ABSTRACT CONGRESSO

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Innovation in Piezoelectric Bone Surgery, Implantology and Periodontology

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ABSTRACTS

EVALUATION OF THE EFFECTIVENESS OF PIEZOELECTRIC TECHINIQUES ON THE DECONTAMINATION OF THE POSTEXSTRACTION SOCKET

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Aim Healing of post-extraction sockets is often compromised by bacterial contamination, which destabilizes the clot and increases risks of alveolitis and delayed healing. Conventional decontamination methods such as saline irrigation have limited ability to remove biofilm. Ultrasonic cavitation, generated by piezoelectric instruments, provides both mechanical disruption and antimicrobial effects, and is established in endodontics and periodontology, but scarcely explored in socket management. The aim of this study was to evaluate post-extraction socket decontamination of cavitation and piezoelectric revision.
Methods A prospective clinical trial was conducted on patients aged 18–100 years requiring extraction of at least two hopeless single-rooted teeth, with ASA ≤3 and good compliance. Exclusion criteria included uncontrolled diabetes, immunosuppression, pregnancy, lactation, heavy smoking, recent oncologic therapy, or complex extractions needing flap or osteotomy. All extractions were atraumatic. After removal, a baseline swab (T0) was collected. Sockets were randomly assigned to: Group P (cavitation with Piezoclean, ESACROM, insert and refrigerated saline, 90 s), Group C (piezoelectric revision with conical insert, 60 s), or Group F (control, saline irrigation, 60 s). A second swab (T1) was then taken. All sockets were sutured with silk 3/0.

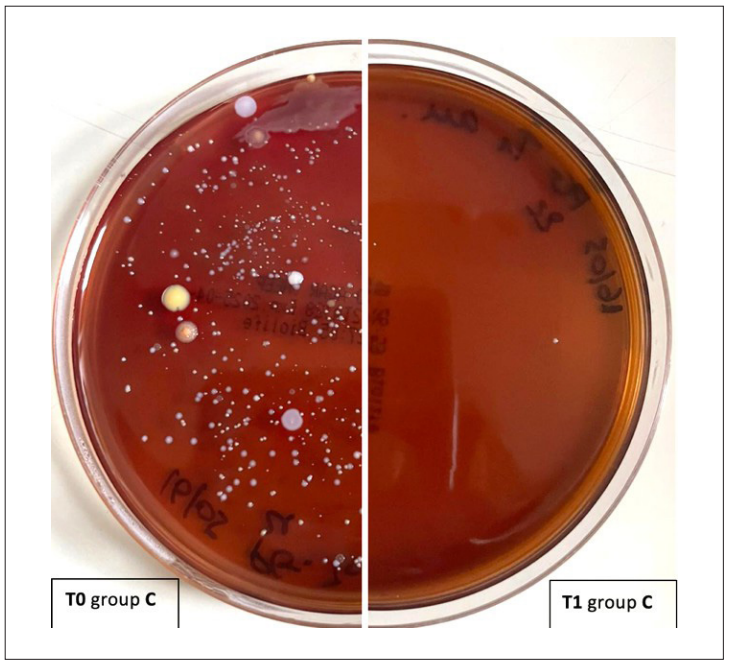

Fig. 1 Colony-forming group C at T0 and T1.

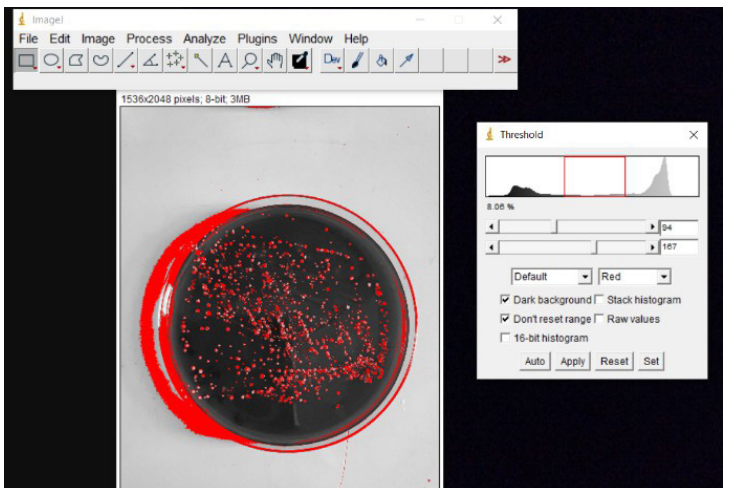

Fig. 2 Colony quantification with ImageJ.

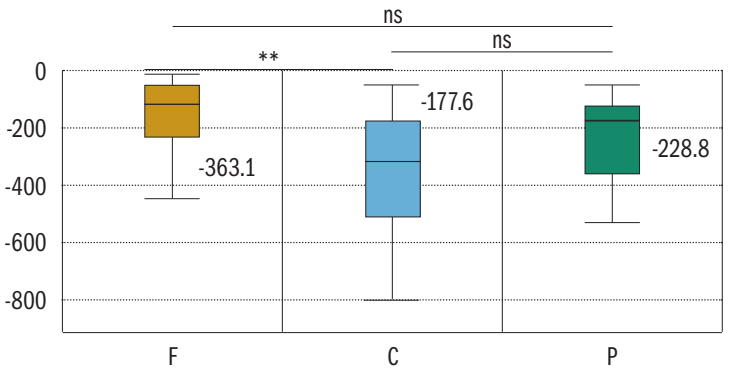

Fig. 3 Reduction in values from time T0 to time T1 for each group, (**p<0.01).

Postoperative care included paracetamol, chlorhexidine rinses, cryotherapy, and no routine antibiotics. Microbiological samples were cultured on blood agar under anaerobic conditions and analyzed blindly (fig 1). Colony-forming units were quantified with ImageJ (National Institutes of Health, USA) (fig 2). Data analysis were compared with Kruskal–Wallis test and Dunn test.

Results A total of 56 post-extraction sockets were analyzed (17 in group C, 18 in group F, and 21 in group P). All three groups showed a reduction in values from time T0 to time T1, indicating that each treatment produced a statistically significant improvement (p=0.0065) (fig 3). The difference between group C and F is significant (p = 0.0017), confirming that treatment C reduces contamination to a greater extent than F. The difference between group C and P is borderline significant (p = 0.056), suggesting that treatment C tends to be more effective than P, even though it does not reach the conventional threshold of p < 0.05.

Conclusions Alveolar decontamination techniques are effective in reducing bacterial contamination, and this effectiveness is particularly significant when piezoelectric curettage or cavitation techniques are used. This result must then be compared with the clinical outcome.

COMPARISON OF IMPLANT PRIMARY AND SECONDARY STABILITY OVER 90 DAYS: MAGNETIC MALLET VS OSSEODENSIFICATION BURS

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Background and aim Primary stability is a pre-requisite for predictable implant osseointegration and depends largely on bone density, implant macro-geometry, and surgical technique. In low-quality bone, electric-driven osteotomes and osseodensification burs aim to compact trabecular bone and establish a densified bony interface, with the objective of improving primary implant fixation.
In this crossover study, paired maxillary premolar sites were prepared with one of these two techniques, and identical implants were inserted and followed for 90 days. The primary endpoint assessed implant stability at placement and throughout early healing, while secondary endpoints examined the association of marginal bone loss (MBL) with preparation method and insertion torque (IT), together with comparisons of operative time.

Materials and methods Test sites were prepared with electric-driven osteotomes (Magnetic Mallet, Metaergonomica, Milan, Italy), while control sites were prepared with osseodensification

Time point	Electric-driven osteotomes	Osseodensification burs	p-value
Baseline	70.0 ± 6.5	74.8 ± 5.0	0.27
7 days	68.7 ± 8.9	74.1 ± 5.4	0.12
14 days	66.2 ± 9.4	72.1 ± 6.3	0.14
21 days	63.4 ± 9.5	69.7 ± 6.5	0.09
28 days	63.6 ± 9.4	71.1 ± 5.8	0.02*
60 days	66.1 ± 8.2	73.8 ± 4.9	0.01*
90 days	69.3 ± 8.2	75.9 ± 4.6	0.02*
	p < 0.0001*	p < 0.0001*	

Tab. 1 Mean ISQ values (± standard deviation) at the different time points in test and control groups. *: statistically significant difference.

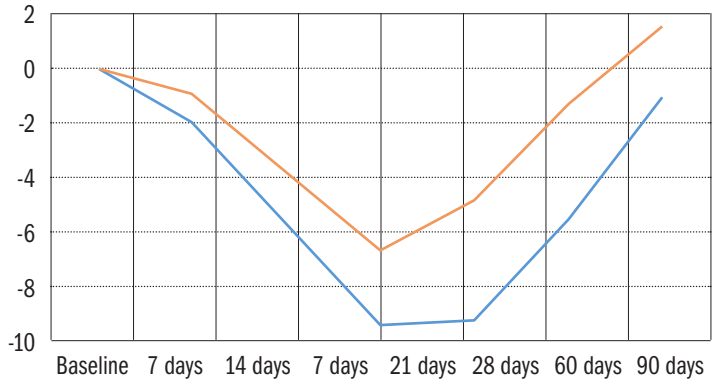

Fig. 1 Changes in implant primary stability shows that the lowest peak is reached by both groups at day 21. After that, stability values progressively increase. Notably, only in the OD group, the final value surpasses the initial stability value. MM: electric-driven osteotomes; OD: osseodensification burs.

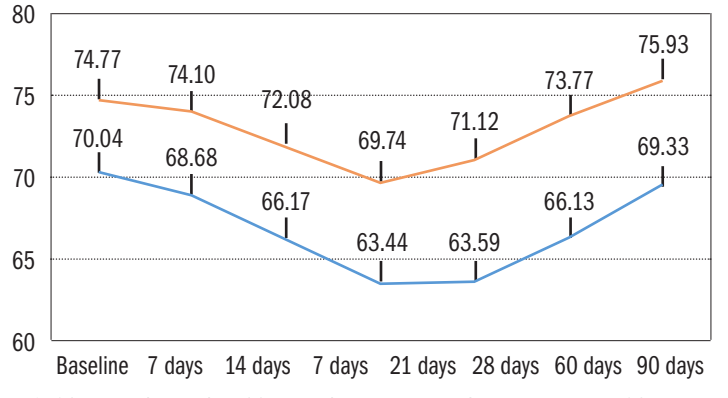

Fig. 2 ISQ values for the first 90 days of healing. In the first three weeks, ISQ values decreased in both groups with no statistically significant differences. However, during the third week, the ISQ values changed differently between the two groups, indicating enhanced biological healing in the OD group. MM: electric-driven osteotomes; OD: osseodensification burs.

burs (Densah, Versah, Jackson, MI, USA). Test and control sites were prepared with the same final diameter (3.2 mm) for insertion of two identical implants (4.0x8.5 mm; Anyridge, Megagen, Gyeongbuk, South Korea) with unsubmerged healing. Surgical time was recorded from the initial use of the pilot osteotome/drill to implant placement. Implant stability (ISQ) was measured immediately after surgery and on days 7, 14, 21, 28, 60, and 90. Radiographic measurements were taken at T0 (post-surgery) and T1 (prosthesis delivery). Parametric and non-parametric tests and linear regression were performed (α = 0.05).

Results Fourteen patients (9 M, 5 F; mean age 49.7 ± 14.3 years) received 28 implants, and all implants were in function at 1 year. Median insertion torque was 55.0 Ncm (IQR 49) for test group and 65.5 Ncm (IQR 20.8) for control group (p = 0.150). Mean baseline ISQ was 70.0 ± 6.5 (test) and 74.8 ± 5.0 (control) (p = 0.273). Both groups exhibited an early decrease in stability, with a subsequent increase beginning after day 21 (Fig. 1). Control group exhibited higher ISQ at days 28, 60, and 90 (p = 0.025, 0.013, 0.017) (Tab. 1 - Fig. 2). MBL from T0 to T1 was significantly associated only with insertion torque (p = 0.016). Surgical time did not differ between the two techniques (p = 0.916).

Conclusion In low-density maxillary premolar sites, clinical outcomes were comparable between electric-driven osteotomes and osseodensification burs. Osseodensification burs yielded greater stability during early healing, whereas marginal bone loss at T1 was associated with insertion torque rather than the site-preparation method.

PREDICTIVE MODELS FOR POST-OPERATIVE COMPLICATIONS IN GUIDED BONE REGENERATION WITH THE SIMULTANEOUS PROTOCOL: A CLINICAL STUDY

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Background Guided bone regeneration (GBR) performed simultaneously with implant placement is a well-established procedure, yet complications such as membrane exposure, dehiscence, infection, and prolonged swelling remain clinical challenges. Identifying predictors is crucial to optimize outcomes and guide decision-making.

Methods A retrospective cohort of 391 patients (mean age 57.5 ± 15.4 years; 208 females, 183 males) treated with simultaneous GBR was analyzed. Demographic, clinical, and surgical variables were collected. Outcomes included membrane exposure, dehiscence, infection, swelling, and need for re-grafting. Univariable and multivariable logistic regressions with stepwise refinement were performed. Models were internally validated with bootstrap resampling. Discrimination was assessed by AUC, calibration by Hosmer–Lemeshow, and diagnostic performance by sensitivity, specificity, and accuracy.

Results Membrane exposure was associated with vertical/combined defects (OR 2.56; p < 0.001) and posterior sites (OR 1.48; p = 0.012). Dehiscence was influenced by defect complexity (OR 1.66; p = 0.017) and posterior location (OR 1.03; p = 0.022), while conservative flap design reduced risk (OR 0.71; p = 0.021). Swelling was linked to flap extension (OR 1.21; p = 0.012) and sedation (OR 2.31; p = 0.028). Infection was rare but correlated with prolonged antibiotics (OR 2.22/day; p = 0.001). Overall, 6.1% required re-grafting. Independent predictors included gingival recession (OR 14.07; p < 0.001), never-smoker status (OR 5.11; p = 0.015), and corticosteroid use (OR 1.61; p = 0.035). The model for membrane exposure showed moderate discrimination (AUC = 0.688), while the re-grafting model performed better (AUC = 0.744; accuracy 80.3%).

Conclusion Defect morphology, anatomical site, and patient factors significantly predict GBR complications. Multivariable models, especially for re-grafting, showed promising accuracy, supporting preoperative risk stratification and clinical decision-making in implant dentistry.

CORRELATION BETWEEN BONE RESISTIVITY AN PRIMARY IMPLANT STABILITY: PRELIMINARY VALIDATION OF AN INTRAOPERATIVE ASSESSMENT METHOD

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Aim The primary implant stability depends on a combination of factors, such as implant design, implant site preparation, and bone quality. However, the bone quality is still mainly based on subjective clinical classifications, characterized by low intra- and inter examiner agreement. The aim of this preliminary study is to propose and validate an innovative method of intraoperative bone density analysis, capable of providing an objective and immediate qualitative estimate.

Materials and methods This ex vivo study was conducted on 19 bovine bone specimens, processed within 6 hours of collection. Following the preparation with a pilot drill, a 30 kHz sinusoidal signal generated by a frequency generator (DG1022Z, Rigol) was applied to the cancellous bone tissue through two metallic pins, while a digital oscilloscope (DS1102Z, Rigol) recorded the peak-

to-peak input and output voltage values. For each specimen, 100 consecutive measurements were acquired using a Python script developed with the PyVISA library, and the percentage attenuation coefficient (damping) as well as the equivalent impedance (Z_0) were calculated. Subsequently, each specimen underwent standardized implant site preparation, followed by the insertion of identical dental implants (3.8 × 10 mm, OneTime, Resista, Omegna, Italy). Primary stability was then assessed using resonance frequency analysis (Osstell Beacon, Osstell, Gothenburg, Sweden).
Results Damping values showed a wide variability (6.07–80.0%), consistent with the different trabecular density of the specimens, while ISQ values ranged from 53 to 76. Statistical analysis revealed a significant positive linear correlation between the attenuation coefficient and ISQ ($r = 0.79$; $p = 0.0001$), further confirmed by Spearman's correlation ($\rho = 0.77$). These findings suggest that higher electrical attenuation, determined by denser trabecular bone, is associated with greater primary implant stability.
Conclusion Accurate intraoperative measurement of bone quality may support the correct calibration of implant site preparation, preventing both excessive cortical compression from under-preparation and instability from over-preparation, thereby favoring optimal conditions for primary stability and osseointegration. This preliminary study tested a novel method based on impedance analysis of bone tissue at a fixed frequency, using electrical signal attenuation as an objective indicator of bone quality. The results indicate a statistically significant positive linear correlation: as the impedance-derived attenuation values increase, there is an increase in bone density and, consequently, with the same implant site preparation, greater rigidity of the bone-implant interface, evidenced by higher ISQ values. Future studies extending impedance analysis across broader frequency ranges may further improve bone quality assessment and enhance clinical applicability.

ATYPICAL STAFNE BONE DEFECT TREATED WITH PIEZOELECTRIC SURGERY

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Background The Stafne bone defect is classified as a pseudocyst of the mandible. It typically appears as a radiographic entity resembling a well-defined osteolytic lesion on the lingual surface of the mandibular angle, below the course of the inferior alveolar nerve. This condition is caused by the ectopic localization of the submandibular gland or its accessory extensions. It is commonly discovered incidentally during routine panoramic radiographic examinations. Diagnosing this pseudopathological condition can be challenging due to its asymptomatic nature and its radiographic resemblance to other conditions, such as bone lesions, odontogenic cysts, or bone tumors.
Case summary A 40-year-old woman referred to our attention for the evaluation of a radiolucent lesion on the mandibular symphysis extending from tooth 4.2 to 3.1, and completely asymptomatic. Intraoral examination revealed no mucosal alterations, and the aforementioned teeth responded positively to cold vitality testing. The Cone Beam Computed Tomography showed a well-defined osteolytic area closely associated with the roots of the involved teeth, as well as a communication between the lesion and the floor of the oral cavity. Given these findings, an excisional biopsy was planned using piezoelectric surgery, in order to preserve the anatomical and functional integrity of the adjacent vascular, neural, and glandular structures of the oral floor. Histolopathological analysis of the sample revealed mixed salivary gland aggregates adjacent to extensively remodeled bone margins, finding consistent with salivary gland ectopia. A final diagnosis of "atypical Stafne defect" was done.
Conclusions Although the Stafne bone defects usually occur in mandibular angle, atypical localizations can be observed, also due to the sublingual gland. This case highlights the value of piezoelectric-guided surgery in managing lesions adjacent to anatomical structures at high risk of neurological, hemorrhagic, or functional complications.

IMMEDIATE LOADING IMPLANT PLACEMENT AFTER INFERIOR ALVEOLAR NERVE LATERALIZATION OR TRANSPOSITIONS

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Introduction After tooth extraction, the alveolar bone of the maxilla and mandible undergoes progressive resorption in height and width due to loss of function and reduced vascularization. As a result, reconstructive procedures or alternative surgical techniques may be required to enable fixed implant-supported rehabilitation. In the mandible, vertical augmentation is generally less predictable and more invasive than in the maxilla, owing to bone quality and the proximity of the inferior alveolar nerve. Consequently, partially edentulous patients in the posterior and premolar regions are among the most challenging to restore with fixed prostheses. This retrospective study aims to evaluate the benefits, complications, and follow-up outcomes of immediate implant placement without grafting materials, using inferior alveolar nerve transposition or lateralization, with or without incisive nerve resection.
Materials and Methods Patients with at least one implant placed through inferior alveolar nerve transposition or lateralization and a minimum follow-up of four years were included, while those with severe systemic diseases were excluded. In the lateralization technique, a vestibular corticotomy was performed from 3 mm distal to the mental foramen to 6–7 mm distal to the most posterior planned implant site, followed by piezoelectric removal of cancellous bone to expose the neurovascular bundle, which was then mobilized and maintained in a displaced position with collagen to allow implant site preparation. In the transposition technique, the inferior alveolar nerve was isolated and transected to enable distal repositioning of the mental nerve.
Results Eight patients were analyzed. No long-term

postoperative complications were observed, and the implant survival rate was 100%. Native bone quality proved superior to regenerated bone, even when autologous grafts are used, as all grafts are subject to resorption or failure. These surgical approaches allowed the use of native bone, including the basal component, to achieve implant stability without the risk associated with non-resorbable substitutes. This treatment may therefore be considered acceptable in terms of implant success and survival rates, and potentially represent a gold standard by enabling a single surgical procedure with immediate provisional loading.

Conclusion Immediate implant placement in the posterior mandible of partially edentulous patients may represent a reliable surgical and clinical approach without the need for reconstructive procedures, by using inferior alveolar nerve transposition or lateralization to exploit the full mandibular width for primary and secondary stability.

IN VITRO COMPARISON OF ROOT DEBRIDEMENT TIME: MANUAL VERSUS PIEZOELECTRIC INSTRUMENTS AND THE ROLE OF CLINICIAN EXPERIENCE

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Aim This randomized controlled in vitro study assesses the effect of instrument type (manual curettes vs piezoelectric inserts) and clinician experience on root surface debridement time.

Methods Hopeless single-rooted teeth with advanced periodontitis (PPD ≥5 mm), which had never undergone nonsurgical or surgical periodontal treatment and with no root alterations, were selected. The teeth were embedded horizontally in a resin matrix, and the root portion to be treated, from the gingival margin to the bottom of the pocket, was delimited with a fine-grit diamond bur. Samples were randomly assigned to manual root surface debridement with Gracey 1/2 curettes (Hu-Friedy, Chicago, USA) or piezoelectric S1-S inserts (Mectron, Carasco, Italy) mounted on a Multipiezo Touch piezoelectric scaler (Mectron, Carasco, Italy). Manual instrumentation employed a calibrated 10 N load cell; piezoelectric inserts were used in “scaler” mode (settings: power 2/6, irrigation 6/6). To evaluate the effects of operator experience and instrument type on procedure duration (seconds), data were stratified into four groups combining operator experience (experienced vs. inexperienced) and instrument type (manual vs. piezoelectric). All procedures were conducted by the same two operators, one with extensive experience and the other with limited experience, under optical magnification (4x) to ensure standardized root surface treatment. Treatment duration was recorded by an independent supervisor. Data distribution was assessed with the Shapiro-Wilk test and, due to the non-normality of data, non-parametric tests were applied. Differences among groups were analyzed using the Kruskal-Wallis test, followed by pairwise comparisons with the Mann-Whitney test when significant differences were detected.

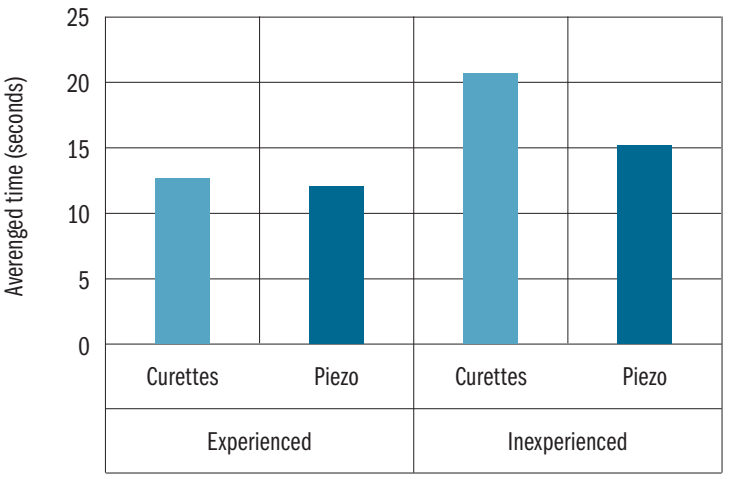

Fig. 1 Average time in seconds for root surface debridement grouped by operator experience (experienced vs. inexperienced) and instrument type (curette vs. piezoelectric).

Results A total of 140 samples were included in the study (65 males and 75 females; 33 smokers and 107 non-smokers; mean age 71.3 ± 9.7 years), with 35 teeth assigned to each of the four groups. Significant differences in debridement time were detected across the four groups ($p < 0.0001$), underscoring the influence of both instrument type and clinician experience. Pairwise Mann–Whitney U tests showed that, among experienced clinicians, debridement times did not differ between curettes and piezoelectric inserts ($p = 0.33$), whereas among inexperienced clinicians, piezoelectric inserts yielded shorter times ($p = 0.0016$) (Fig. 1).

Conclusions Piezoelectric inserts shortened debridement time, particularly for less-experienced clinicians, likely mitigating the impact of limited hand skills. Experience remained a major determinant of procedural efficiency and debridement accuracy. Early incorporation of ultrasonic instrumentation into training curricula may help standardize performance and optimize time management.

CLINICAL OUTCOMES OF TRANSCRESTAL SINUS FLOOR ELEVATION AFTER 10 YEARS: IMPLANT SURVIVAL, MARGINAL BONE LOSS, AND VOLUMETRIC STABILITY

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Background and aim Although transcrestal sinus floor elevation (tSFE) is an established option for implant placement in the posterior maxilla, supporting long-term evidence remains scarce. This multicenter prospective study evaluated the 10-year outcomes of tSFE with staged implant placement in patients

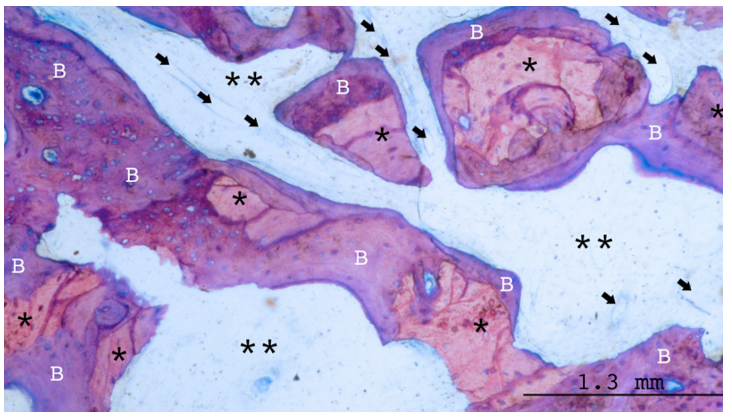


Fig. 1 Microscopical aspects of specimens retrieved aVer 6 months of healing. Residual biomaterial particles (*) appeared integrated with newly formed bone (B), forming well-developed bony trabeculae. Within the marrow spaces (**), numerous blood vessels are visible (black arrows).

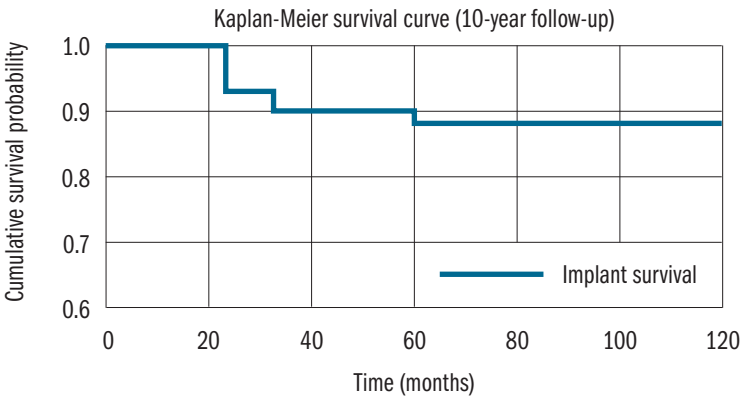
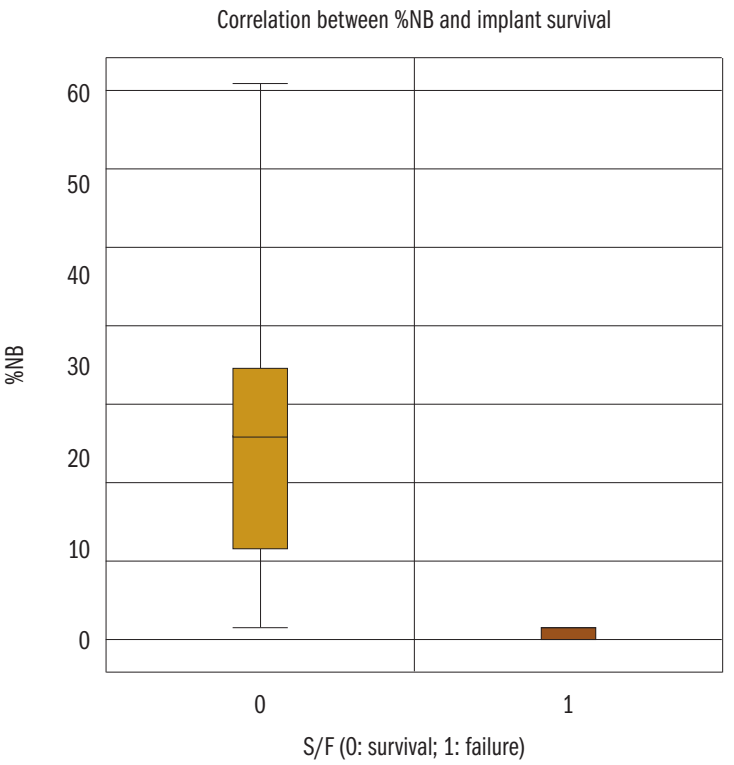


Fig. 1 Kaplan–Meier survival curve of implants placed aVer transcrestal sinus floor elevation.



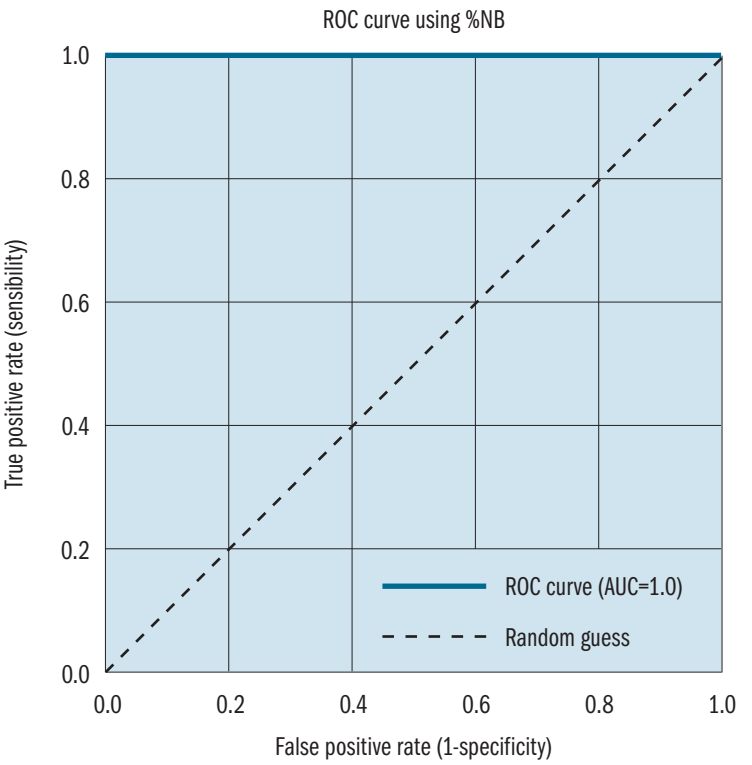


Fig. 1 Correlation between newly formed bone percentage (%NB) at 6 months and implant survival. (LeV) Box plot showing perfect separation: all implant failures occurred in patients with %NB below the threshold, while implants with higher %NB survived at 10 years. (Right) ROC curve analysis confirmed %NB as a perfect predictor of implant survival (AUC = 1.0).

with residual bone height < 5 mm, focusing on implant survival, marginal bone loss, graV stability, and predictive factors for implant failure.

Materials and methods Forty-four partially edentulous patients (mean residual bone height 3.4 ± 1.0 mm) were treated between 2014 and 2015 by three experienced operators. Sinus access was performed with piezoelectric instrumentation (Piezosurgery Touch, Mectron, Carasco, Italy), ensuring precise and safe management of the Schneiderian membrane, and xenograV granules (SmartBone, IBI, Mezzovico-Vira, Switzerland) were then graVed with progressive increments. Bone core biopsies were harvested for histological evaluation at implant insertion, aVer six months of healing (T1) (Fig. 1). Patients were followed for 10 ± 0.3 years, with radiographic and clinical evaluations at baseline (T0), prosthetic loading (T1), and 10 years (T2).

Results Thirty-nine patients completed the full follow-up period. At 10 years, implant failure rate was 13.9%. Kaplan–Meier analysis showed cumulative survival rates of 92.3% at 24 months, 89.7% at 36 months, and 87.2% between 60 and 120 months (Fig. 2). Mean marginal bone loss from T1 to T2 was 0.60 ± 1.19 mm, while mean graV height reduction from T0 to T2 was 3.79 ± 2.14 mm. Histological evaluation revealed a mean percentage of newly formed bone (% NB) of 21.8 ± 16.7%, inversely correlated with sinus width ($r = -0.814$, $p < 0.01$). Importantly, all implant failures occurred when %NB aVer 6 months of healing was below 2.1%. ROC curve analysis confirmed %NB as a perfect predictor of implant survival aVer 10 years (AUC = 1.0; Fig. 3). No significant associations between implant failure and variables like age, gender, smoking, or initial residual bone height were demonstrated.).

Conclusions AVer 10 years of functional loading, implants placed following tSFE in sites with residual bone <5 mm

demonstrated high survival rates, limited marginal bone loss, and stable graV height. The decisive influence of %NB on implant survival highlights that the biological quality of regeneration, rather than patient-related variables, is the true determinant of long-term prognosis.

SHAPING THE FUTURE OF DENTAL CARE: THE ROLE OF NAO ROBOT IN ENHANCING COOPERATION AMONG AUTISTIC PATIENTS

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Objective of the Study The dental environment presents significant challenges for autistic individuals with sensory processing disorders. These challenges are compounded by the difficulty of allowing unfamiliar individuals to touch or explore sensitive areas such as the oral cavity. In children with autism spectrum disorder (ASD), this can lead to psychomotor agitation, overt aversion and/or refusal behaviors, which may manifest as early as the waiting room and prevent dental visits.
This study evaluated the effectiveness of the humanoid robot NAO in reducing stress and psychomotor agitation in children with ASD before and during dental visits. The primary objective was to enhance patient cooperation, enabling a calm approach to the dental environment and facilitating dental examinations during interaction with the robot, without resorting to sedation techniques.
Materials and Methods Twenty children with ASD (aged 4–14 years) were recruited from patients with insufficient cooperation for dental visits (showing evident aversion reactions and psychomotor agitation already in the waiting room), some of whom had previously undergone standard desensitization approaches without achieving appreciable results. The protocol included two phases: an initial assessment (T1) using behavioral scales (modified Frankl scale and Venham scale) completed by dental staff and a questionnaire (CFSS-DS) filled out by parents, followed by a second session (T2) involving the NAO robot and a reassessment using the same methods. The robot was programmed to interact with the children, greeting them in the waiting room, performing songs, and explaining dental procedures and instruments.
Results At T1, 90% of the children exhibited a negative or completely negative attitude (measured by the modified Frankl scale). In the session with the NAO robot (T2), 70% of the children showed sufficient or good cooperation (Venham scale), with only 30% persisting in a negative or completely negative attitude. The Frankl scale also recorded an increase in “positive” behaviors (60% vs. 10% at T1). The CFSS-DS questionnaire indicated reduced stress in critical situations (e.g., noise from instruments, physical contact), improving tolerability. The approach was particularly effective in younger children (aged 4–10 years).
Conclusions The use of the NAO robot proved effective in reducing stress and improving cooperation in children with ASD. These findings support the integration of robotic technologies in clinical settings, although further studies are needed to assess long-term stability and applicability to larger populations..

IMPACT OF PIEZOSURGERY ON THE INTEGRATION OF AUTOGENOUS BONE GRAFTS IN RECIPIENT SITES: A PRECLINICAL STUDY

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Introduction Piezosurgery has been established as a minimally invasive technique, capable of reducing tissue trauma compared to conventional rotary instruments. This suggests that piezosurgery may represent a valuable alternative to optimize bone healing in recipient sites of autogenous bone grafts.
Objective To compare the integration of autogenous block bone grafts obtained and implanted with recipient sites prepared using either rotary burs or piezosurgery.
Methods Twenty four male rabbits were allocated into four groups: Rotary (RT), Rotary Piezo (RP), Piezo (PZ), and Piezo Rotary (PR). In each animal, four calvarial bone blocks were harvested (two using a 7 mm trephine bur and two via piezosurgery), and two blocks were grafted on each side of the mandible, with each recipient site prepared by one of the methods. Graft integration was evaluated through histometric, immunohistochemical, and microcomputed tomography analyses at 15, 30, and 60 days.
Results Histometric analysis demonstrated a higher percentage of newly formed bone in the RT and PZ groups, with no significant difference between them, whereas the RP and PR groups exhibited reduced bone formation, with statistically significant differences. Quantification of osteocytes, osteoblasts, and osteoclasts corroborated these findings. Immunohistochemical analysis revealed moderate osteoclastic activity, as indicated by Immunostaining for TRAP, in all groups; regarding osteocalcin, the PR group presented low Immunostaining at 15 days, while the remaining groups showed moderate Immunostaining. At 30 days, the RT and RP groups displayed moderate to intense Immunostaining, the PZ group showed moderate Immunostaining, and the PR group maintained low Immunostaining. Microcomputed tomography at 60 days revealed that the PZ group exhibited greater bone volume and higher trabecular number ($p<0.05$), whereas the groups subjected to combined techniques presented increased porosity ($p<0.05$) and trabecular thickening ($p<0.05$), indicative of lower-quality bone formation.
Conclusions Piezosurgery optimizes the integration of

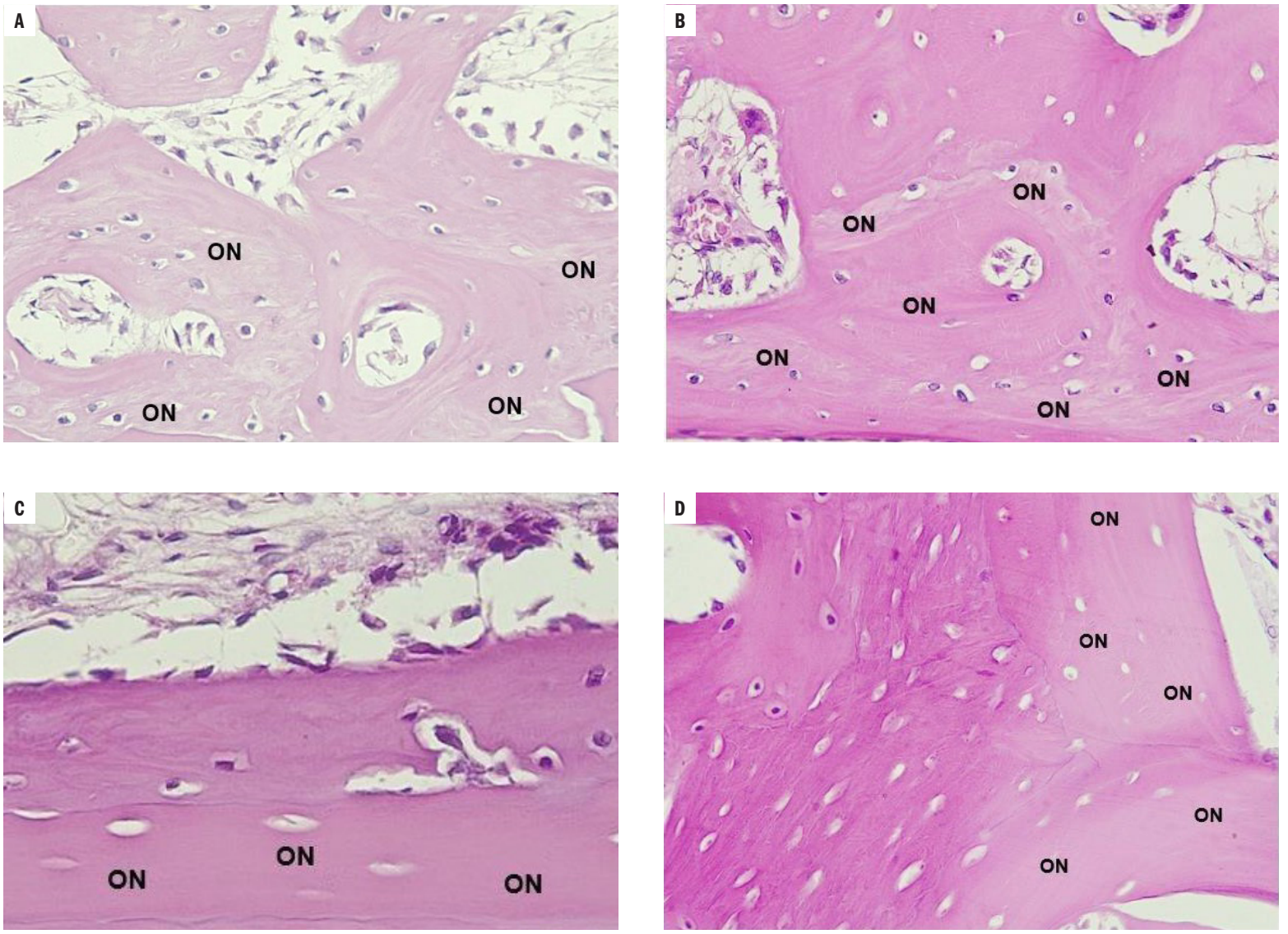

Fig. 1 Representative images of histological analysis at 30 days, at 100× magnification. (A) Rotary; (B) Rotary Piezo; (C) Piezo; (D) Piezo Rotary. ON: newly formed bone.

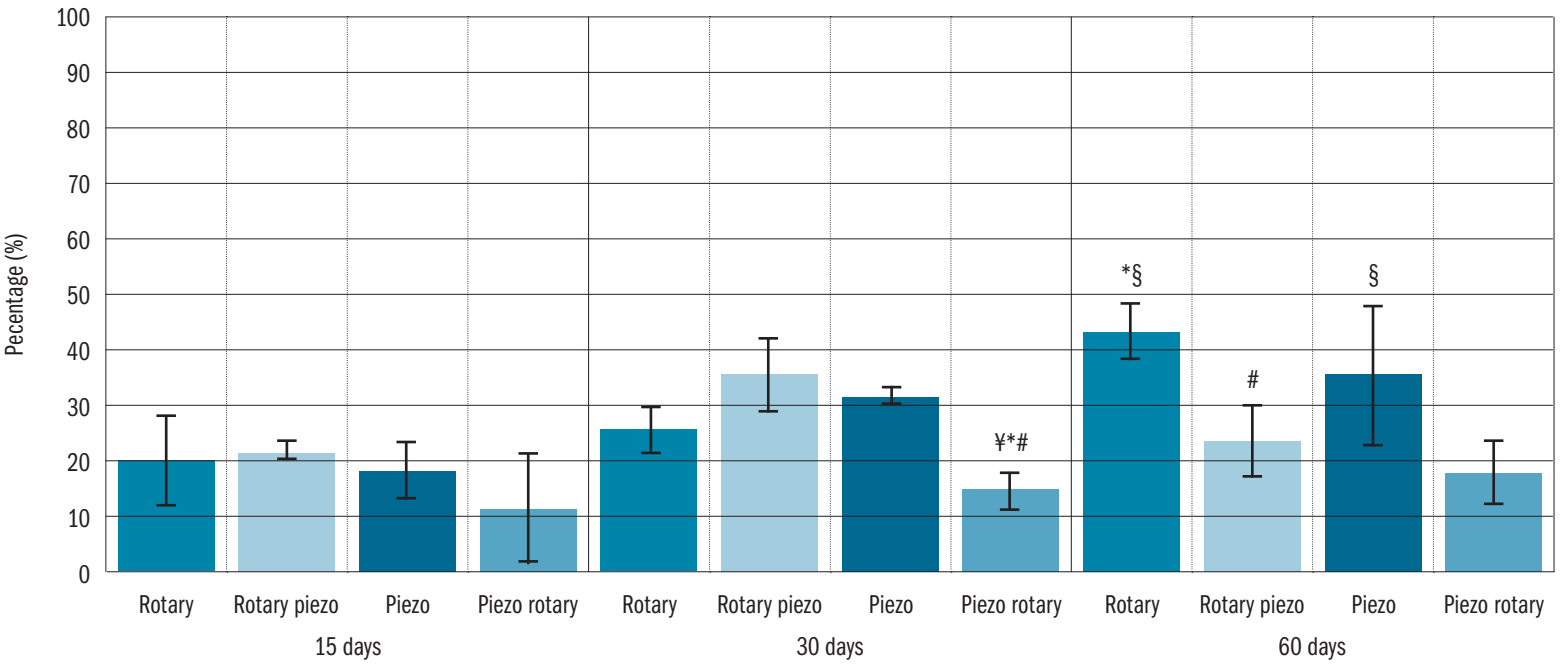

Fig. 2 Graph representing the mean percentage of the newly formed bone area at 30 days. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

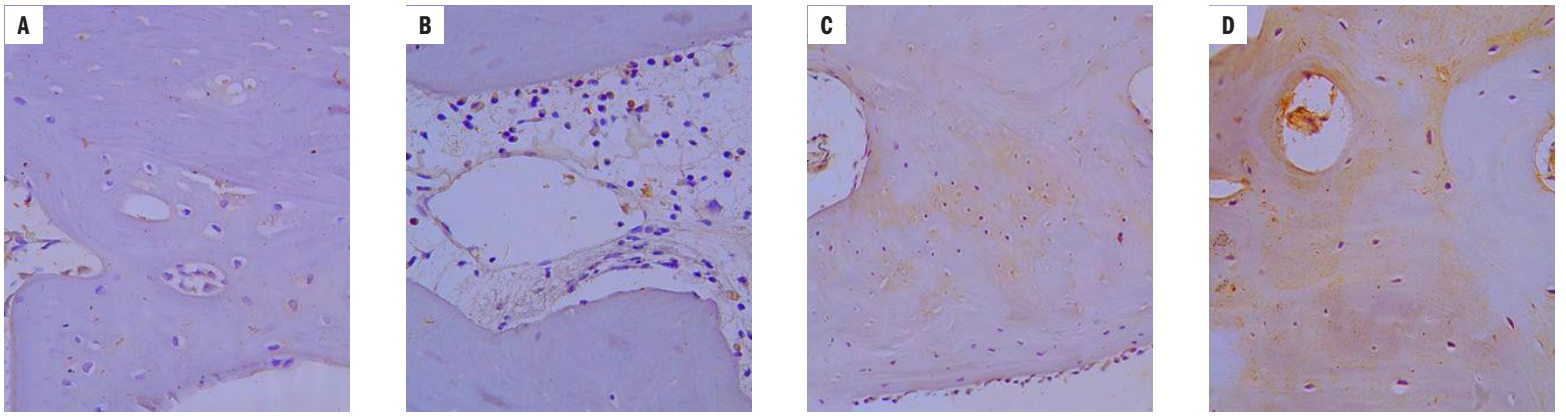

Fig. 3 Immunohistochemical images of the marking from the OCN of the bone tissue at 30 days. (A) Rotary; (B) Rotary Piezo; (C) Piezo; (D) Piezo Rotary.

Fig. 4A-4F Quantitative analysis of the parameters evaluated by microtomographic analysis among the Rotary, Rotary Piezo, Piezo, and Piezo Rotary groups at 15, 30, and 60 days. (**A**) BV - Bone volume (mm^3). (**B**) BV/TV - Bone volume fraction (%). (**C**) Tb.Th - Trabecular thickness (mm). (**D**) Tb.N - Trabecular number (/mm). (**E**) Tb.Sp - Trabecular separation (mm). (**F**) Po.tot - Total porosity (%)

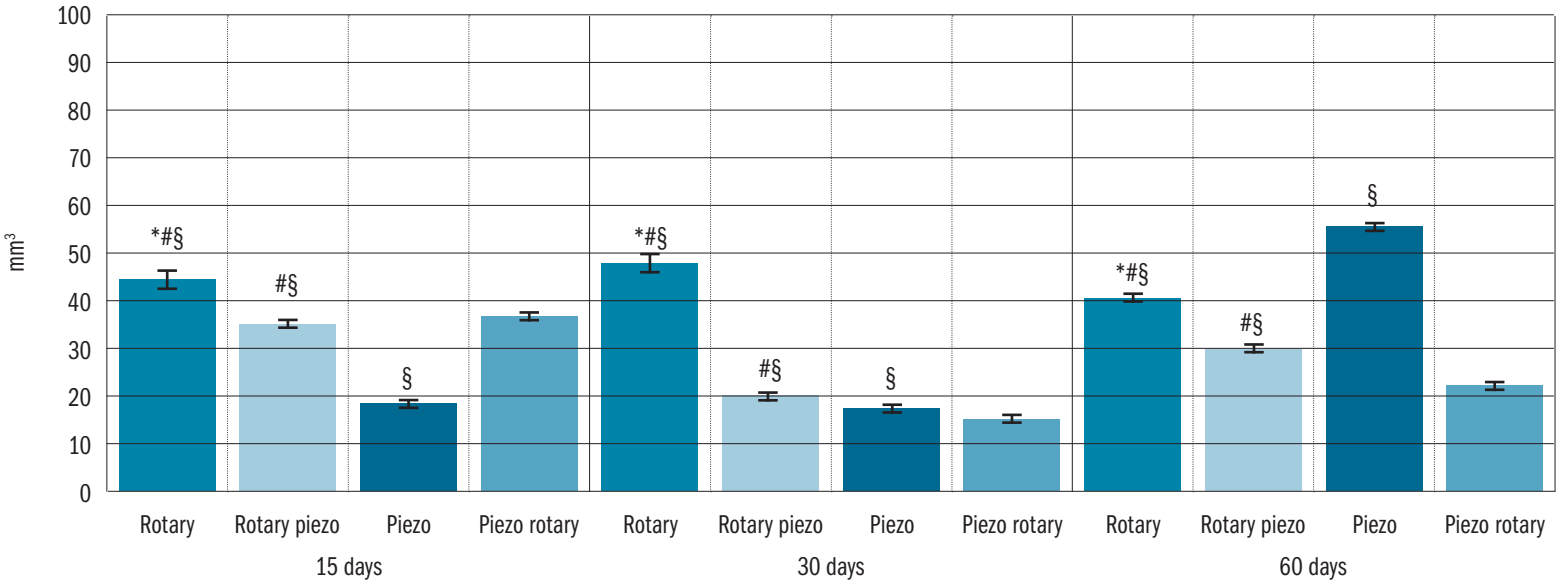

Fig. 4A BV. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

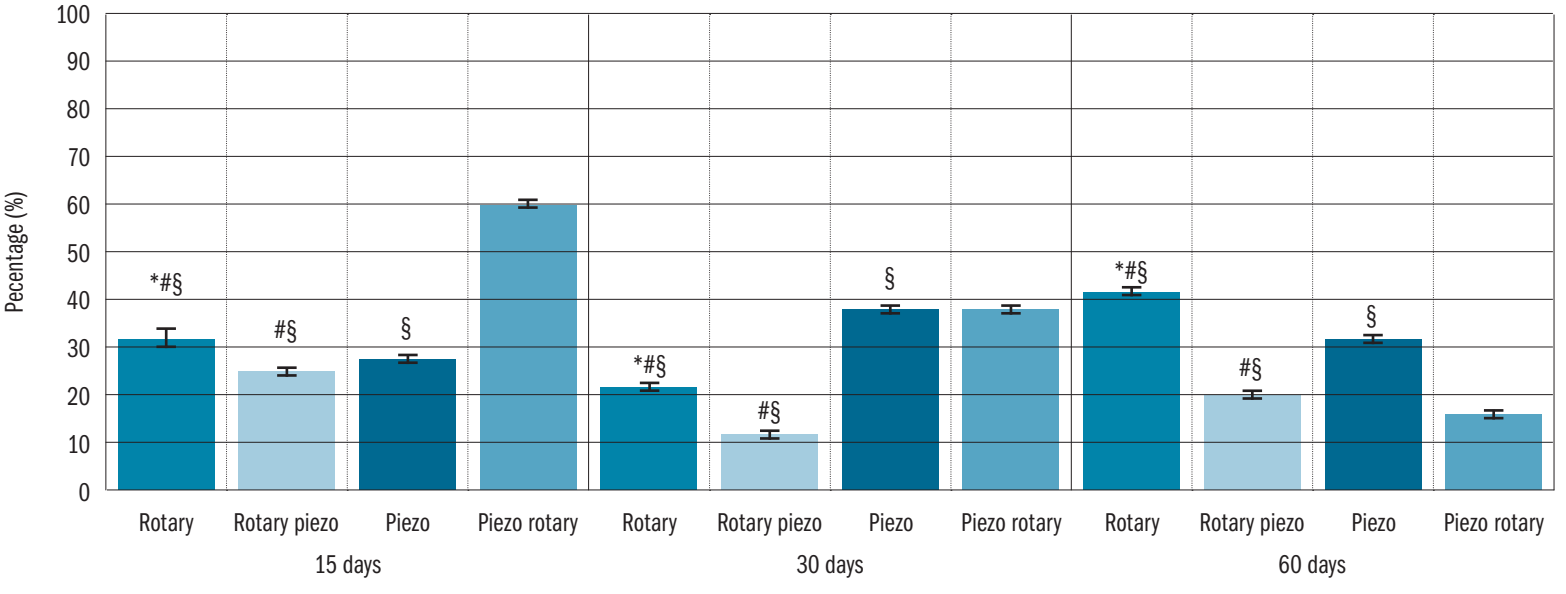

Fig. 4B BV/TV. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

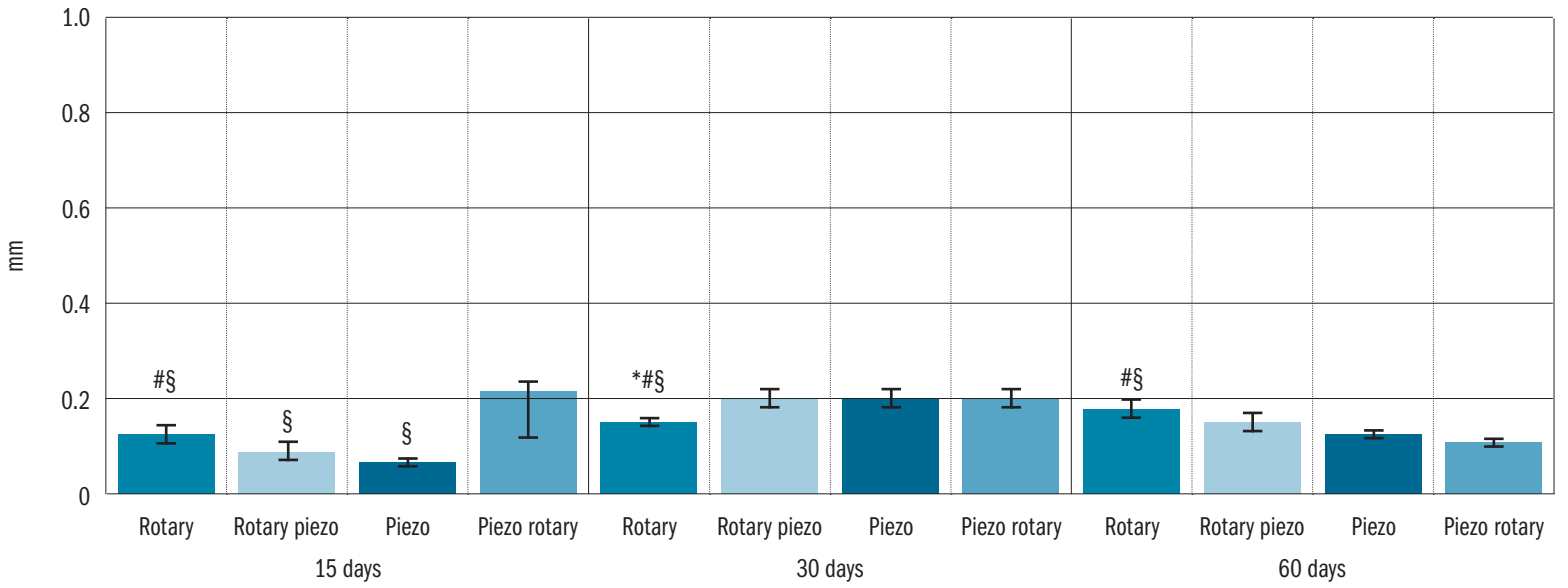

Fig. 4C Tb.Th. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

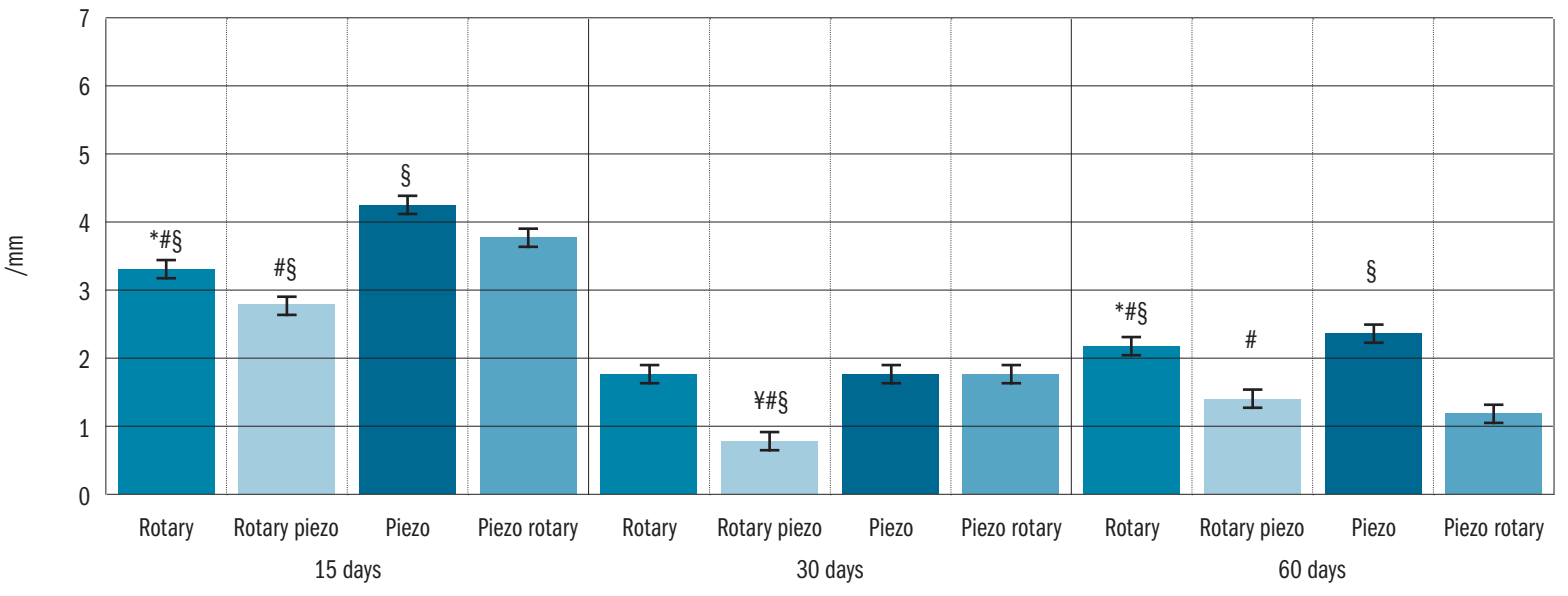

Fig. 4D Tb.N. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

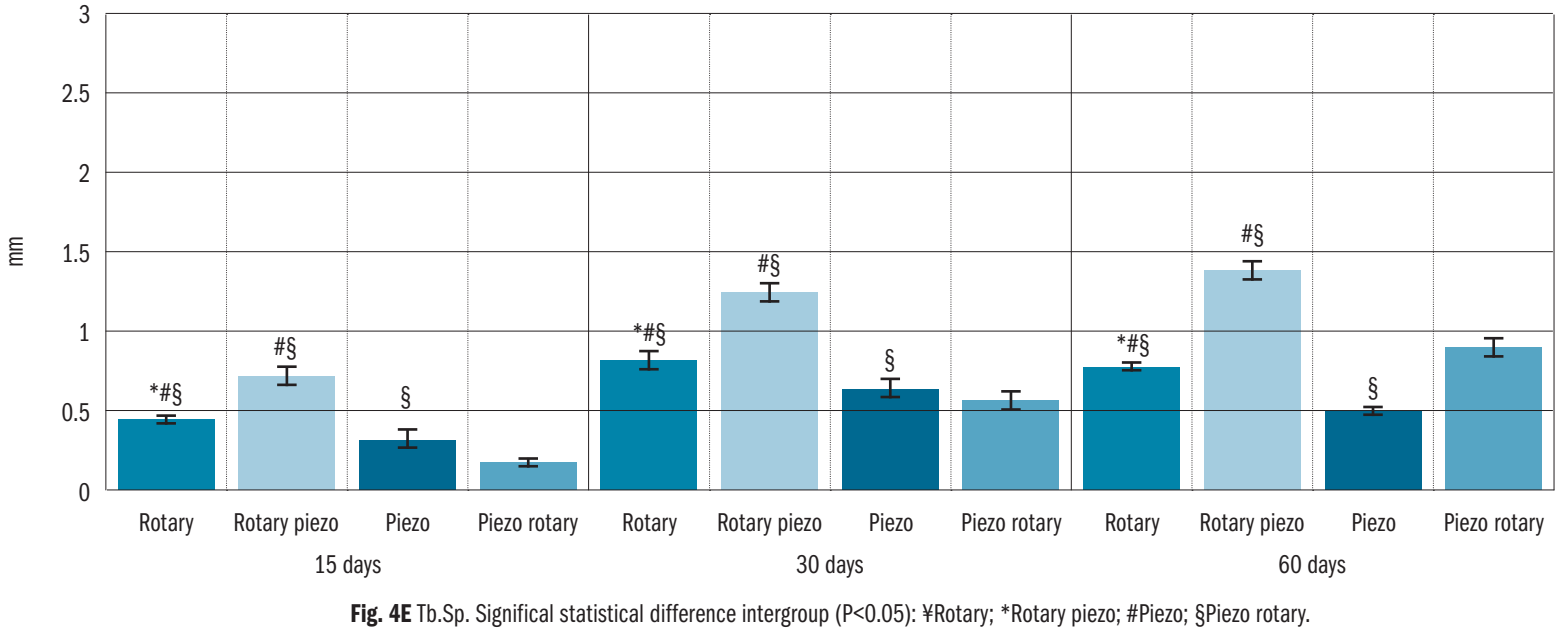

Fig. 4E Tb.Sp. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

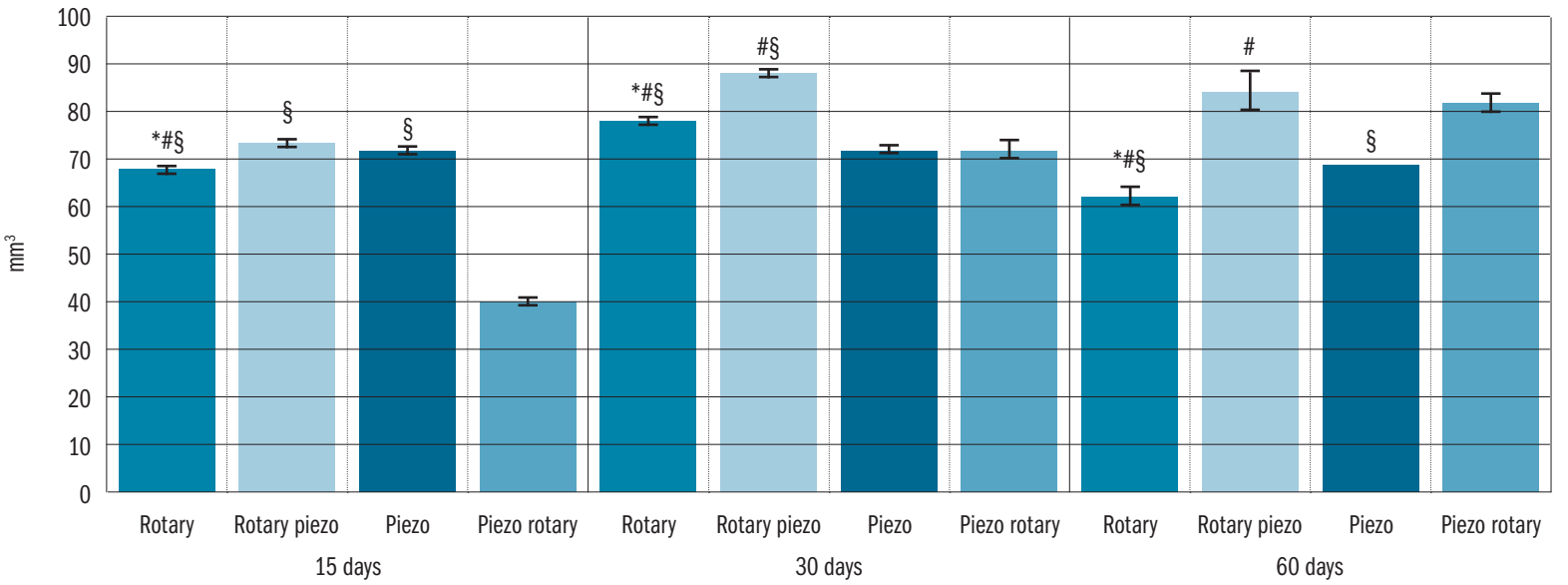

Fig. 4F Po.tot. Significal statistical difference intergroup (P<0.05): ¥Rotary; *Rotary piezo; #Piezo; §Piezo rotary.

autogenous bone block grafts, demonstrating superior microstructural and histomorphometric parameters, reinforcing its potential as a technique in reconstructive surgeries.

ASSOCIATION BETWEEN RESONANCE FREQUENCY ANALYSIS AND CLINICAL OUTCOMES IN IMPLANT DENTISTRY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Objectives Given the growing use of resonance frequency analysis in clinical implantology and the inconsistent evidence regarding its prognostic value, this systematic review aimed to clarify the association between implant stability quotient (ISQ)

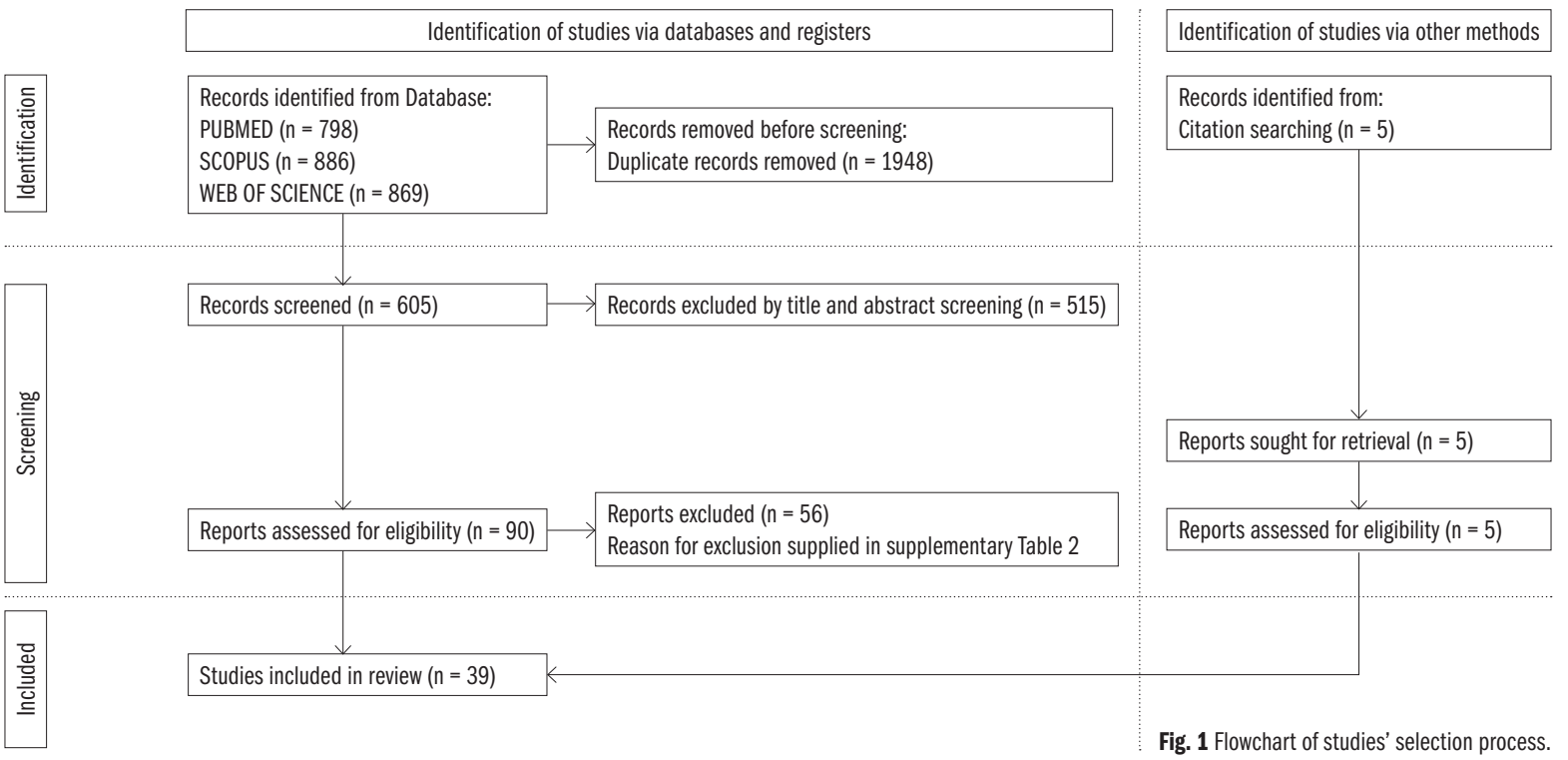

Fig. 1 Flowchart of studies' selection process.

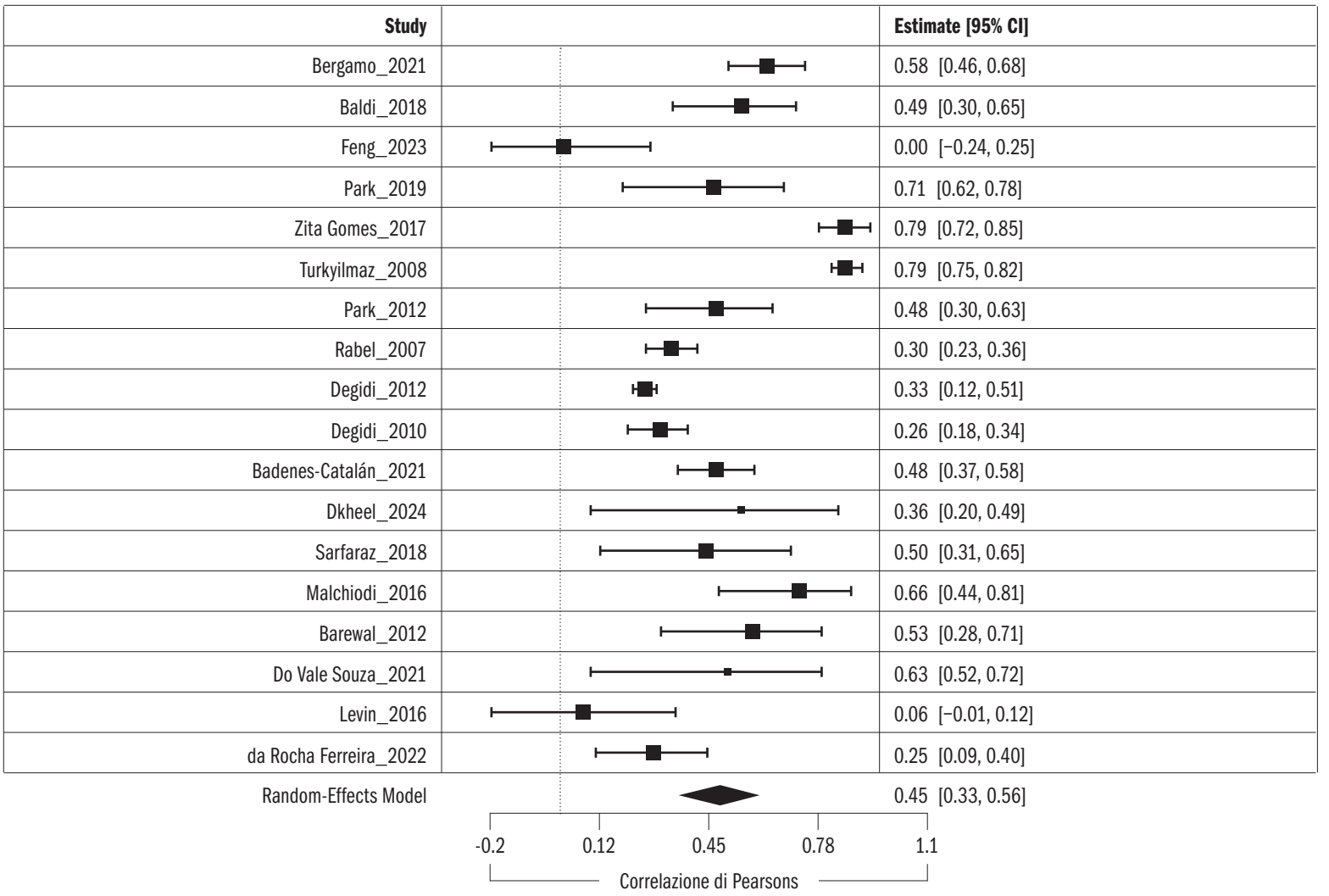

Fig. 2 Forest plot depicting overall pooled correlation coefficient between IT and ISQ values across included studies.

with insertion torque (IT), marginal bone loss (MBL) and implant survival/success rate.

Materials and Methods Following PRISMA guidelines, a comprehensive literature search was conducted across PubMed, Scopus and Web of Science to answer the PIO question: "In systemically healthy patients undergoing implant placement, are ISQ values associated with intraoperative and postoperative clinical surrogate outcomes such as insertion torque, marginal bone loss and implant survival/success?". Eligible clinical studies reported ISQ and at least one target outcome. Risk of bias was assessed using design-specific tools appropriate for each study type.

Results Thirty-nine studies (n = 3161 patients, > 8000 implants) were included. Eighteen studies entered the meta-analysis, showing a moderate positive correlation between ISQ and IT with a pooled Pearson's r = 0.45 (95% CI: 0.33 – 0.56, p < 0.001). Correlations were stronger in high-density bone and varied with implant macrogeometry and surgical protocols. ISQ demonstrated weak or inconsistent correlations with MBL and survival/success rates, with only one study reporting statistically significant associations.

Conclusions ISQ shows a moderate correlation with insertion torque, supporting its role as a complementary indicator of primary implant stability. However, this relationship should be interpreted with caution due to clinical and methodological variability. The limited predictive value for MBL and implant outcomes further highlights the need to combine ISQ with other diagnostic parameters. Standardized research is needed to clarify its prognostic reliability.

LOCAL OZONE THERAPY IMPROVES PERI-IMPLANT REPAIR IN RATS TREATED WITH ZOLEDRONIC ACID: A PRECLINICAL STUDY

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Introduction Patients undergoing prolonged use or high doses

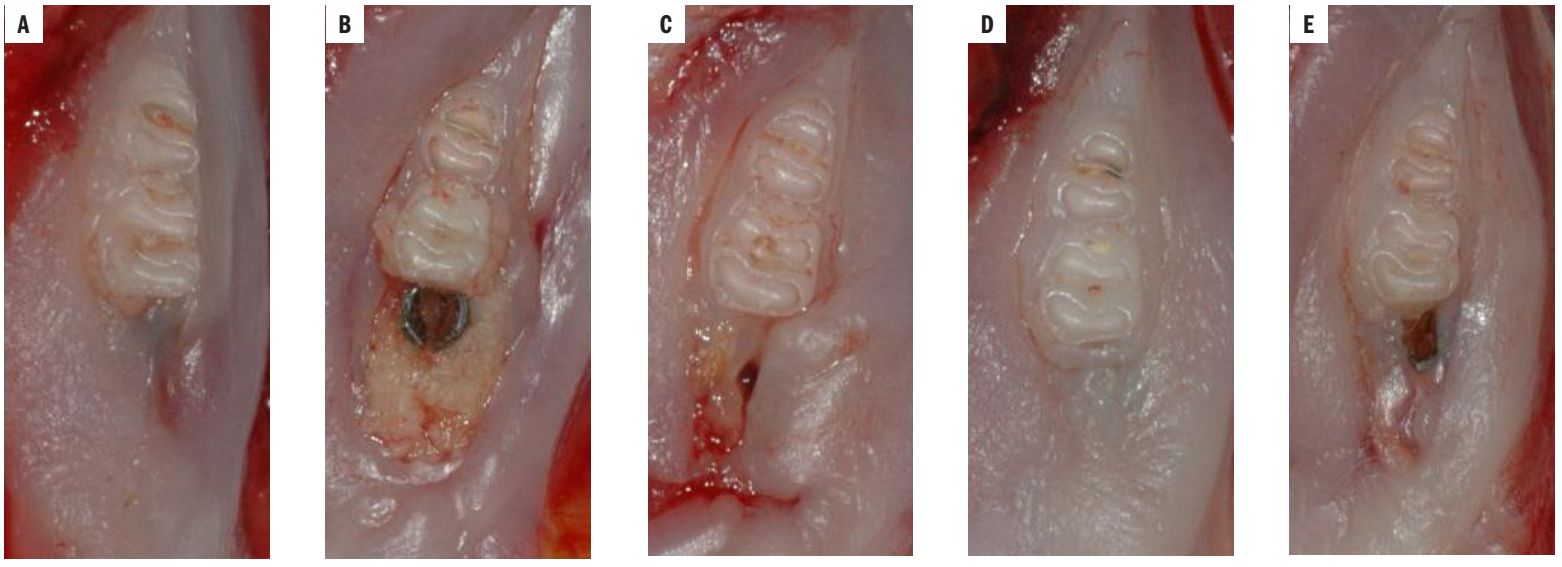

Fig. 1A-1F Representative images of clinical analysis at 28 postoperative days. SAL: saline solution group (**A**); ZOL: zoledronic acid group (**B**); GO: ozonated oil group (**C**); GG: gaseous ozone group (**D**); GGO: gaseous and ozonated oil group (**E**); Statistical analysis (**F**).

of bisphosphonates are at risk of developing medication-related osteonecrosis of the jaw (MRONJ) after implant placement. Ozone therapy has shown positive effects on peri-implant repair and may be a preventive alternative for MRONJ.

Aim To evaluate the effects of local ozone therapy on peri-implant repair in rats treated with zoledronic acid (ZA).

Methodology Eighty male Wistar rats were divided into five groups (n = 16): SAL (saline solution), ZOL (ZA treatment), GG (gaseous ozone, 60 μg/mL), GO (ozonated oil, 0.1 mL), and GGO (gaseous ozone and ozonated oil). All groups, except SAL, received six applications of ZA (0.035 mg/kg) administered caudally at 15 day intervals. Implant placement was performed immediately after extraction of the mandibular right first molar. Ozone therapies were applied to the peri-implant mucosa every four days for four weeks. Animals were euthanized 28 days postoperatively for clinical, biomechanical, microtomographic, and surface characterization analyses by scanning electron microscopy (SEM/EDS).

Results The SAL, GG, and GGO groups presented lower clinical severity compared to the ZOL group ($p < 0.05$), indicating better tissue repair. Removal torque values showed no significant differences among groups ($p > 0.05$), although GG presented the highest mean. SEM revealed biological material in all groups.

Fig. 2A-2E Representative scanning electron microscopy images of the implants removed at 28 postoperative days. Magnification at 75× highlighting the three upper threads. SAL (**A**); ZOL (**B**); GO (**C**); GG (**D**); GGO (**E**).

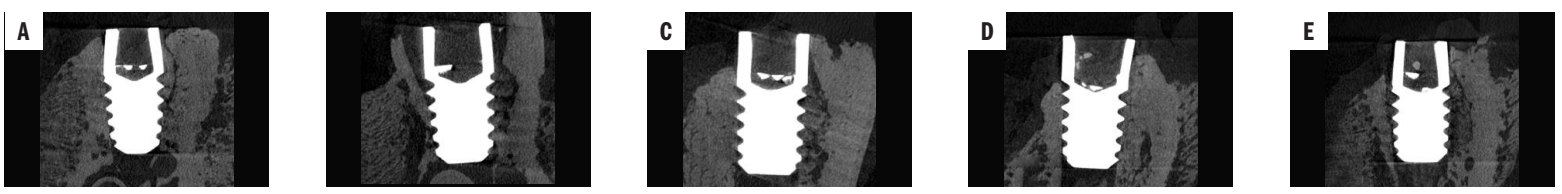

Fig. 3A-3E Representative μ-CT images. Coronal section in the implant installation region, corresponding to the distal root of the lower first molar. SAL (**A**); ZOL (**B**); GO (**C**); GG (**D**); GGO (**E**).

Higher concentrations of Ca and P were detected in the GO and GG groups. Microtomographic analysis demonstrated greater bone volume ($p < 0.05$) in ozone treated groups compared to ZOL. **Conclusion** Local ozone therapy positively modulated tissue healing and peri-implant bone repair in an experimental model of zoledronic acid induced osteonecrosis. Further studies are warranted to investigate cellular responses and elucidate the mechanisms by which ozone promotes peri-implant repair under compromised conditions.