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# CLINICAL AND RADIOGRAPHIC EVALUATION OF USING AUTOGENOUS GRAFT VERSUS XENOGRAFT FOLLOWING IMMEDIATE IMPLANT PLACEMENT IN THE POSTERIOR MANDIBULAR REGION

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**Abstract**

**Background:** Bone grafting materials are commonly used to preserve peri-implant tissues, with xenografts being widely preferred due to their low substitution rate and strong osteoconductive properties. The aim of this study was to evaluate and compare bone density and implant stability among different groups. **Methods:** This study included 10 patients (18 implants), all medically fit with no systemic conditions affecting bone density, and presenting with hopeless mandibular posterior teeth indicated for extraction and implant replacement. Patients were allocated into three groups, each receiving Neobiotech (Neobiotech Company, Korea) implants. Group I (control) received a gelatin sponge (modified collagen sponge) alone to fill the peri-implant gap. Group II received a gelatin sponge combined with bovine xenograft particles, while Group III received autogenous bone particles harvested from the mandibular ramus using ACM (Auto Chip Maker) burs. **Results:** The mean bone density was higher in groups A and B compared with group C at all time intervals. In the xenograft group (Group A), a significant difference was observed in bone density between the immediate postoperative period, 3 months, and 6 months. Bone density increased at 3 months compared with the immediate postoperative measurements, followed by a decrease at 6 months in all groups. Bone stability was highest in Group A, followed by Group B, and lowest in Group C across all time points. Significant differences were observed between baseline (0 months) and 6 months in Groups A, B, and C (P<0.,05). **Conclusions:** Using bovine xenograft gets more implant stability and bone density and less resorption than autograft particles harvested by AutoChipMaker from the ramus.

**Keywords:** Autogenous Graft, Xenograft, Immediate Implant Placement, Posterior Mandibular Regio.

## INTRODUCTION

Immediate implant placement into fresh extraction sockets has become a routine procedure aimed at shortening treatment time, with survival rates now approaching those of delayed implant placement. However, management of the gap between the implant and buccal wall remains controversial, particularly in the esthetic zone where the buccal plate is often <1 mm thick, increasing the risk of facial bone loss, implant exposure, and soft tissue recession. Factors influencing outcomes include facial bone thickness, implant design, implant positioning, and soft tissue biotype [1].

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Bone grafting materials are frequently used to preserve peri-implant tissues. Xenografts are among the most widely utilized grafting materials due to their low substitution rate and favorable osteoconductive properties [2]. Traditional xenografts undergo thermal processing that removes proteins and growth factors, whereas newer sterilization methods such as atelopeptidation and lyophilization preserve approximately 30% type I collagen, potentially enhancing bone regeneration [3].

No single grafting material is ideal for all maxillofacial applications. Autogenous bone remains the gold standard because it possesses osteogenic, osteoinductive, and osteoconductive properties, integrates well with surrounding bone, and achieves high success rates exceeding 95% [4]. Nevertheless, its use is limited by donor-site morbidity, graft resorption, increased operative time, and limited availability [5].

Bone augmentation procedures are often required to facilitate implant placement in an optimal three-dimensional position and achieve predictable functional and esthetic outcomes [6]. Xenogenic grafts are readily available, cost-effective alternatives that support bone formation and reduce alveolar ridge resorption, although they lack the biological advantages of autogenous bone [7].

Guided bone regeneration with autologous bone blocks remains a common augmentation technique, utilizing donor bone from intraoral or extraoral sites.

Intraoral donor sites are frequently preferred because of their accessibility, proximity to the recipient site, and reduced patient morbidity compared with extraoral sources [4]. However, complications such as graft resorption, oral exposure, and donor-site morbidity must be considered when selecting the most appropriate harvesting site.

The aim of this work was to measure the difference in bone density and implant stability between each group and to evaluate of autograft versus xenograft in immediate implants at the posterior mandibular region.

## PATIENTS AND METHODS

This study was carried out on 10 patients (18 implants), aged between 21 and 50 years, free of any systemic disease affect bone density, presence of a hopeless mandibular posterior tooth that requires extraction and extraction site suitable for replacement by dental implant. The study was done after approval from the Ethical Committee Suez Canal University Hospitals, Ismailia, Egypt. An informed written consent was obtained from the patients.

Exclusion criteria were heavy smokers, pregnant or lactating females and presence of any periapical lesion.

Patients were divided into three groups: Group I (control group): represented by six Neobiotech (Neobiotech Company, Korea) implants followed by gelatin sponge (Modification of collagen sponge) application in the prepared socket in order to fill the created gap. Group II: represented by six Neobiotech implants followed by gelatin sponge (Modification of collagen sponge) application in the prepared socket with Bovine xenograft

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in order to fill the created gap, Group III: represented by six Neobiotech implants with the application of autograft particles harvested from the ramus by using ACM (Auto Chip Makers) burs to fill the created gap.

**Surgical Technique**

Local anesthesia of Articaine Hydrochloride 1 :100000 (68 mg/1.7 ml) and with adrenaline 0.017 mg/ 1.7 ml was given to the patient buccally and lingually at the site of the implant , we tend to use infiltration more than inferior alveolar nerve block so that we can avoid numbing the canal and in turn during drilling the operator can feel if they have breached the area or approximated the inferior alveolar nerve. Surgical Incision using bard parker blade 15 was done, a crestal incision and a sulcular incision were done to open the flap. **Figure 1, A**

Using Periotomes and Luxators, atraumatic extraction of the remaining root or roots of the premolar or molar was achieved, the main use of periotomes and mechanism of action was to incise the periodontal ligaments which creates a pathway for the luxator to enter and remove the loosened remaining root. **Figure 1, B**

If the tooth was in the premolar area, drilling was achieved by obtaining stability from the lingual bone (slight curvature of the drill) which in turn creates the gap that needs to be filled, so an osteotomy was created in the premolar site followed by implant placement. If the tooth was in the molar site, stability was achieved by drilling in the interradicular bone, which in turn leaves gaps medially and distally, and then the implant was placed in osteotomy site created. the selected graft according to the group was placed followed by closure. Stability is measured by a device called ANYCHECK that measures the implants IST (implant stability test) from a range of 0-100. **Figure 1, C, D, E**

4-0 Prolene sutures are used to close the surgical site. The use of Prolene sutures was beneficial due to its biocompatibilty without inflammation to the soft tissues.

Postoperative instructions were given to the patient which include: Cold and soft foods and drinks must be ingested on the other side of the wound, no rinsing for at least 24 hours post-operatively, smoking is completely prohibited, medications include Voltaren (intramuscular) the first day one ampoule 75 mg. In Autograft harvesting groups: An extra ampoule of Dexamethazone was given. Brufen 600 mg when there was pain with a maximum dose of 2 tablets per day, the paracetamol (1000 mg.) was the alternative analgesic in case of any kidney problem. Hibiotic 1 gm. once every 12 hours for five days, and history was taken from the patient and incase of penicillin sensitivity cefotax Intramuscular is given. Cefotex 1 gm. / 24 hours for 2 days. (Cefotxiem which belongs to third generation cephalosporins). The course of antibiotics prescribed was over 7 days (2 days Cefotax 1 gm. and 5 days hibiotic 1 gram). Hexitol mouth wash (Cholorohexidine 0.01mg.) to be used two days after the surgery, it acts as an antibacterial agent, once every 12 hours for one week, should not be used for more than one week as can produce stains on the teeth. Ice packs to be applied for 2 hours post-surgery, and hot fomentation the day after for 2 hours as well for control of swelling with improvement of circulation. **Figure 1, F**

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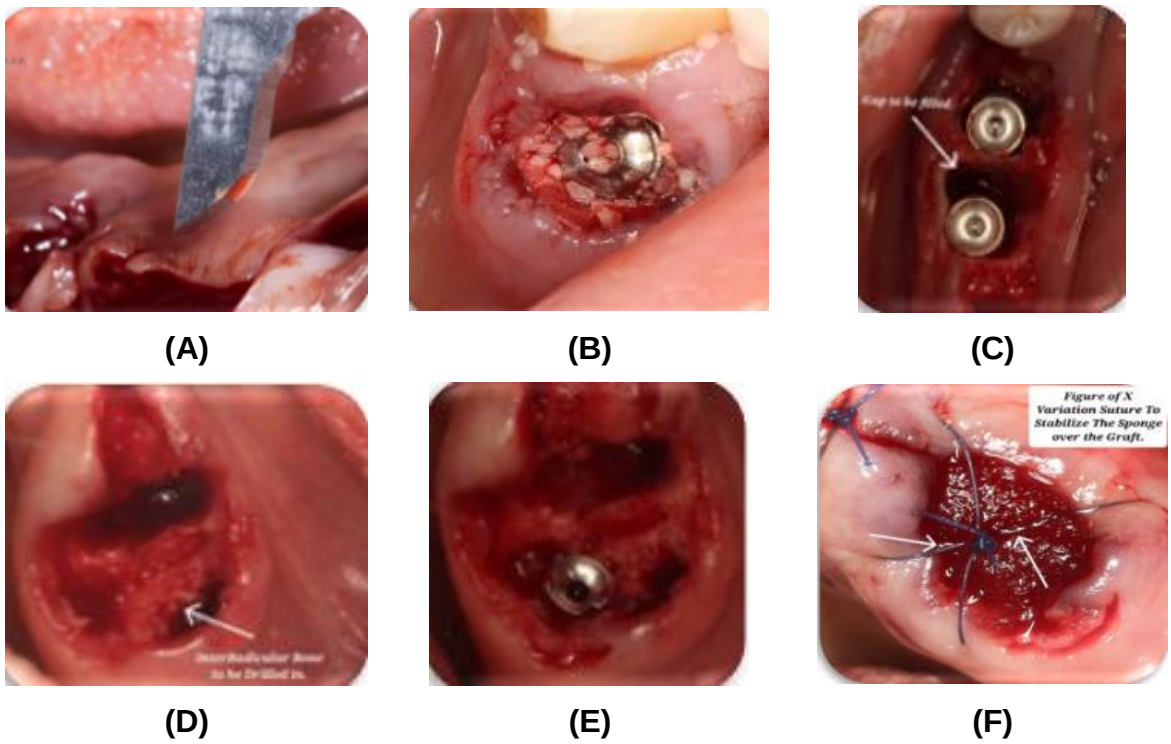


**Figure 1: (A) Bard Parker blade 15, (B) immediate implant in premolar with xenograft fill, (C) immediate implants in Molar site, (D) inter-radicular bone site, (E) implant placement in Inter-radicular bone and (F) Gelatin sponge covered with figure of eight sutures with Prolene 4/0 sutures**

## Radiographic evaluation

Cone-beam computed tomography (CBCT) was performed once preoperatively for each patient. Standardized intraoral periapical radiographs were obtained immediately after surgery (baseline), at 3 months, and at 6 months. Clinical photographs were taken at baseline, 3 months, 6 months, and at prosthesis delivery to evaluate soft tissue healing. Digital periapical radiographs were acquired using the Kavo Scan eXam™ One photostimulable phosphor (PSP) imaging system and the Rinn extension cone paralleling (XCP) holder to ensure reproducible image standardization. A size-2 imaging plate (31 × 41 mm active area) was exposed using a Fona XDC intraoral X-ray unit with fixed exposure parameters and a 16-inch-long cone. Images were processed automatically and evaluated by a single examiner on two separate occasions to minimize observer variability, with the mean value of both assessments recorded. Radiographic evaluations were performed immediately postoperatively and at 3- and 6-month follow-up visits.

## Digital Image analysis and bone density calibration

Radiographic image analysis was performed using IDRISI Kilimanjaro software, which enabled image restoration, enhancement, and densitometric assessment. Image restoration facilitated retrieval of radiographs, while image enhancement allowed

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standardized contrast adjustment and accurate identification of implant margins. The implant image was subsequently separated from the surrounding bone background, and bone density measurements were calibrated using a 255-point grayscale system, with a value of 0 representing completely black areas and higher values indicating increased radiographic density.

**AnyCheck Implant Stability Tester:** Accurate stability measurement and utilizes a physical tapping technique and dumping capacity analysis for precise implant stability assessment. Provides quick stability assessment directly on various components: [Healing Abutments, abutments and impression copings]. Eliminates the need for additional Smart Pegs.

Safe Mode: Includes a built-in safety mechanism. In case of low implant stability, device tap once or twice only indicating that the implant is still not stable. Halts tapping if movement or low stability readings are detected. Ensures patient safety and prevents implant damage.

### Autograft group

The Main purpose of this group is placement of an Immediate Implant in either a premolar or molar mandibular area, then bone graft was harvested from the ramus by the use of ACM bur (*AutoChipMaker) and placing it either in the gap created following extraction if in the premolars, or in the mesial and distal gaps created after drilling is achieved in the inter-radicular septal bone in the molar area. **Figure** 2


**(A)** **(B)**

**Figure 2: (A) Non-restorable remaining root indicated for extraction and (B) immediate implantation in lower premolar area and gap to be filled**

### Surgical Technique

For mandibular premolars, atraumatic extraction was performed using periotomes and luxators to sever the periodontal ligament and gradually luxate the tooth. Forceps were then used with gentle rotational movements to minimize damage to the buccal bone plate. When residual roots were covered by soft tissue, a minimal crestal flap was raised to gain

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access while preserving soft tissue integrity. Implant osteotomy preparation was modified according to root angulation and socket anatomy, with drill redirection toward the lingual aspect to obtain primary stability and prevent buccal plate perforation. The manufacturer's drilling protocol was followed to the final implant size at 1200 rpm and 35 N·cm torque under copious sterile saline irrigation. Following osteotomy preparation, the residual gap between the implant and socket wall was filled with either graft material or the control material. A Neobiotech implant was then inserted using a contra-angle handpiece at 30 rpm and 30 N·cm torque. In the autograft group, bone particles harvested from the mandibular ramus using the ACM (AutoChipMaker) device were used to fill the gap. Finally, a gelatin sponge was placed over the surgical site and secured with a figure-of-eight suture to stabilize the graft and promote wound healing. **Figure 3.**

**Immediate implants in molars (Autograft group)**

For immediate implant placement in mandibular molar sockets, socket morphology was assessed according to the classification of Dennis P. Tarnow (2013), based on the width of the interradicular septal bone: Type I (>4 mm), Type II (3–4 mm), Type III (2–3 mm), and Type IV (<2 mm). Type I sockets are the most favorable for achieving primary stability, whereas Type IV sockets present the greatest challenge due to limited septal bone and may require wider or longer implants, or alternatively socket preservation followed by delayed implant placement. Surgically, the mesial and distal roots were separated and extracted atraumatically using periotomes and luxators. Osteotomy preparation was performed within the interradicular septal bone following the manufacturer's drilling protocol at 1200 rpm and 35 N·cm torque under irrigation. Autogenous bone graft particles were harvested from the mandibular ramus using the ACM (AutoChipMaker) bur at 80–100 rpm and placed into the residual gaps around the implant. Finally, a gelatin sponge was adapted over the occlusal aspect of the grafted site and stabilized with figure-of-eight sutures to ensure graft protection and wound closure. **Figure 3, 4**

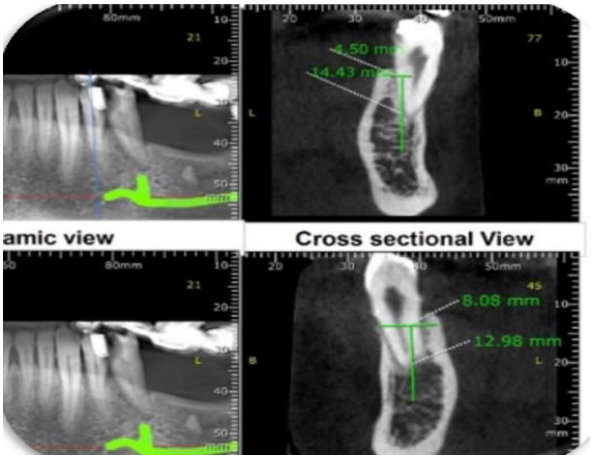


**Figure 3: Cone Beam Computed Tomography And distance to inferior alveolar nerve with drill direction**

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**Figure 3: Classifications of inter-radicullar septal bone in lower molars**

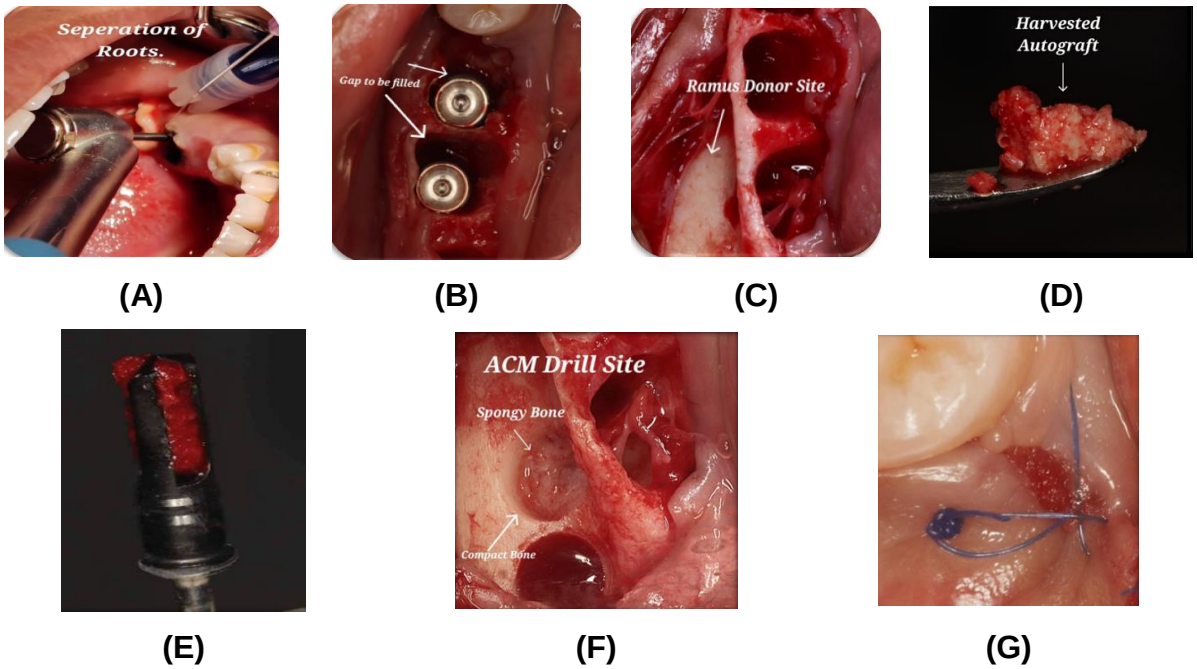


**Figure 4: (A) Separation of mesial and distal roots using contra, (B) immediate implants in molar sockets placed in inter-radicular septal bone with view of the gap to be filled, (C) ramus donor site, (D) harvested autograft by ACM bur, (E) CM bur with autograft harvested from ramus, (F) ACM donor site, (G) height sutures with 4-0 prolene sutures**

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### Xenograft Group

Atraumatic extraction was performed using periotomes and luxators to sever the periodontal ligament, followed by further luxation and gentle rotational force with forceps to minimize buccal plate damage. In cases where residual roots were covered by soft tissue, a minimal crestal flap was raised when necessary, with emphasis on preserving soft tissue integrity. Osteotomy preparation was adjusted according to root angulation and socket position, with a general principle of directing the drill toward the lingual aspect to enhance stability and prevent buccal plate perforation. The manufacturer's drilling protocol was followed to the final diameter at 1200 rpm and 35 N· cm torque under copious sterile saline irrigation. Following osteotomy preparation, the residual gap was filled with either graft or control material. A Neobiotech implant was then placed using a contra-angle handpiece at 30 rpm and 30 N·cm torque. Xenograft particles (OneGraft, Germany) were packed into the created gaps. Finally, a gelatin sponge was applied over the site and secured using an X-shaped figure-of-eight suture to stabilize the graft and support wound healing.

### Immediate Implants in molars (Xenograft)

The same technique was Followed as the autograft group except for one difference: After Drilling at the interradicular septal bone followed by placement of the implant, Xenograft particles were applied in the gaps and gelatin sponge was applied on the occlussal layer.
**Figure 5**

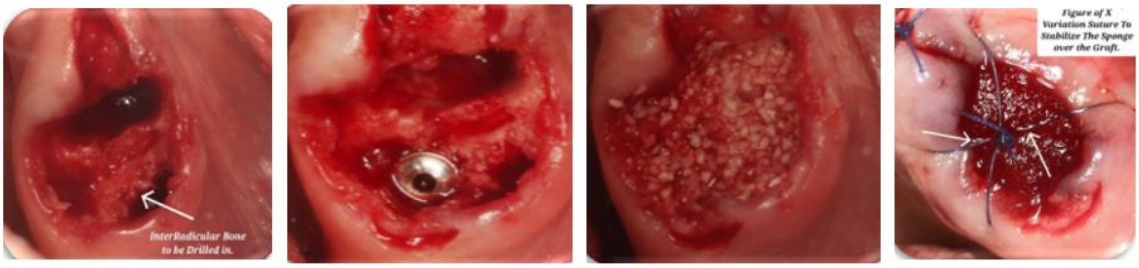


**Figure 5: (A) type I inter-radicular septal bone in lower molar, (B) implant placed in interradicular septal bone, (C) xenograft placement in gaps, (D) gelatin sponge covering the socket with 4-0 prolene sutures**

### Control Group

The same surgical protocol as the autograft and xenograft groups was followed, except that no graft material was used; instead, a gelatin (collagen) sponge was placed over the socket as the control material. It is important to distinguish between the biological mechanisms of bone regeneration, namely osteoconduction (the scaffold function supporting bone cell ingrowth), osteoinduction (stimulation and recruitment of bone-forming cells), and osteogenesis (direct bone formation by living cells within the graft).

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These principles are essential when evaluating and selecting appropriate graft materials for regenerative procedures.

### Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Chicago, IL, USA). Quantitative variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t-test. Qualitative variables were presented as frequency and percentage and analyzed using the Chi-square or Fisher's exact test when appropriate. A two-tailed P value < 0.05 was considered statistically significant.

## RESULTS

Concerning the 18 patients, healing was satisfactory in all cases except one case showed periimplatitis represented by gingival infection (swelling, inflammation) around the implant without pus formation. No lymphadenopathy reported.

### Bone density

There was no statistically significant difference between group A, B and C regarding bone density at immediate post operative while there are significant differences at 3 Months and 6 Months using one way ANOVA test at P<0.05. The mean bone density was relatively higher in A and B groups than group C at all different times. For group A(xenograft), there was significant difference between immediate post operative, 3 Months, and 6 Months in mean value of bone density measured time (F5.48, P=0.016) in addition, there was no significant difference between times interval at group B(autograft) and C(control) (F= 0.442, P=0.651 and F= 0.441, P=0.652). The bone density was increased at 3 Months compared with immediate post operative while at 6 Month was decreased compared with 3 Month for all groups. **Table 1**

**Table 1: Bone density among the studied groups**

| | Group A(Xeno) | Group B(Auto) | Group C(Control) | F test | P |
|---|---|---|---|---|---|
| **0M** | 102.5±6.3a | 102.4±8.9a | 98.0±8.2a | 0.618 | 0.552 |
| **3M** | 114.0±7.6a | 107.5±7.2b | 98.1±4.0c | 5.726 | **0.0142*** |
| **6M** | 104.1±5.28a | 103.1±4.34a | 94.8±6.5b | 6.17 | **0.0111*** |
| **F test** | 5.48 | 0.442 | 0.441 | | |
| **P value** | **0.016*** | 0.651 | 0.652 | | |

Data are presented as mean ± SD. *Significant P value <0.05.

### Bone stability

There was statistically significant difference between group A, B and C regarding bone stability at 0 (P=0.035) and 6M (P=0.008) using one way ANOVA test at P<0.05. The mean bone stability was relatively higher in group A followed by group B and the lowest value was recorded in group C at different times. For group A, B and C, there was significant difference between 0, and 6M in mean value of bone stability (F= 4.30, P=0.008), (F= 3.05, P=0.0.025) and (F= 2.60, P=0.048) respectively. The high bone stability was increased significantly after 6M for all groups compared at 0M. **Table 2**

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**Table 2: Bone stability among the studied groups**

| | Group A | Group B | Group C | F test | P |
|---|---|---|---|---|---|
| **0M** | 62.8±8.6[a] | 67.2±2.8[a] | 54.3±4.4[b] | 2.600 | **0.035*** |
| **6M** | 78.5±4.5[a] | 71.8±3.7[b] | 67.7±5.9[c] | 1.767 | **0.008*** |
| **F test** | 4.30 | 3.05 | 2.60 | | |
| **P value** | **0.008*** | **0.028*** | **0.048*** | | |

Data are presented as mean ± SD. *Significant P value <0.05.

## DISCUSSION

The current study was applied on 18 implants in 10 patients who attended Oral and Maxillofacial surgery department at Suez Canal University. In our study, 18 immediate implants were placed in the posterior mandibular region following the atramautic extraction.

The implants were divided into three groups, Autograft group (Through ramus bone graft were harvested by ACM bur), Xenograft group (Using Bovine bone) and Control group, the aim was to measure the difference in bone density and implant stability between each group.

The main measuring factors were bone density and implant stability.

Concerning the implant stability, according to the current study, there was significant difference of using Bovine Xenograft than Autograft particles that were harvested from the ramus and placed alone. Le B, Burstein J et al.[8] had studied Cases of immediate implants for where they placed autograft blocks around the implant. They found better implant stability for autograft blocks than autograft particles harvested from the ramus. They also evaluated the different bone qualities in from different harvesting areas, and the morbidity that arises with it.

The ramus and iliac crest were the most preferred donor sites, and although high bone quality can be harvested from the chin, it showed the highest rate of morbidity with patients.

According to the current study it was found that using autograft blocks gets more promising results than autograft particles, this is because autograft particles have a higher rate of resorption than autograft blocks. Selim Ersalni, Volkan Arisan et al. [9] studied the difference in alveolar bone resorption between the sympheseal area and the ramus. They found the results in the beginning to be almost the same, but after 6 months the bone loss was at 83%.

But we have to note that they used particulate xenograft particles with the autograft. Xenograft has a main advantage that it provides osteoconduction qualities and provides a scaffold for bone formation, which can decrease the rate of bone resorption in autografted sites. Hafez, W.K. et al. [10] studied the effect of autograft particles with immediate implants , they placed Platelet rich fibrins with immediate implants, when used

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with autogenous bone grafts, fibrin can increase bone formation, act as a scaffold for bony defects, and support bone morphogenic protein (BMP) transplants.

This implicates that the presence of a scaffold in augmented sites is very important, according to our research, implant stability was affected when autograft particles harvested from the ramus using AutoChipMaker was placed alone with no scaffolding agent.

Concerning the bone density, according to the present study, there was significant difference between Bovine xenograft than the Autograft group. Elbarashy A, Osman A et al. [11] found high rate of bone density when using bovine xenograft. Jing Zhou, Xue Li et al. [12] compared the difference between using Platelet rich fibirin mixed with Xenografts in the jumping gap of immediate implants, and the results of placing PRF alone, their study showed no significant difference between both groups, which proves that PRF can be used a scaffoled agent for bone growth.

This points out the importance of scaffolding mechanisms in the graft materials, the placement of autograft particles alone not suffice, as the resorption rate is higher than xenografts, so autograft particles have to be mixed with a scaffolding agent, such as Platelet rich fibrin, or xenograft.

According to the date received in this research, it was concluded that the use of bovine xenograft gives more bone stability and density than autograft particles harvested from the ramus by the use of ACM bur.

This was because autograft particles have higher rate of resorption specially in the first 6 months, they need to be mixed with another graft material to act as a scaffold to decrease resorption rate.

Xenograft particles have less resorption rate than autograft particles harvested from the ramus, so when a good Xenogenic bone graft material is used, the results can be fairly predictable.

Limitations of the study included that the sample size was relatively small. This research needs more investigations and evidence data, and the placement of another group (Xenograft mixed with autograft) in the study could add more valuable data to the research.

## CONCLUSIONS

Using bovine xenograft gets more implant stability and bone density and less resorption than autograft particles harvested by AutoChipMaker from the ramus.

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**Conflict of Interest:** Nil

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