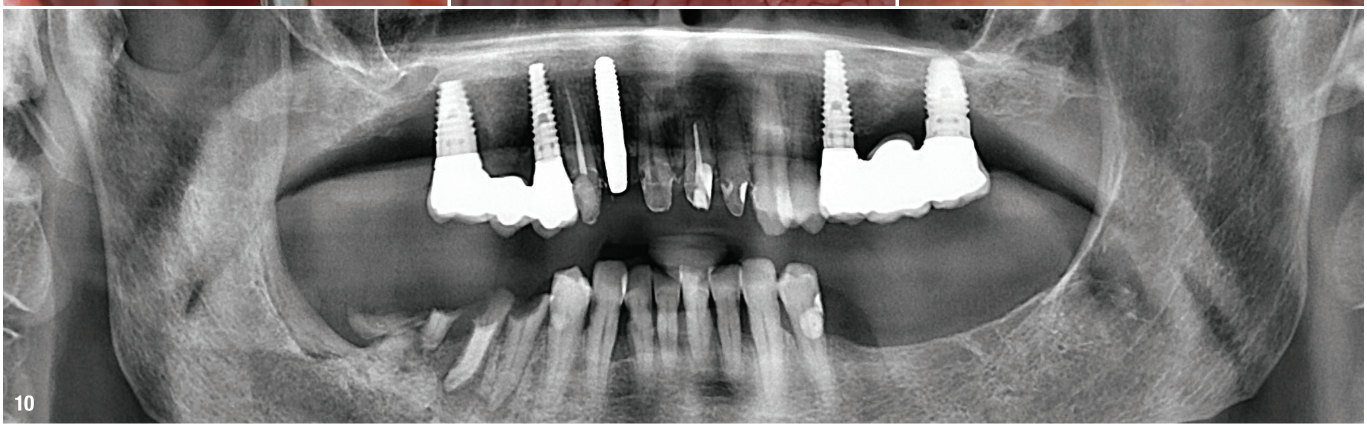
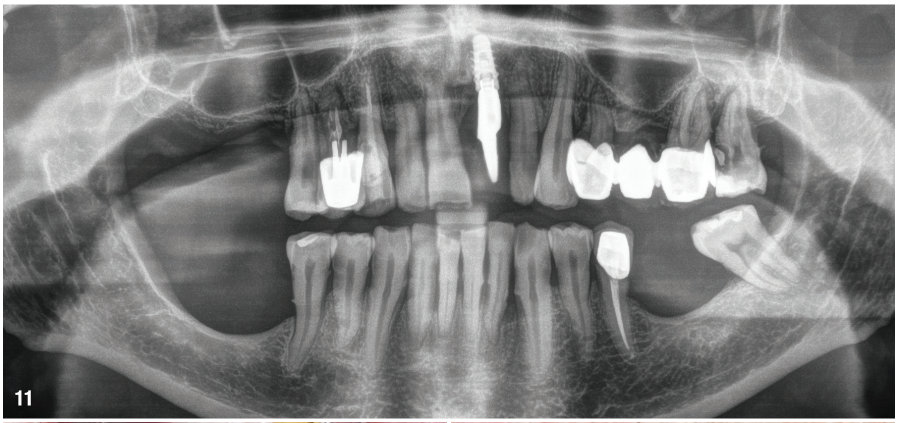


Fig. 7: Implant impacted in the implant site by means of a Magnetic Mallet device at force Level 1. **Fig. 8:** Final position of the one-piece ZiBone implant. **Fig. 9:** Frontal view after implant placement. **Fig. 10:** Dental panoramic tomogram after surgery.

Case 2

A 60-year-old man presented for the removal of a titanium dental implant and minimally invasive rehabilitation of the mouth using ceramic implants. The anamnesis found that the patient had Crohn's disease and an allergy to metals. The dental evaluation found severe periodontal disease, edentulous areas and peri-implantitis with bleeding deep periodontal pockets in the area of the previously inserted titanium implant (Figs. 11 & 12). Given the patient's request and pathological conditions, it was decided to perform a targeted periodontal treatment, extract the compromised teeth and rehabilitate the mouth using one-piece zirconia implants positioned with the Magnetic Mallet to reduce trauma and preserve residual bone tissue.

The extraction of the teeth was performed using forceps (Fig. 13), and the alveoli were first cleaned and then disinfected using ozone at a concentration of 20 µg/ml. Subsequently, the implant sites were prepared by osteotomy creation and sinus lift via the crestal route using standard inserts for bone condensation (160-F, 230-F and 300-F osteotomes; Fig. 14). Once the appropriate dimensions of the sites had been reached, the implants were positioned first using a surgical handpiece and then with a manual dynamometric ratchet up to a torque



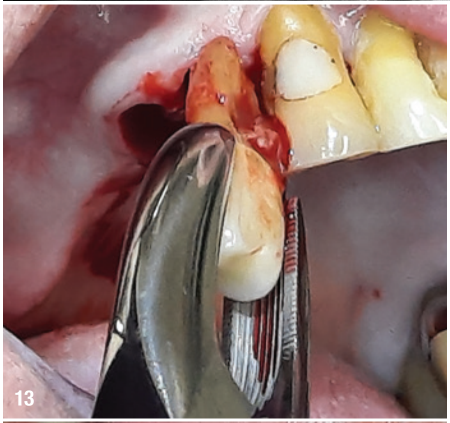
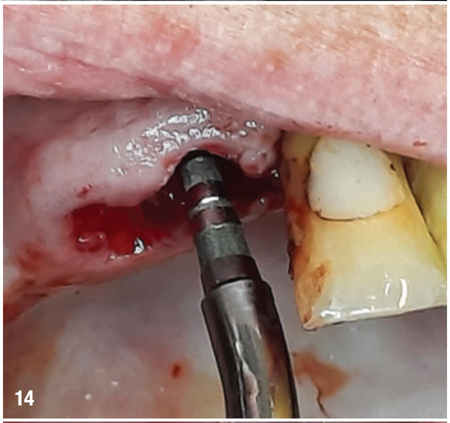
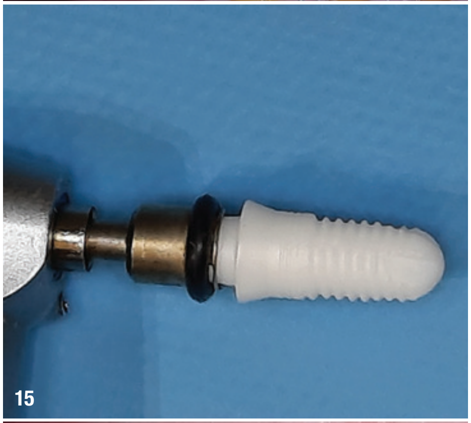
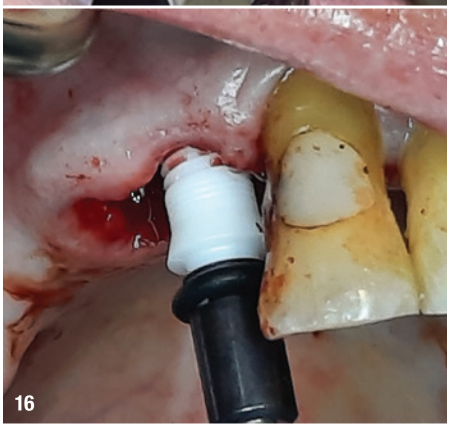





Fig. 11: Dental panoramic tomogram before surgery. **Fig. 12:** Lateral clinical view of the affected area. **Fig. 13:** Atraumatic extraction of the compromised tooth. **Fig. 14:** Initial preparation of the socket with a 100-P pointed osteotome. **Fig. 15:** One-piece implant (ZiBone Zr-I5010) mounted on a surgical micromotor. **Fig. 16:** Screwing of the implant into the prepared site. **Fig. 17:** Lateral view of the implants after placement. **Fig. 18:** Clinical situation the day after surgery.

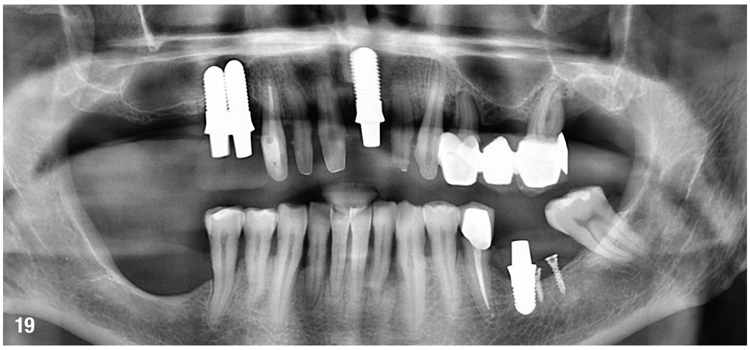


Fig. 19: Dental panoramic tomogram after treatment.

of 35 Ncm (Figs. 15–17). At the end of the treatment, the peri-implant tissue was infiltrated with i-PRF and the patient underwent a session of systemic ozone therapy at a concentration of 30 µg/ml. The patient returned the next day for the positioning of provisional prosthesis and reported that he had not taken any analgesics, having had no pain (Figs. 18 & 19).

Case 3

A 56-year-old dental phobic woman presented to our clinic for aesthetic smile rehabilitation. The clinical and radiographic evaluation found widespread dental caries and apical granulomas associated with devitalised teeth (Figs. 20–22). Patients who are attentive to natural therapies and very sensitive to pain want to quickly improve their dental aesthetics without putting their health at risk. It was therefore decided to proceed with the extraction of the compromised teeth using a minimally invasive technique and placement of zirconia implants in the same session.

The extraction of the compromised teeth was performed first gently to detach the periodontal ligament and then more decisively to complete the dislocation of the tooth root. We worked on the mesial and distal sides not to damage the thinner and more delicate vestibular cortical bone. We continued with the cleaning and disinfection of the alveoli using ozone at a concentration of 20 µg/ml. The implant sites were prepared using standard osteotomes

Fig. 20: Dental panoramic tomogram before surgery. **Fig. 21:** Frontal view at the first dental visit. **Fig. 22:** Occlusal view of the affected arch. **Fig. 23:** Initial osteotomy preparation with a 100-P pointed osteotome. **Fig. 24:** Subsequent preparation with a 230-F osteotome. **Fig. 25:** One-piece zirconia implants (ZiBone Zr-I5010) correctly positioned. **Fig. 26:** Occlusal view after surgery. **Fig. 27:** Dental panoramic tomogram after surgery.

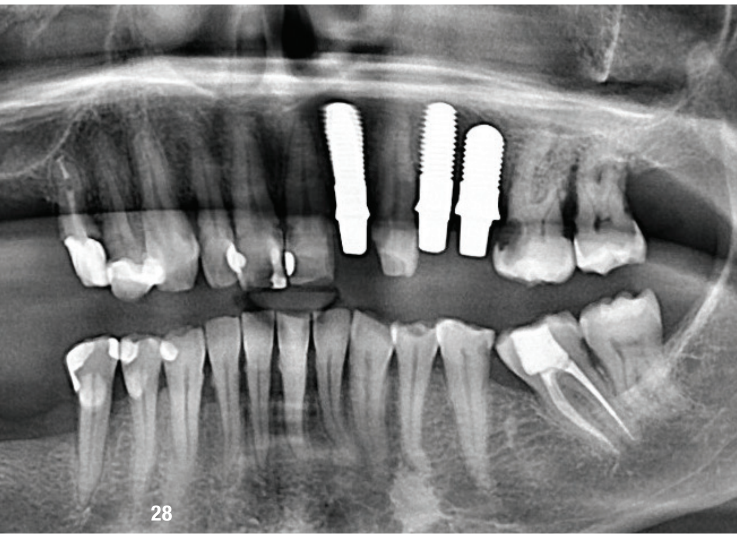


Fig. 28: Cementation of the resin prosthesis the day after surgery after preparing the abutment teeth.

for bone condensation to the chosen size (Figs. 23 & 24). After the surgery, a systemic ozone therapy session was performed at a concentration of 30 µg/ml, and peri-implant infiltration was performed with i-PRF to reduce postoperative discomfort and promote healing of damaged tissue to ensure primary stability. The one-piece zirconia implants were inserted to a torque of 35 Ncm to ensure primary stability (Figs. 25–27). The following day, all the teeth of the maxillary arch were prepared, and a resin prosthesis was positioned (Fig. 43).

Discussion

The aim of this article is to demonstrate an alternative way to place zirconia implants into poor-quality bone in fragile patients. In bone that is less dense, Magnetic Mallet osteotomes increase the density around the implant. In the cases reported in this article, the implant sites were prepared by use of osteotomes which compressed the native bone and by cortical sinus lift as reported by the literature. These surgical procedures, supported by data from several experimental studies, resulted in faster and greater bone apposition compared with conventional drilling. The Magnetic Mallet site preparation increased the bone–implant ratio in early phase placement, enhancing primary stability of the implant and expediting bone healing.

Conclusion

The use of the Magnetic Mallet in poor-quality bone (Types D3 and D4) and in fragile patients can make zirconia implant surgery safer, more predictable, faster and more comfortable for patients. The surgery improves tissue healing and long-term implant survival. All the patients treated with ZiBone implants placed with magneto-dynamic surgery had less pain and little postoperative discomfort; therefore, they did not need to take analgesics and their healing was quicker.

The positioning of implants using the Magnetic Mallet also has advantages for the dentist, as it is faster, more precise and more efficient. The absence of drills and irrigation leads to a lower risk of infectious contamination, avoids bone overheating and saves bone tissue in the case of thin alveolar ridges. The ZiBone one-piece implants adapted perfectly to the implant sites prepared using the Black Ruby inserts. Magneto-dynamic surgery represents a good alternative to traditional osteotomy preparation using rotary drills.

Literature

about the author

Dr Franco Giancola is serving as a specialist in Ceramic Implantology and Guided Regenerative Surgery at DENTZIA Clinic in Barcelona since September 2022. He is registered with the Valencia College of Official Dentists and Stomatologists and the Barcelona College of Physicians. Dr Giancola is also a Director of Health and Freelance specialist in Immunocompatible Implantology, Ozonotherapy and Regenerative Medicine at the Domus Medica European Ceramic Implantology Clinic in San Marino since October 2018.

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