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Implant Site Preparation Using Conventional Drilling Technique Versus Magnetic Malleting Technique (Randomized Clinical Study).

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Implant Site preparation using conventional drilling technique versus Magnetic Malleting technique (Randomized Clinical Study)

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Abstract

Background The purpose of our current study is to determine whether using a Magnetic Mallet during oral and implant surgical procedures is more effective than using traditional instruments with regard to complication rate, tissue healing, and surgical results (primary stability and crestal bone loss). According to a number of writers, a Magnetic Mallet can be utilized for implant insertion, ridge expansion, sinus lifts, tooth extractions, and implant site preparation.

So, this study was conducted to ascertain whether using a Magnetic Mallet Throughout the process of oral and surgical implant operations is effective and to assume on whether it might help prevent failures and implications.

Material and Methods:

In the current investigation, nine patients had twenty implants placed bilaterally in the posterior maxilla to compare the advanced osteotome technique (Magnetic Mallet) with the conventional drilling approach clinically and radiographically after loading. They were chosen from the Department of Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Future University in Egypt's outpatient clinics.

On one side, eight patients were recruited as study subjects, while on the other side, then they were recruited as control subjects. They were given one implant on the control side and one on the study side. The last patient had two implants on the control side and two on the research side.

Results:

It was noticed that Stability at baseline was significantly higher in the Magnetic Mallet (Study group) (71.77±2.71) than in the Conventional (Control group) (68.67±2.36) in our study.

When the amount of difference from baseline to 6 months was compared between groups, it was shown that the Magnetic Mallet (Study group) showed an increased gain in stability (6.21±1.78) than the Conventional (Control

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group) (4.49±0.9). Regarding marginal bone loss, there was no statistically significant difference between the two groups in the current investigation.
Conclusion: From the current study it was concluded that the usage of Magnetic Mallets is reported to offer better clinical benefits than the traditional instruments. Due to its safety, predictability, speed, and simplicity of use, it can be useful during dental and implant surgery procedures. The Magnetic Mallet improves implant stability compared to conventional drilling technique, but it doesn't reduce the amount of marginal bone loss around dental implants. The Magnetic Mallet is quick, precise, and effective in bone condensing and an appropriate tool for preparing implant bed in softer maxillary bone.
Keywords: Implant Site - Osteotome - Drilling technique - Magnetic Mallet.

Introduction One of the most significant duties in dentistry is the rehabilitation of patients with lost teeth. Dental implants' current success has changed treatment options and quality more than any other dental specialty.[1]
Lower density of maxillary bone has resulted in lower implant treatment success rates due to the difficulty in achieving implant stability, which is one of the fundamental criteria for obtaining osseointegration and is dependent on bone density, quantity, and surgical technique.[2]
The traditional drilling technique is efficient nowadays; however, it has some drawbacks such as debris and ship spread resulting in foreign body reaction, significant hematoma at drilling site, heat generation, difficulties that may affect osseointegration and primary stability.[3]
Summers developed the osteotome procedure to improve the main stability of dental implants in the posterior maxilla. However, the use of osteotomes is often a process with low patient compliance due to the discomfort generated by the tapping motion. At this point, the advent of Magnetic Mallets can be viewed as an invention that is supposed to give improved working standards.[4]
The Magnetic Mallet (MM) equipment uses magneto-dynamic technology in modern dental surgery. It is made up of a time-controlled handpiece that is powered by a power control unit. The handpiece, which produces a shock wave from its tip according to surgical techniques, can be equipped with a variety of inserts.[5]
Magneto-dynamic technology quickly transfers controlled forces to an object by utilizing the basic principles of electromagnetism. Because of the management and consistency of the applied pressures, interventions are safe for both patients and surgeons.[6]
The purpose of this study is to evaluate the efficacy of MM in oral and implant surgery operations and to speculate on its potential contribution to failure and complication prevention.

Patients and Methods

The current study included 9 patients who received 20 implants and were chosen from the Outpatient clinics of the Department of Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Future University in Egypt based on inclusion and exclusion criteria.

a) inclusion criteria: Adults with Age range of 35 to 55 who are partially edentulous but have enough height and width in their posterior maxilla to support dental implants.
b) exclusion criteria: medically compromised patients, patients with poor oral hygiene, Patients having inadequate space for the prosthesis, Patients with suspected local pathosis at the surgery site.

The selected patients were told of the study's objectives and provided with consent.

The trial methodology used in this investigation was a randomized clinical trial (RCT), which is one of the most straightforward and efficient methods in clinical research.

Participants were randomly divided into two groups at random:

The control group: Sides of patients who had implants with traditional drilling technique for preparing the implant bed.

The study group: Sides of patients who had implants by advanced osteotome technique using Magnetic mallet device.

Preoperative phase:

Preoperative evaluation comprises taking a thorough medical history, confirming that the patient meets the inclusion criteria by clinical examination, Study diagnostic casts were fabricated for the purpose of arranging the placement of upcoming implants and creating surgical guides (Figure 1) and arranging the procedures virtually through preoperative radiographic examination. (Figure 2)

Figure 1: Preoperative study cast.

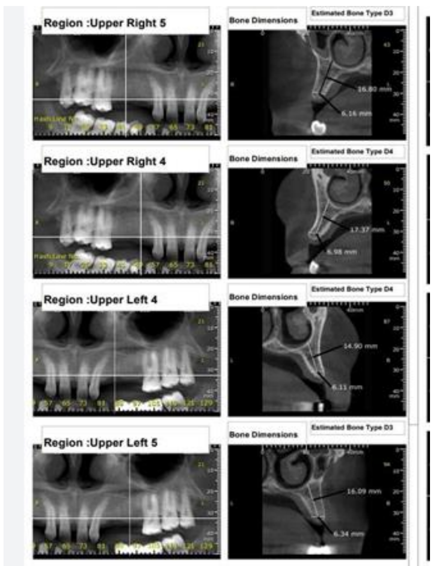

Figure 2: Preoperative CBCT.

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Surgical guide fabrication:

For each patient in both groups, a surgical guide was made. The goal of these guidelines is to make a smooth dental implant process. They were created by imaging software that generates a remapped design.

A surgical guide was created and exported in STL format before being manufactured on a 3D printer. (Figures 3&4)

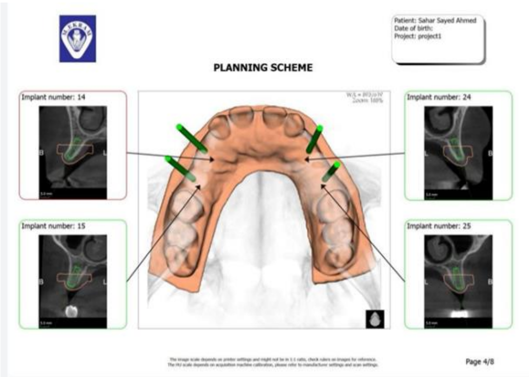

Figure 3: showing implant planning software.

Figure 4: showing surgical guide.

Surgical procedures:

The surgical guide was inserted in the patient's mouth after full thickness flab elevation at the ridge crest to guide fixture preparation. (Figure 5)

Figure 5: Showing surgical guide seated in patient's mouth.

<u>Study group:</u>

<u>Magnetic Mallet system</u>

The implant bed was prepared utilizing a magnetic mallet system with graded osteotomes that were applied gradually to achieve the required diameter and length of the prospective implant. (Figure 6)

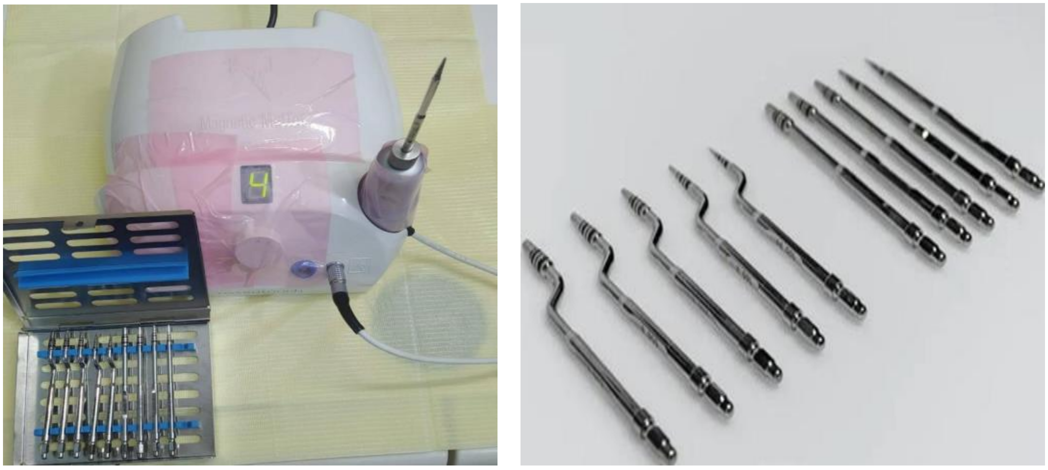

Figure 6: Showing Magnetic Mallet device and its kit.

For the implants in the study group, a special surgical guide offset (bone to top of sleeve) design was created, and a rubber stopper was attached to the osteotome shank to ensure the correct implant depth. (Figure 7)

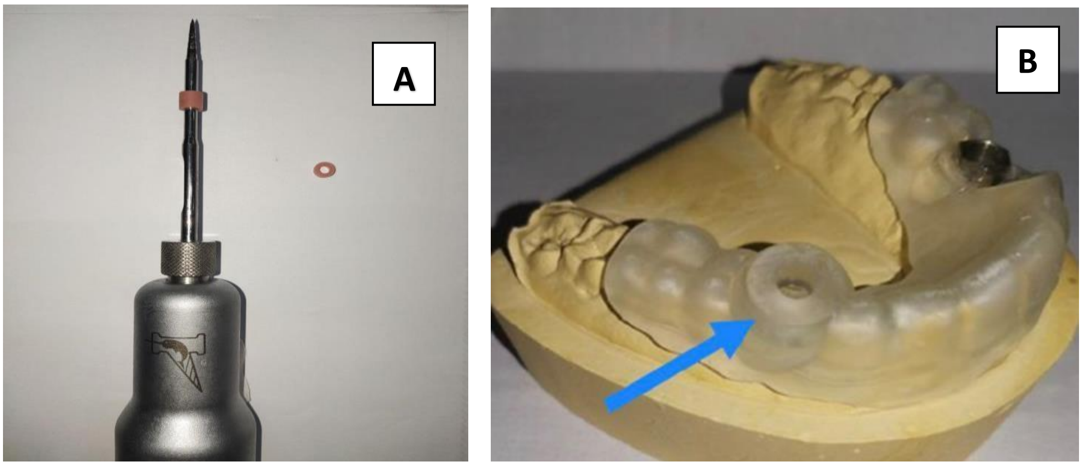

Figure 7 (A) Showing rubber stopper on magnetic osteotome shank for proper implant depth. (B) Showing special guide design for mallet osteotomes.

The 100-p sharp tip osteotome (pilot osteotome), which was used to make the initial hole to the required implant length, was inserted in the associated surgical guide and utilized to initiate the osteotomy. (Figure 8)

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Figure 8: Showing surgical guide with pilot osteotome.

The surgical guide was then removed in order to continue implant bed preparation with subsequent osteotomes. The larger osteotomes were utilized with mild and controlled malleting to continue preparing the desired implant bed. The implant and fixture mount were taken out of their sterile packaging and placed within the osteotomy site. (Figure 9)

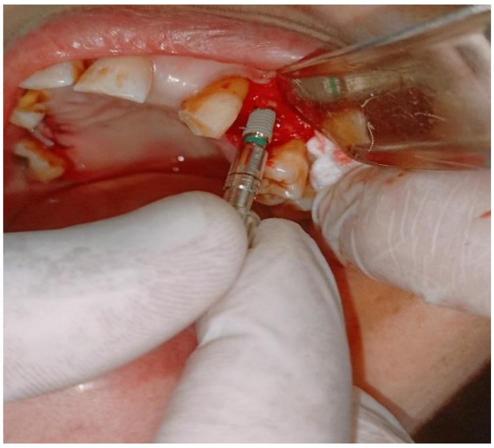

Figure 9: Implant was handled in its position.

Control Group:

The traditional drilling method was used to prepare the implant bed. A pilot drill was used to begin drilling the implant bed in preparation. The prospective implant's diameter and length were then reached by drilling with progressively larger drills. (Figure 10)

Figure 10: Showing surgical guide with pilot drill.

<u>For both groups:</u>

Hand torque ratchets were used to screw implants into their beds in a clockwise motion until the implants were level with the bone. (Figure 11)

Figure 11: Implant screwing using hand ratchet.

A smart peg was put into the implant, and the osstell device was used to test implant stability at the time of implantation. (Figure 12)

Figure 12: Photograph showing implant stability measuring using osstell device.

The implant stability quotient (ISQ) value was shown after the gadget beeped. The buccal, palatal, mesial, and distal measurements were taken again on either side of the implant, and the results were recorded. After that, a screwdriver was used to install the cover screws and flap closure was done. (Figure 13)

Figure 13: Photograph showing installing of cover screw.

Radiographic examination Immediately following implant placement, digital periapical radiographs of all patients were taken using the paralleling technique. All patients were called back for follow-up visits at 3, 6 months, and periapical radiographs were taken for each one in the same manner as the one taken at the insertion time.

Evaluation of outcomes

Primary outcome: Resonance frequency analysis (RFA) was used by osstell TM to determine the implant's stability. Finger-tightening the smart peg to the fixture. Two planes that were perpendicular to one another were used to test implant stability. The readings were added up, and the average was taken into account. The same clinical assessor completed all readings, which were recorded at regular intervals—first intraoperatively and then six months later. Numbers between 1 and 100 ISQ were used to express the values.

Secondary outcome: Evaluation of digital radiographs for calculating marginal bone loss on the same day as the procedure, three and six months afterwards.

phase of prosthetics the identical prosthetic approach was followed in both groups, which included covering the implants after six months (a delayed loading technique), and installing healing abutments. (Figure 14)

Figure 14: Photograph showing healing abutments installed on fixtures after 6 months of implant placement.

After the healing abutment's surrounding soft tissue had time to heal, impression pegs were put on the implants, and impressions were then taken using the open tray method.

At the appropriate locations inside the impression, implant analogs were affixed to the impression posts. Following that, final cemented cement- and/or screw-retained prostheses were created and put in place. (Figures 15,16)

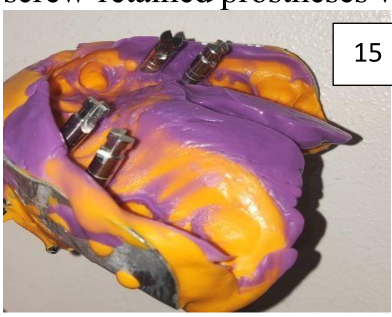

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Figure 15: Photographs showing open tray impression technique with impression post and implant analog placed inside their corresponding places in the impression.

Figure 16: Photographs showing final restoration fabricated and installed in patient mouth.

Results

Demographic data:

The mean age of this study participants was (44.88±4.6) years.
The patients of this study consisted of 6 females (66.7) and 3 males (33.3).

Implant stability:

At baseline A significantly higher value was recorded in Magnetic Mallet (Study group) (71.77±2.71), in comparison to Conventional (Control group) (68.67±2.36). The difference between groups was statistically significant (p=0.02).

At six months A significantly, higher value was recorded in Magnetic Mallet (Study group) (77.98±1.23), in comparison to Conventional (Control group) (73.16±1.88). The difference between groups was statistically significant (p=0.000). (Table 1, Figure 17)

Table (1) Descriptive statistics and comparison of primary stability between groups (independent t test) and within the same group from baseline to 6 months (paired t test).

	Conventional (Control group)		Magnetic mallet (Study group)		P value Between groups
	Mean	Std Dev	Mean	Std Dev	
Baseline	68.67	2.36	71.77	2.71	.020*
Six months	73.16	1.88	77.98	1.23	.000*
P value within group (effect of time)	.000*		.000*		

Significance level P≤0.05, *significant

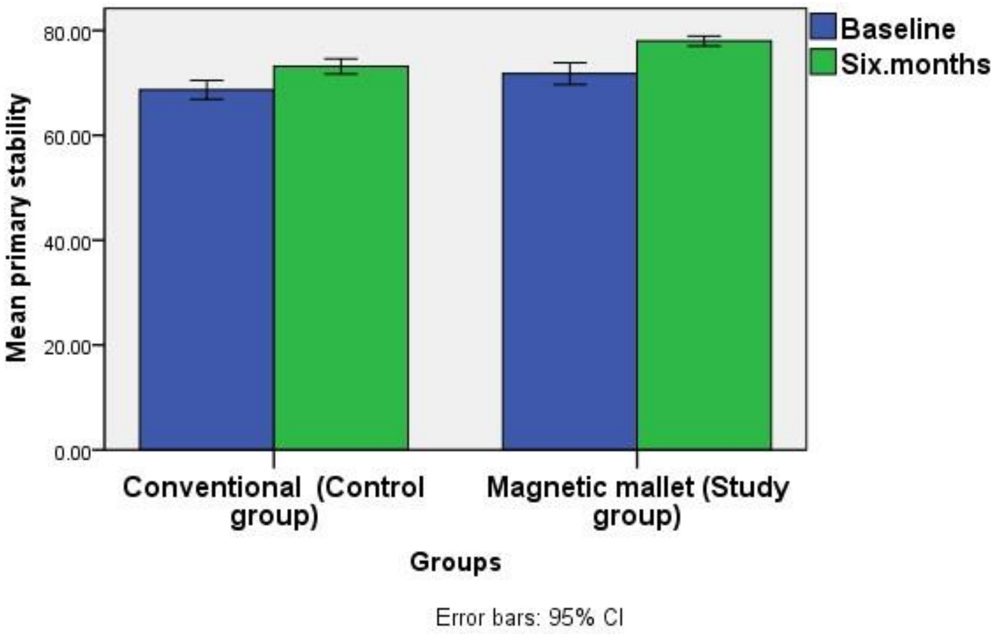

Figure: (17) Bar chart illustrating mean value of primary stability in control and study group.

Marginal bone loss:

At baseline, the median bone loss recorded in Conventional (Control group) was 0 (range 0 to 0.2; mean 0.02), in comparison to Magnetic Mallet (Study group) recording median=0 (range 0 to 0.25; mean 0.03). The difference between groups was not statistically significant (p=0.936).
At 3 months the median bone loss recorded in Conventional (Control group) was 0 (range 0 to 1.25; mean 0.31), in comparison to Magnetic Mallet (Study group) recording median=0.65 (range 0 to 1.1; mean 0.44). The difference between groups was not statistically significant (p=0.671).
At 6 months the median bone loss recorded in Conventional (Control group) was 0.65 (range 0 to 1.5; mean 0.58), in comparison to Magnetic Mallet (Study group) recording median=0.75 (range 0 to 1.65; mean 0.87). The difference between groups was not statistically significant (p=0.285). (Table 2, Figure 18).

Table (2) Descriptive statistics and comparison of overall marginal bone loss between (Mann Whitney U) and within group (Friedman test).

Groups		Overall bone loss			
		Baseline	3 months	6 months	P value #
Conventional (Control group)	Mean	.02	.31	.58	0.002*
	Median	.00[b]	.00[b]	.65[a]	
	Std. Dev	.07	.51	.53	
	Min	.00	.00	.00	
	Max	.20	1.25	1.50	
Magnetic mallet (Study group)	Mean	.03	.44	.87	0.001*
	Median	.00[c]	.65[b]	.75[a]	
	Std. Dev	.08	.44	.61	
	Min	.00	.00	.00	
	Max	.25	1.10	1.65	
P value between groups		.936 ns	.671 ns	.285 ns	

Significance level P≤0.05, *significant, ns=non-significant P# value within group (effect of time)

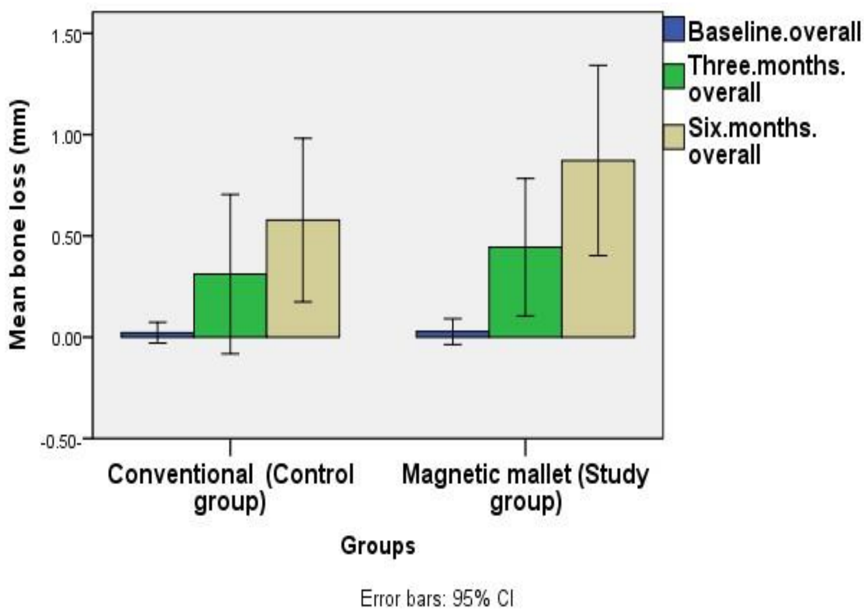

Figure: (18) Bar chart illustrating mean marginal overall bone loss in different observation times in control and study groups.

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Discussion

Several publications have described multiple modifications to the surgical procedure to improve the primary implant stability by locally optimizing the posterior maxillary bone density.[7]

Drilling must be done carefully and with enough of irrigation in order to preserve the health of the osteomatized bone, since stress from increasing pressure and heat might impede healing and induce implant failure.[8]

To strengthen the primary stability of dental implants in the posterior maxilla, some authors suggested using the osteotome approach rather than the standard drilling method. Osteotomes are substantially more visible in the posterior maxilla than a rotating drill [9]**.**

In oral implantology, research and innovation are ongoing processes**,** one example is the introduction of the enhanced osteotome technology "the Magnetic Mallets." [10]

The Magnetic Mallet is a newer system for implant bed preparation that offers benefits such as faster recovery, no bone loss, less trauma during surgery, improved bone quality, and prevention of the so-called benign paroxysmal positional vertigo (BPPV) syndrome. The magnetic mallet aids in lateral compression of bone during the osteotome procedure. These are the most essential factors in determining osseointegration success and implant stability.[11]

In our study Stability at baseline was significantly higher in the Magnetic Mallet (Study group) (71.77±2.71) than in the Conventional (Control group) (68.67±2.36).

When the amount of difference from baseline to 6 months was compared between groups, it was shown that the Magnetic Mallet (Study group) showed a bigger gain in stability (6.21±1.78) than the Conventional (Control group) (4.49±0.9).

This shows a greater survival rate of implants put with a Magnetic Mallet, **as Crespi et al. agreed between 2012 and 2016**[12].

Crestal bone loss was measured using (ImageJ software) as a radiographic parameter. It was examined immediately, three and six months afterwards. There was no statistically significant difference in marginal bone loss between the two groups in the current study and more investigations and studies will be needed to confirm good prognosis, successful osseointegration and high survival rate of implants inserted using MM. This agrees with the review by **Bennardo F. et al. 2022** [.13]

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