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Usefulness of the Magnetodynamic Mallet in Tooth Extraction: A Case Series

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Abstract: Background: Tooth extraction techniques have been refined over the years in order to be less traumatic and to better preserve alveolar bone. A recently introduced extraction method involves the use of the Magnetic Mallet®, which allows clinicians to be more precise and perform extractions faster. Moreover, the instrument enables the procedure to be less traumatic for patients. The aim of the present study was to clinically evaluate whether extractions performed using the Magnetic Mallet® can lead to less buccolingual bone resorption. **Methods:** Between February 2023 and June 2023, nine patients with an average age of 62 years underwent 29 extractions using the Magnetic Mallet®. Sectorial CBCTs were performed in order to measure buccolingual bone thickness at time 0 (T0, before extraction) and 3 months after extraction (T3M). All the extractions were performed by two different expert operators exclusively using the Magnetic Mallet®. For statistical analysis, a two-sample *t*-test was performed to determine the difference between the measurements taken at T0 and those taken at T3M in the 29 dental elements and the difference in bone loss between the surgeries conducted by the two clinicians. **Results:** A total of 22 teeth were extracted in the upper jaw and 7 in the lower jaw. The average degree of mobility was 1. The average degree of force impressed by the instrument to extract the teeth was 2, while the average frequency of blows administered was 7. The average time taken for the extractions was 3½ min. After 3 months, the mean buccolingual bone resorption was 1.54 mm (SD: ±). The difference in buccolingual bone thickness between T0 and T3 was significant at an alpha significance level of 0.01. No difference in bone resorption was found between the surgeries conducted by the two clinicians. **Conclusions:** The use of the Magnetic Mallet® results in bone loss in the buccolingual direction comparable with existing data in the literature on healing the post-extraction socket. This tool seems to be predictable in producing the same results between different operators.

Keywords: tooth extractions; magnetodynamic surgery; socket preservation; oral surgery; bone resorption

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1. Introduction

In Western countries, aging of the population leads to an increase in total or partial edentulism. As a result, the need for complex prosthodontic and implant prosthodontic solutions is expected to increase. Therefore, new surgical procedures are necessary to improve the results and stability of prosthodontic solutions over time [1].

Following tooth extraction, the bone ridge undergoes a process of remodeling that leads to its dimensional reduction [2–6]. Such physiological changes in the alveolar process adversely affect the prosthodontic rehabilitation of the edentulous area, whether or not the patient has to be treated with implant-supported or traditional prosthodontic procedures. Knowing that the extent of bone resorption is correlated with the degree of trauma during extraction, in recent years, several studies dealing with extraction surgery have focused on techniques different from traditional approaches, and gradually, methods that are more conservative and respectful of the supporting tissues have emerged [7–17].

The tools commonly used in tooth extractions are levers and forceps. In both cases, their use can be decidedly traumatic for the socket, causing significant bone contractions and intra- and post-operative discomfort for the patient.

Over time, research has focused on identifying less invasive techniques to ensure less discomfort for the patient, in particular, post-operative pain. Likewise, the use of more advanced techniques and instruments has allowed clinicians to perform faster and less laborious extractions.

In particular, countless tools have been developed to facilitate making the extraction phase less traumatic, such as periotomes, physics forceps, and extractors [18–29].

One of the most recent minimally invasive extraction methods to have been introduced involves the use of the Magnetic Mallet®, which is capable of generating well-calibrated and predefined electromagnetic pulses that allow the clinician to perform surgical procedures much more precisely, quickly, and less traumatically for the patient than using a manual hammer and traditional chisels and levers, which, in the vast majority of cases, have been shown to result in trauma to the supporting tissues, with destruction of the surrounding bone structure [5,30,31].

In this perspective, the purpose of the present study is to clinically evaluate buccolingual bone resorption of the alveolar crest 3 months after extractions performed using the Magnetic Mallet®.

2. Materials and Methods

Between February 2023 and June 2023, a sample of 9 consecutive patients (6 males and 3 females), with an average age of 62 years (range of 38–73 years), underwent 29 tooth extractions using the Magnetic Mallet® (Osseotouch, Gallarate, Italy). This sample of patients was subsequently rehabilitated with implant-supported partial fixed prostheses with delayed loading at the Division of Prosthodontics and Implant Prosthodontics, Department of Surgical Sciences (DISC), of the University of Genova. A diagnosis of the dental elements to be extracted was performed with clinical examination and radiographs. All of the patients were accurately informed about the expected operative procedures and the research protocol and provided signed informed consent before being included in the study. The project was approved by the local Ethical Committee (approval n. 2023/68 21 September 2023).

The extractions were performed by two operators of equal clinical experience.

2.1. Inclusion Criteria

Patients referring to the Division of Prosthodontics and Implant Prosthodontics were included in this study if they matched the following inclusion criteria:

- Good systemic health without any contraindications to oral surgery and subsequent prosthetic rehabilitations planned;
- Presence of at least one severely compromised dental element to be extracted;
- Willingness to participate in the study protocol, attend the planned appointments, and follow the instructions given by the clinicians;
- Degree of mobility (0 or 1): the degree of mobility was graded clinically by applying firm pressure using the handle of a mirror and a metal tweezer, as specified in Miller's classification.

2.2. Exclusion Criteria

The exclusion criteria were as follows:

- Patients with systemic diseases representing a contraindication to oral surgery;
- Irradiation of the head/neck region within 12 months prior to surgery;
- Pregnancy or breast-feeding;
- Poor oral hygiene and lack of motivation to return for checkups.

The inclusion and exclusion criteria evaluations were performed by a single operator.

2.3. Patient Evaluation

Anamnestic data (biographical data and near and remote pathological history) were carefully collected. Clinical and radiographic examinations were conducted in order to assess the health condition of the oral cavity. If one or more elements were assessed as unrecoverable, the patient was included in the study.

Once the diagnosis was made, an appointment was scheduled for a professional oral hygiene session and then the extraction of the identified dental elements was scheduled.

The following data were assessed:

- Level of oral hygiene, assessed on the basis of the plaque index;
- Location of the dental element(s) to be extracted;
- Presence of hard lamina as evaluated through endoral X-ray;
- Cause of extraction: caries, orthodontic reasons, or trauma;
- Degree of mobility (0, 1) at the time of extraction;
- Periodontal probing to assess the presence of the buccal plate.

The preliminary evaluation of the patient inclusion parameters was carried out by a single operator to reduce the incidence of discordant evaluations.

Occlusal and lateral endoral pictures of the elements to be extracted were taken before commencing the surgery session (Figures 1 and 2).

Figure 1. Occlusal view of the dental element to be extracted.

Figure 2. Lateral view of the dental element to be extracted.

Pre-operative sectoral cone beam computed tomography (CBCT) was conducted in order to three-dimensionally assess root conformation (to avoid possible complications during extraction) and in order to measure the thickness of the bone crest at time 0 (extraction time). A second CBCT procedure was conducted 3 months post-extraction to evaluate the buccal–palatal/lingual bone resorption. RealGuide software v5.20230221 (RealGuide, 3Diemme srl, Cantù, Italy) was used to compare the two exams by superimposing one image over the other, with adjacent teeth used as positioning points (Figure 3) Buccolingual bone resorption was measured as the difference between bone crest thickness recorded at T0 and bone crest thickness at T3M.

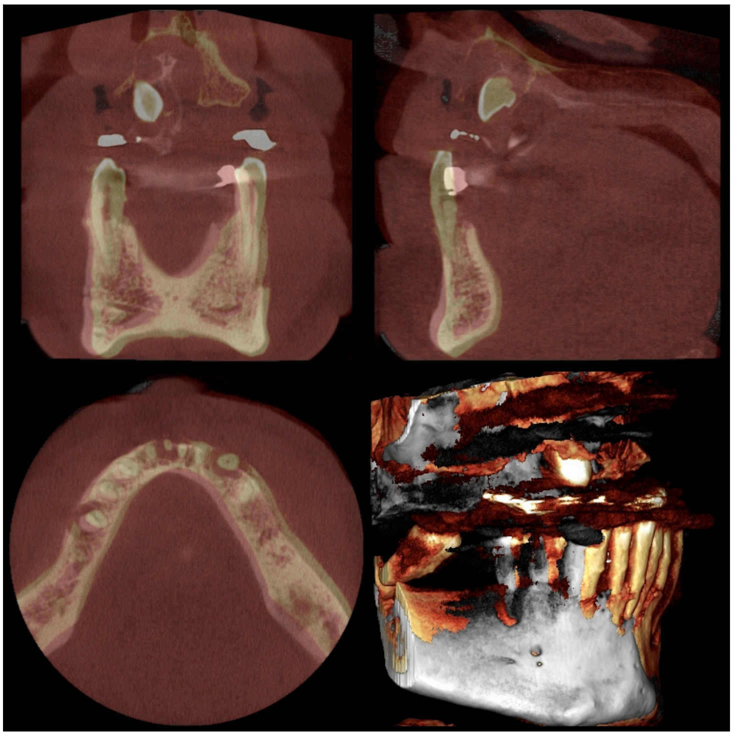

Figure 3. T0 and T3 CBCT's exam superimposition.

2.4. Surgical Procedure, Evaluation at Follow-Up, and Collection of Radiographic Data

Before extraction, the patient was instructed to rinse with a 0.2% chlorhexidine solution for 1 min. Then, local anesthesia was administered using the most appropriate technique to control the pain of the affected element: in the case of plexus anesthesia, a vial of Optocain® (Molteni Dental srl, Milano, Italy) Mepivacaine with adrenaline 1:100,000 was used, while in the case of truncular anesthesia, Scandonest® 3% (Septodont, Saint Maure De Fosse, France) without a vasoconstrictor was used, followed then by further plexus anesthesia at the level of the affected tooth. Thereafter, the patient was instructed to perform another oral rinse with the 0.2% chlorhexidine solution.

Next, the Magnetic Mallet® was prepared on the work surface, which consists of a handpiece, which is activated using an electronic power supply that can control forces and timing of application, on which specific instruments and inserts can be mounted to perform the desired work. The handpiece transmits a magnetic wave to the insert, which generates a shock wave that is calibrated with respect to force application times and induces axial movements at the tip of the insert itself.

Once the Magnetic Mallet® was prepared on the work surface, the next step was to choose the most suitable extraction insert to be mounted on the handpiece. The extraction kit offers a set of 5 inserts, both straight and curved, for better access to the posterior regions, for a total of 10 instruments. For each extraction, the insert that offered the most suitable morphology to perform the required surgical maneuvers in relation to the dental anatomy was used.

The Magnetic Mallet® provides 4 different force settings, the intensity of which varies from a minimum of 1 to a maximum of 4. Having set the lowest power (equal to one) via the ferrule selector, the insert was inserted parallel to the long axis of the tooth within the gingival sulcus, and the Magnetic Mallet® was activated via the foot pedal connected to the instrument. The objective was to induce dislocation of the periodontal ligament fibers circumferentially along the entire circumference of the root of the tooth element.

During activation of the unit, the insert, moving rapidly and longitudinally on a constant 1.1 mm stroke between the root surface and the hard lamina of the alveolus, advanced easily with minimal hand pressure, achieving much faster and less strenuous results than conventional periotomes.

In the case of single-rooted elements, the most suitable extraction insert was mounted on the handpiece until the tooth was completely dislocated and avulsed. In the case of multi-rooted elements, the roots were always separated using a turbine (E 680L, Kavo Dental, Biberach, Germany) and drills (H162SL, KometDental, Lemgo, Germany) to make the elements single-rooted. In tooth separation with a turbine, dentists must work for a very short period at the level of the floor of the tooth to separate the roots. The turbine was not used circumferentially.

Then, the same manner was employed to extract the single-rooted elements in order to avoid the risk of bone or dental fractures (Figure 4).

Figure 4. Surgical sectioning of roots.

The extractions were carried out through the action of the Magnetic Mallet® only; pliers were used only when necessary during the final phase of the extraction in order to remove the tooth once it became completely detached following activation of the magnetodynamic device.

Once the operation was completed, the mobility of the tooth was assessed using the handle of a mirror and a metal tweezer. In cases where the degree of mobility was shown to be 0 or 1, the circumferential dislocation operation was repeated at a higher level of intensity.

Once a sufficient level of mobility was achieved, the tooth elements were removed from their socket by the action of the Magnetic Mallet®, using the tip of the insert as a lever (Figures 5–8).

During the surgical procedure, different types of extraction inserts were used: specifically, in 1 case only (and, more specifically, in the only tooth element to which roots were separated, with a degree of mobility of 0), the EXTR3 insert was used; in 15 teeth (13 single-rooted and 2 multi-rooted), the EXTR2F insert was used; in 11 teeth (all single-rooted), the use of the EXTR3F insert was employed; in 1 tooth element (multi-rooted), the angled EXTR3F insert was used; and in 1 tooth (single-rooted), the EXTR4F insert was used (Figure 9).

After extraction, a manual alveolar debridement was performed and a 4–0 silk suture was placed.

Ice was applied and patients were instructed to follow the usual post-extraction home procedures:

- Icepack in the surgical area for 6 h after surgery, alternating 30 min with and 30 min off;
- Administrations of 875 mg amoxicillin + 125 mg clavulanic acid every 8 h for 5 days;
- Fresh, soft diet for the first 24 h;
- No rinsing during the first 24 h;
- Normal home oral hygiene procedures the day after surgery and rinsing with mouthwash with 0.12% chlorhexidine twice a day for 2 weeks.

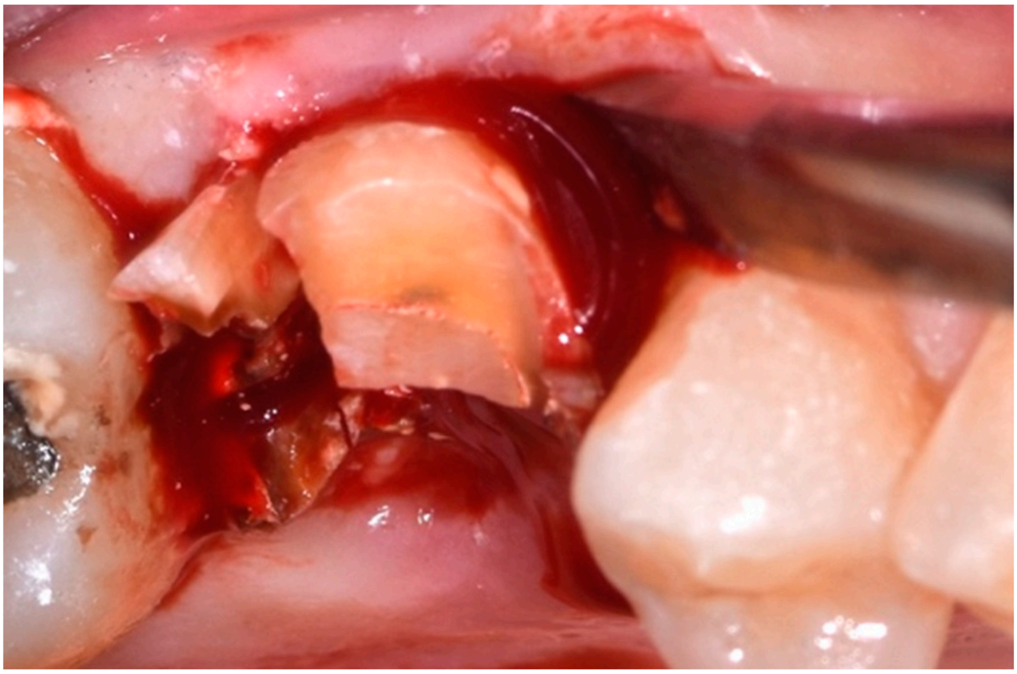

Figure 5. Root separation before using the Magnetic Mallet®.

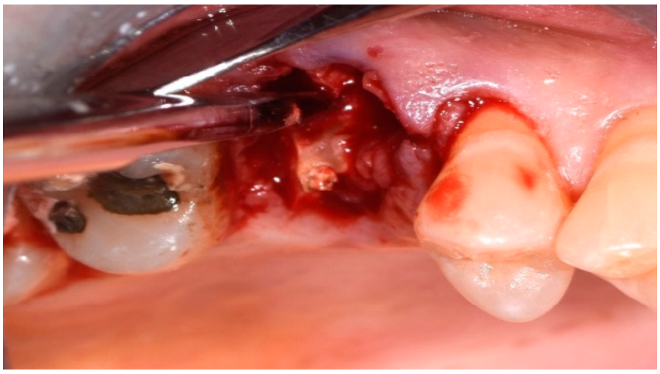

Figure 6. Use of the EXTR2F insert on the mesial and distal sides of the root.

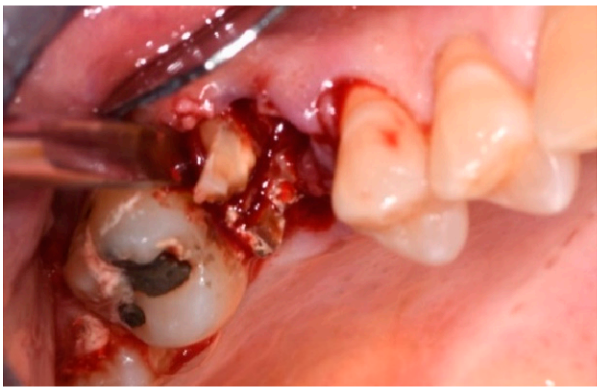

Figure 7. The insert EXTR2F used as a lever after root dislocation.

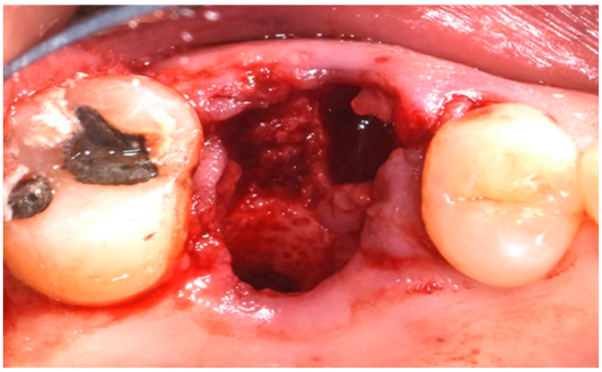

Figure 8. Post-extraction socket. The integrity of the residual bone walls can be appreciated.

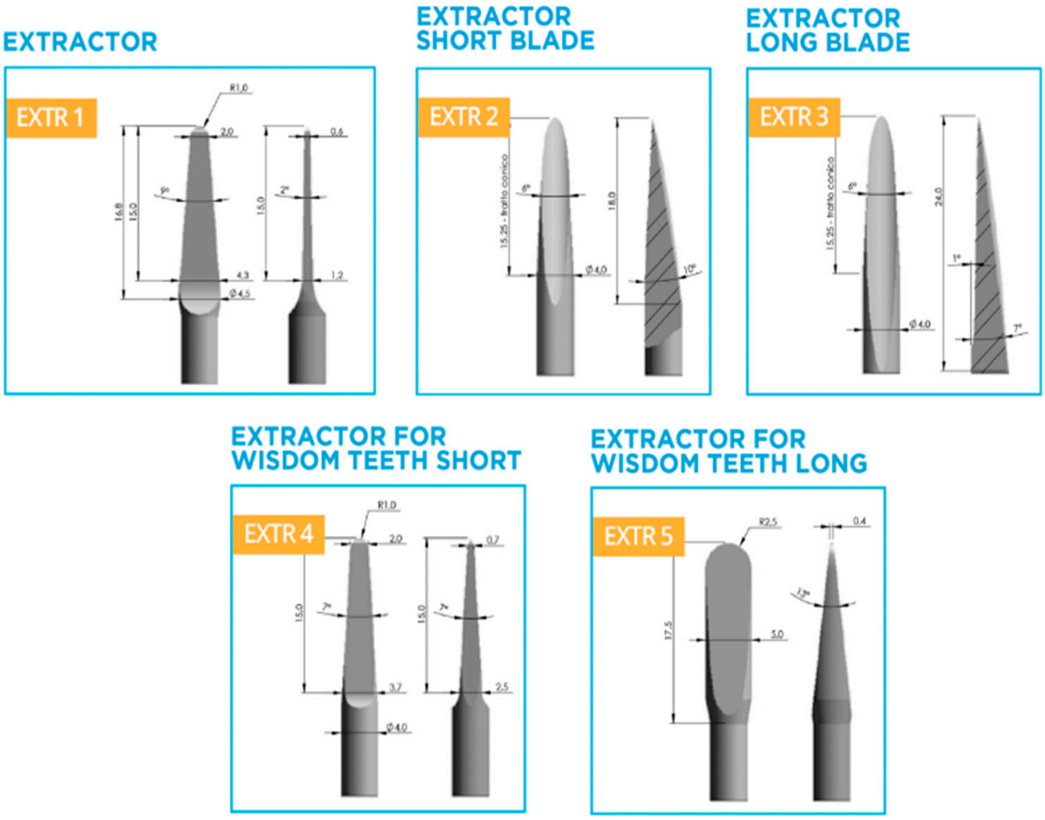

Figure 9. Different types of extraction inserts and related shapes and dimensions.

All the extractions were carried out by two expert surgeons. At the end of the surgical procedure, the following information was recorded for each patient:

- Maximum intensity value selected during dislocation (from 1 to 4);
- Use of Magnetic Mallet® inserts only and code of the insert(s) used;
- Use of Magnetic Mallet® inserts and extraction pliers only;
- Use of inserts, pliers, and hand levers;
- Time of the extraction considered between the end of anesthesia and the avulsion of the element;
- Measurement in mm of the depth of insertion of the instrument into the gingival sulcus;
- Whether inserts were used as levers;
- Indicative percentage of dislocation obtained with the Magnetic Mallet® only;
- Assessment of the heating of the handpiece during use;
- Indicative frequency of blows administered;

- Positioning of the insert;
- Approximation of instrument entry angle with respect to the root;
- Type of noise during instrument use;
- Presence of the buccal plate. The presence of the buccal plate was assessed also with preoperative probing. After extraction, further probing was carried out to verify its integrity (Figures 10 and 11).

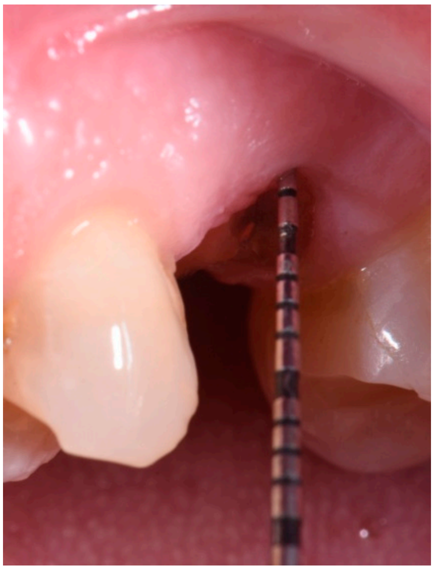

Figure 10. Preoperative buccal probing.

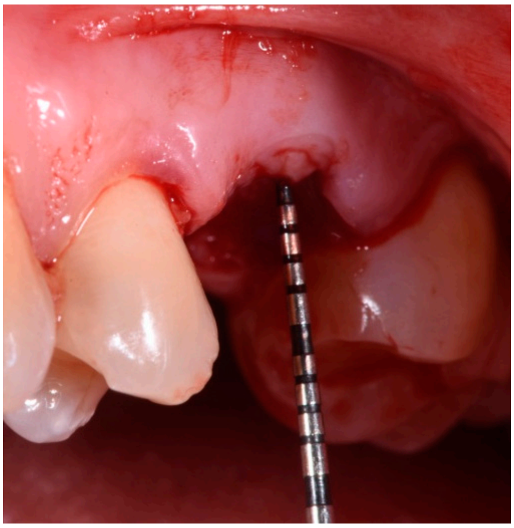

Figure 11. Postoperative buccal probing to assess the integrity of the buccal plate.

The patient was reobserved after 1 week/10 days to assess the healing progress and remove any sutures.

Regarding radiographic investigations, sectional CBCTs were performed to measure the thickness of the bone ridge at time 0 (extraction time) and at 3 months in order to assess vestibulo–palatal/lingual bone resorption.

For statistical analysis, a two-sample *t*-test was performed between measurements taken at time T0 and those taken at 3 months (T3M) in the 29 tooth elements.

The same test was repeated for comparison of the two operators who performed the extractions.

3. Results

A total of 29 dental elements were extracted due to the presence of destructive caries.

Seven extractions were performed at the level of the lower jaw, which is more rigid and compact with a harder bone theca.

Of the 29 extracted teeth, 4 were multi-rooted and 25 were single-rooted.

The level of oral hygiene was rated as "good" for four patients, "sufficient" for one patient, and "poor" for four patients (of whom two were smokers).

A total of three molars, three premolars, three canines, and 20 incisors were removed.

Three elements, belonging to three patients, were extracted for trauma, while the remaining 26 were removed for the presence of destructive carious lesions.

Twenty-two extractions were performed in the upper jaw and seven in the lower jaw.

A total of 17 teeth (including 2 multi-rooted) showed a degree of mobility of 0, and 12 teeth (including 2 multi-rooted and 5 located in the lower jaw) had a degree of mobility of 1.

Based on the radiographic examination, it was possible to examine the presence of the lamina dura.

In the course of the extraction procedure, in cases in which the root morphology of the dental elements would have made the use of the Magnetic Mallet® difficult, surgical separation of the roots into a single tooth element was performed.

Regarding the clinical data on the use of the Magnetic Mallet® instrument, it was observed that the maximum level of force used to extract the tooth was equal to 1 in 2 cases (1 monoradiculated and 1 pluriradiculated), equal to 2 in 20 cases (all monoradiculated, and equal to 3 in 7 cases (4 monoradiculated and 3 pluriradiculated). There were no cases in which it was necessary to use an instrument force level equal to 4.

During the dislocation maneuvers, the insert was placed mesial, palatal/lingual, and distal to each element and used parallel to the root. The average depth achieved by inserting the instrument in the socket was 4 mm, ranging from 3 mm (in three single-rooted teeth) to 6 mm (in one single-rooted tooth).

The average frequency of blows administered to achieve avulsion of the tooth elements was approximately seven blows (6.6) in a range between 2 (in a lower lateral incisor with an initial degree of mobility of 1) and 12 (in an upper canine with an initial degree of mobility of 0). The average time taken to extract each tooth calculated from the beginning of instrument use was 3½ min, ranging from 2 min (for 12 teeth of which one was multi-rooted, with a degree of mobility equal to 0 in five cases and equal to 1 in seven cases) to 7 min (in a single-rooted element with a degree of mobility equal to 0).

Regarding the measurements concerning the alveolar ridge, the bone thickness at 0 and 3 months after the extractions was calculated using sectorial CBCT in order to evaluate the vestibulo–palatal/lingual bone resorption at 3 months after the dental avulsions.

RealGuide software (RealGuide, 3Diemme srl, Cantù, Italy) was used to compare the two exams by superimposing one image over the other, with adjacent teeth used as positioning points (Figures 12 and 13).

The average bone thickness was 1.56 mm, ranging from 0.7 mm to 2.7 mm. The minimum resorption occurred at the level of 11 (thus at the level of a monoradiculated element located in the upper jaw), belonging to a non-smoking patient presenting poor hygiene, with a degree of mobility equal to 1. The identified dental elements of this patient were extracted in 2 min, using an instrument force level equal to 1 and a number of strokes equal to 3. The maximum peak of bone ridge thickness reduction was observed at the level of 23 (thus again at the level of a single-rooted tooth placed in the upper jaw), also belonging to the same patient, with a degree of mobility equal to 1. The dental elements were removed in 5 min using a force level equal to 2, and a number of strokes equal to 10.

The bone ridge thickness was measured from the most buccal to the most lingual points at 2 mm apical to the crestal margin. An approximate allowance was made for the reduction in the height of the alveolar ridge that may occur during the 3 months following extraction (Table 1).

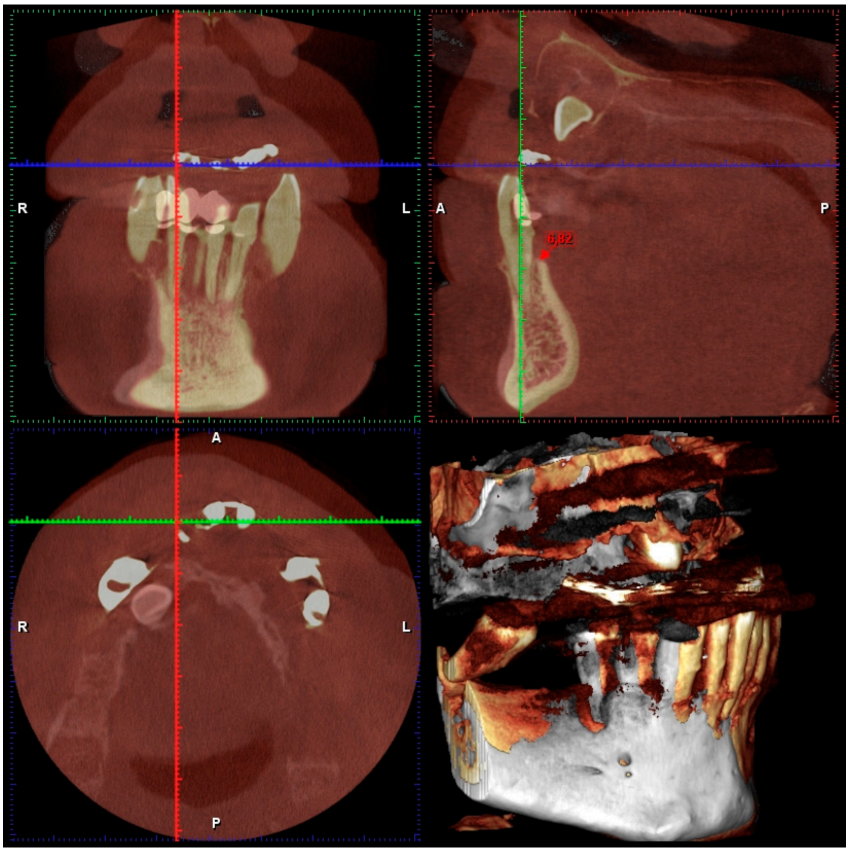

Figure 12. Preoperative bone thickness calculated after superimposition of T0 and T3 CBCT.

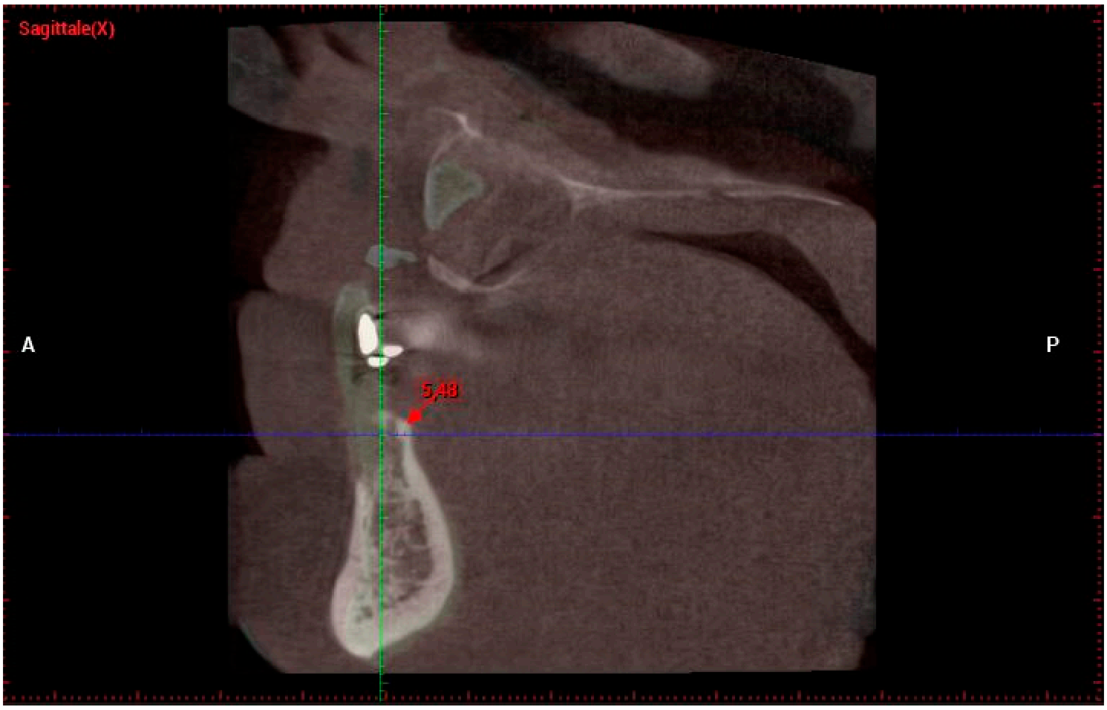

Figure 13. Postoperative bone thickness calculated using CBCT superimposition.

Table 1. Measurements at T0 and T3 of bone thickness and details on how to use the magneto-dynamic inserts.

Patient/Age	Surgeon	Tooth	MM's Power Set	MM Insert	Instrument's Insertion Depth	Extraction Time	T0	T3
S.M.—66	D.B.	16	2–3	EXTR 3	5 mm	4 min	12.8	11
M.F.—70	D.B.	12	2	EXTR 3F	4 mm	3 min	7.97	6.72
		11	2	EXTR 3F	4 mm	2 min	7.88	6.38
		21	2	EXTR 3F	4 mm	2 min	6.77	5.02
		22	2	EXTR 3F	4 mm	4 min	7.83	6.58
		32	3	EXTR 3F	4 mm	5 min	7.78	6.03
G.F.—59	D.B.	13	2	EXTR 2F	5 mm	5 min	8.2	6.2
		12	2	EXTR 2F	3 mm	5 min	6.5	4
		11	2	EXTR 2F	3 mm	2 min	6.4	5.7
		21	2	EXTR 2F	4 mm	3 min	8.2	7
		22	2	EXTR 2F	5 mm	2 min	7.2	6
		23	2	EXTR 2F	5 mm	5 min	8.7	6
		17	3	EXTR 2F	5 mm	5 min	10.4	8.6
M.M.—62	D.B.	25	3	EXTR 2F	4 mm	6 min	8.1	7
		22	3	EXTR 2F	4 mm	7 min	7.25	6
		23	2	EXTR 2F	5 mm	5 min	6.3	4.6
		21	2	EXTR 3F	4 mm	2 min	8	6.5
		11	2	EXTR 3F	4 mm	2 min	8.4	7
		12	2	EXTR 3F	4 mm	2 min	7.5	6.5
		27	3	EXTR 2F	5 mm	5 min	11.4	10
C.M.—73	D.B.	21	3	EXTR 3F	5 mm	3 min	5.6	4.2
		22	2	EXTR 3F	5 mm	3 min	5.97	4.12
F.M.—65	D.B.	34	1	EXTR 3F	6 mm	2 min	7.01	5.26
J.C.—72	J.C.	43	2	EXTR 4F	4 mm	4 min	6.82	5.48
J.C.—72	J.C.	42	2	EXTR 2F	4 mm	5 min	6.28	4.89
J.C.—72	J.C.	41	2	EXTR 2F	4 mm	2 min	5.69	3.92
J.C.—72	J.C.	31	2	EXTR 2F	4 mm	3 min	5.56	3.8
J.C.—72	J.C.	32	2	EXTR 2F	4 mm	2 min	6.42	4.75
L.M.—38	J.C.	24	1	EXTR 3F	5 mm	2 min	8.92	7.46

For statistical analysis, a two-sample *t*-test was performed between measurements taken at time T0 and those taken at 3 months (T3M) in the 29 tooth elements. The difference between the samples was significant, with an alpha significance level of 0.01. Figure 14 shows the mean and standard deviation of bone thickness at T0 and T3M.

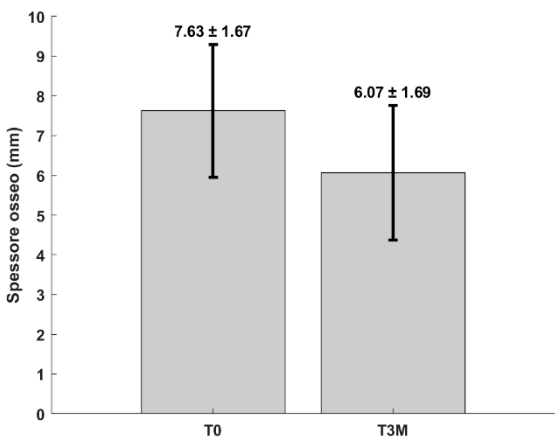

Figure 14. Mean and standard deviation of bone thickness at T0 and T3M.

The same test was repeated for comparison of the two operators who performed the extractions. Surgeon 1 extracted 15 teeth, while surgeon 2 extracted 14 teeth. The figures below show the mean and standard deviation of bone thickness. No statistically significant difference was found with a significance level of 0.01 at time T0, nor at time T3M (Figure 15).

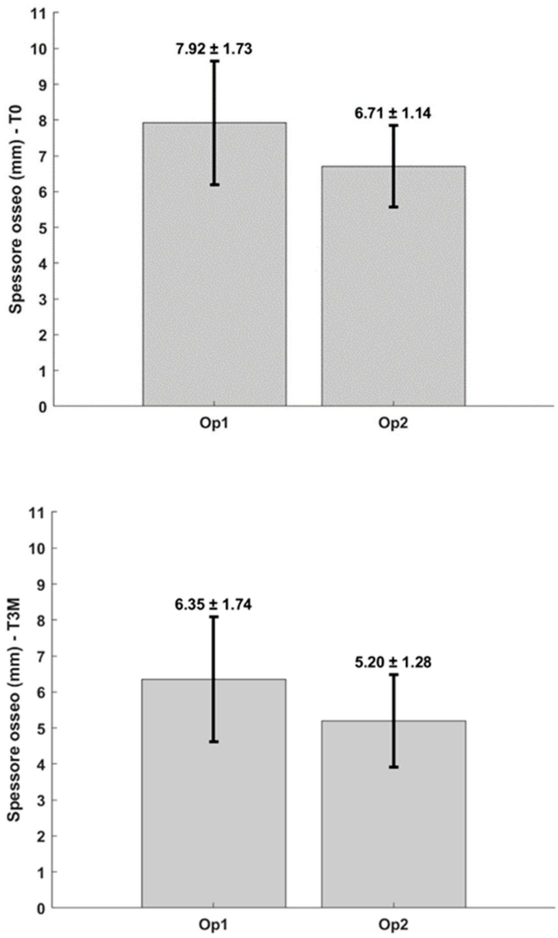

Figure 15. Comparison of the two operators who performed the extractions. Mean and standard deviation of bone thickness at T0 and T3M.

4. Discussion

Magnetodynamics has been used in a large number of surgical techniques and appears to yield encouraging results.

In an in vitro study, Baldi et al. demonstrated how the Magnetic Mallet® can be more conservative towards the bone tissue during the preparation of the implant site compared with traditional drills [32]. There are also case reports that highlight the usefulness of the Magnetic Mallet® compared with drills in complex implant cases [33].

Other authors have highlighted how the use of the Magnetic Mallet® to prepare the implant site can lead to an increase in primary stability [34,35].

In a recent publication, De Robertis proposed the use of the Magnetic Mallet® in association with guided surgery [36].

Extractions of dental elements are often correlated with the immediate or deferred insertion of an implant to restore chewing ability. The possibility of performing atraumatic and conservative extractions represents one of the prerequisites for maintaining bone volume. The use of traditional techniques such as levers and forceps can cause some complications. In particular, the fracture of the buccal plate is one of the most frequent complications, which causes an increase in post-extraction bone resorption. Fractures in predisposed patients can also lead to osteonecrosis and subsequent further loss of bone volume.

One of the advantages of the Magnetic Mallet® is that it allows a much more constant and greater force to be applied than manual hammers. The magnetodynamic device, on the other hand, provides four different intensity settings, from 1 to 4, corresponding to 65, 85, 120, and 260 kg, respectively.

The average degree of force used for the extractions in this study was 2. In no case was level 4 used, while grade 3 was used for the removal of all four molars, underscoring that it is usually more difficult to extract this type of element.

Whether there is a correlation between the degree of force used and bone density has not been investigated, but it would be interesting to address this topic in future studies.

Regarding the frequency of blows administered, the lowest number of blows occurred at the level of a lower lateral incisor with a degree of mobility equal to 1, while the maximum frequency of blows was found in an upper canine with a degree of mobility equal to 0. This is consistent with the fact that the canine has the largest root at the level of the maxilla. In fact, a rather large number of shots were also used to remove the contralateral canine.

On the other hand, it should be noted that in the elements without hard lamina, the frequency of the number of blows was lower than the average, as was the time taken to perform the extractions, which was, however, higher at the level of the three molars and three canines, and in the teeth where the avulsion maneuvers can actually prove to be a little more investigative. The minimum value of time was found in the extractions of both upper and lower central and lateral incisors and first premolars. However, it should be emphasized that, unlike what has been previously stated, the maximum peak also occurred at the level of an anterior element, in particular, in an upper lateral incisor that had an initial degree of mobility equal to 0. In fact, it should be noted that the number of blows administered and the degree of force used in this tooth were rather high (eight blows with a degree of force equal to 3).

With regard to bone resorption 3 months after extractions, which is the focal point of this study, the teeth that presented a greater contraction of the alveolar ridge in the vestibulo–palatal/lingual direction were the two upper canines and a lateral incisor, and also an upper canine, all belonging to the same non-smoker patient, for which the extractions required more than the average time, i.e., 5 min. Moreover, it was also necessary to use a high number of strokes (12 strokes for the right canine and 10 strokes for the right lateral incisor and left canine). This confirms the fact that there is a correlation between the extent of resorption and the degree of trauma that occurs during the intra-operative phase.

The percentage of teeth with greater than average bone resorption (1.56 mm) was higher in the mandible (71%) than in the maxilla (32%). This could suggest that there is also a correlation between the different bone types in the maxilla and mandible.

The results obtained in this study were compared with data from previous works.

In 2003, Schropp et al. [37] observed an approximately 30% reduction in bone crest width 3 months after extraction. However, the average resorption was calculated to be approximately 20%. Indeed, if the width of the crest had been reduced by approximately 30%, the observed bone resorption would not have been 1.56 mm, but 2.29 mm. Therefore, from this first analysis, it can be seen that the use of the Magnetic Mallet® in extraction procedures actually provides benefits regarding a minor reduction in the vestibulo–palatal/lingual dimension of the alveolar process.

Over the years, numerous clinical studies have been performed regarding the use of grafting materials and mechanical barriers in post-extraction sockets in order to prevent the contraction of the alveolar ridge that occurs following tooth extraction.

Analyzing the following data, we note how the use of some types of biomaterials resulted in less bone resorption [38–43]. However, in other cases, the use of grafting materials led to similar, if not worse, results than those obtained in the present study. For example, Cardaropoli and Cardaropoli [44] observed a change in the width of the bone crest of 1.85 mm at 4 months following the use of bovine bone mineral, which was a greater reduction than that found in our analysis. Similarly, Kutkut et al. [45] obtained resorption of 1.7 mm after 3 months using calcium sulfate hemihydrate and platelet-rich plasma. Moreover, Clozza et al. [46] found buccal–palatal/lingual bone loss of 1.8 mm at 3 months after using bioactive glass. In the study by Neiva et al. [47], whose aim was to evaluate the matrix of hydroxyapatite combined with the synthetic P-15 cell-binding peptide, the change in bone thickness at 16 weeks was 1.31 mm, which is a value similar to that of our research. Moreover, Shakibaie-M24 at 12–14 weeks in the second test group using hydroxyapatite and silicon dioxide (1.5 mm) and Toloue et al. [48] at 3 months using calcium sulfate (1.33 mm) also reported similar bone thickness results. Furthermore, the resorption observed by Cook and Mealey [33] at 21 weeks in test group 1 following the use of a bovine xenogenic graft is very similar to ours (1.57 mm) [49].

However, it is important to note that in most of the control groups in which only extractions were performed without the use of biomaterials, the reduction in the buccal–palatal/lingual dimension of the bone crest was significantly higher than that found in this study, reaching values ≥ 2 mm.

Therefore, we can state that the use of the Magnetic Mallet® to perform dental extractions allows for less bone resorption to occur, even without the use of biomaterials that counteract the contraction of the alveolar ridge. This outcome can be partially explained by the results of a biomolecular and histological study on minipigs about bone healing using the Magnetic Mallet® in implant placement [50].

This study found that implant sites prepared using the Magnetic Mallet® presented a significant increase in newly formed bone, osteoblast number, and a smaller quantity of fibrous tissue, together with significant BMP-4 augmentation and a positive trend in other osteogenic factors. Therefore, this study concludes that the Magnetic Mallet® is able to induce osseocondensation and improve newly formed bone during implant site preparation.

In a 6-month prospective study, Saldanha et al. [51] showed that smoking can lead to greater bone size reduction, stating that it is possible to have an additional 0.5 mm crest bone decrease after tooth extraction in smokers compared with non-smokers. However, in the present study, the two patients who were smokers did not show higher bone resorption than the non-smokers. It would be interesting to extend the study follow-up period in order to evaluate bone behavior over time.

Finally, no statistically significant difference was found between the two operators involved in this study. This suggests that the use of the Magnetic Mallet® for tooth extraction requires a short learning curve and, consequently, can be easily used by both expert operators and less experienced clinicians.

A further advantage of using the Magnetic Mallet® is the prevention of the formation of aerosols, which increases the dissemination of viruses and bacteria in the environment. In fact, the operation of the Magnetic Mallet® does not require the use of water or coolants. This is particularly important for the health of operators, especially in the post-COVID-19 pandemic era [52,53].

The main limitations of this study are the small sample of patients and the lack of observation of bone behavior over a longer follow-up period.

Furthermore, patient satisfaction with the surgeries was not recorded and some parameters assessed as inclusion criteria (e.g., degree of tooth mobility) were determined based on subjective evaluations by the operators.

5. Conclusions

The results of the present study demonstrate that the use of the Magnetic Mallet® during extraction procedures promoted less resorption of the buccolingual dimension of the bone ridge in the 3 months following dental extractions compared with the use of manual hammers and traditional chisels and levers. Moreover, it was also observed that, in some cases, the extent of this resorption was even less than the reduction in bone thickness found in previous studies in which different types of biomaterials were used, with the aim of preserving the socket. This suggests that when the magnetodynamic device is used, the use of such graft materials may not be required. However, it would be interesting to undertake new combined studies in which the action of the Magnetic Mallet® is evaluated in conjunction with the use of a filler material to be applied in the alveolus to determine if less bone resorption can be achieved.

In conclusion, we consider the use of the Magnetic Mallet® as a viable alternative to the well-established minimally invasive extraction techniques. Employing the Magnetic Mallet® for dental element extraction can enable surgeries that are faster, atraumatic, and more effective, thus leading to minimal or no requirement for bone grafts.

However, further investigations are required, including a greater sample of patients and a longer follow-up period, to deepen the knowledge of the use of the Magnetic Mallet® and the possible variables affecting clinical outcomes in order to develop standardized protocols for its use.

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