# RADIOGRAPHIC EVALUATION OF MINI-IMPLANTS VERSUS SHORT IMPLANTS IN REHABILITATION OF MANDIBULAR EDENTULOUS ARCH

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## ABSTRACT

**Objective**: the aim of this study was to compare the marginal bone loss between mini-implants and short length implants in patients rehabilitated with implant retained mandibular complete overdenture.

**Material and methods**: Fourteen completely edentulous male patients were selected from those attended the out-patient clinic of Removable Prosthodontic Department, Faculty of Dentistry-Ain Shams University to participate in this study. Based on the cone beam computed tomographic (CBCT) assessment, the selected patients were divided into two equal groups: **Group (I):** Patients received conventional complete maxillary dentures opposed by mandibular overdentures supported and retained by four Mini-implants of 2.5mm diameter and 12 mm length in the interforaminal region. **Group (II):** Patients received conventional complete maxillary dentures opposed by mandibular overdentures supported and retained by two conventional short implants of 4mm diameter and 8mm length placed in the lateral-canine regions. CBCT records were obtained upon Overdenture Insertion (Baseline), Six Months, Twelve Months after insertion.The Mesial, Distal, Buccal and Lingual marginal bone heights around the implants were evaluated, using the linear measurement system of the software with flat panel detector supplied by the cone beam CT.

**Results:** *Peri-Implant Bone Loss in Group (I):* At six months following denture insertion calculated means of the measured bone loss for the Mesial surfaces were 0.5±0.1 mm, for the Distal surfaces were 0.55±0.03 mm ,for the Buccal surfaces were 0.50±0.12 mm and for the Lingual surfaces were 0.49±0.03mm.The calculated means of the measured bone loss was statistically significant at P < 0.05. At twelve months following denture insertion, the calculated means of the measured bone loss for the Mesial surfaces were 0.78±0.1 mm, for the Distal surfaces were 0.92±0.7 mm, for the Buccal surfaces were 0.79±0.1mm and for the lingual surface 0.74±0.03mm. The calculated means of the measured bone loss were statistically significant (P ≤ 0.05).

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*Peri-Implant Bone Loss in Group (II)*:  At six months following denture insertion calculated means of the measured bone loss for the Mesial surfaces were $0.56 \pm 0.07$ mm,for the Distal surfaces were $0.67 \pm 0.06$ mm,for the Buccal surfaces were $0.56 \pm 0.06$ mm and for the Lingual surfaces were $0.55 \pm 0.05$mm.The calculated means of the measured bone loss were statistically significant at $P < 0.05$. At twelve months following denture insertion calculated means of the measured bone loss for the Mesial surfaces were $0.7 \pm 0.07$ mm,for the Distal surfaces were $0.87 \pm 0.07$ mm,for the Buccal surfaces was $0.7 \pm 0.08$ mm and for the Lingual surfaces were $0.74 \pm 0.007$ mm. The calculated means of the measured bone loss were statistically significant ( $P \leq 0.05$).The calculated means of the measured bone loss in group I of mini implants were higher than group II of short implants for the Mesial, distal,buccal and lingual surfaces and over all bone loss at 6 months and 12 months but was found statistically insignificant ( $P \leq 0.05$).

**Conclusions:** Within the limitation of this study, it could be concluded that marginal bone loss around mini implants supporting and retaining mandibular complete overdenture is higher than the marginal bone loss around conventional short implants supporting and retaining mandibular complete overdenture although the difference was statistically insignificant.

## INTRODUCTION

According to the academy of prosthodontic terms, dental implant is defined as a prosthetic device of alloplastic material implanted into the oral tissues beneath mucosal and/or periosteal layer, and/or within the bone to provide retention and support for a fixed or removable prosthesis. [1]

Oral implants have revolutionized the practice of dentistry. Many experimental and clinical studies have focused on the mechanisms of tissue integration and the possibilities to secure long-term success. The concept of *osseointegration* was developed by BRANEMARK in the middle of the 1960s and led to the predictable long-term success of oral implants. [2]

### Mini implants

In the early 1990s, some innovative practitioners started using Mini- implants for long-term use in situations with insufficient bone. At that time, Mini-implant were considered to be used for transitional use only.

As a result of their obvious clinical success, Mini- implant were cleared by the FDA "for long-term intrabony applications" with the help of the Imtec company in 1997. Subsequently, numerous other Mini- implant brands have received similar FDA clearance. Thousands of these Mini- implant are now in successful restorative use with a reported 91% to 97% survival rate. Numerous surveys, testimonials, research projects, and satisfied dentists and patients attest to that fact. Many more positive references are available in the restorative, prosthodontic, and orthodontic literature. [3]

The primary advantages of using mini implants for definitive prosthodontic treatment are: low cost, ability to be placed in narrow or wide ridges, simplified treatment procedures, almost always placed through a flapless surgical procedure, which is known to decrease postsurgical discomfort and morbidity for patients and the majority are designed as a one-piece implant with the ability to immediately load the prosthesis and provide treatment benefit to the patient in a single clinical visit. [4]

### Short dental implants

The use of dental implants was initially limited to sites with substantial residual ridges. However, there are some edentulous patients with extreme resorption of the mandibular alveolar bone in whom the bone volume is so minimal and insufficient for implant installation without extensive bone grafts.[5]

Treatment success has always been related to variables such as volume and anatomy of

the remaining bone, the longer the implant the more favorable the prognosis. However, in many situations, placement of long implants is hindered by anatomical limitations. [6]

Various strategies have been proposed to overcome the dimensional limitations of the bone available for implant placement. Several surgical interventions for bone augmentation have been proposed, including bone grafts, guided bone regeneration, distraction osteogenesis, sinus floor elevation, mandibular nerve transposition, and the use of tilted or zygomatic implants. Although these techniques have gained a degree of success through the years, with the exception of sinus floor elevation, there are insufficient data on their predictability.[5]

Limitations in bone augmentation procedures (especially vertical bone augmentation) and limited predictability of these techniques makes the use of dental implants in extremely resorbed jaws more problematic. Where ridge augmentation or sinus grafting with simultaneous implant placement has shown more intra and postoperative complications.[6]

There is agreement that onlay bone grafts placed to gain vertical height undergo extensive bone resorption. In addition, unfavorable results of mandibular onlay grafts have been reported due to severe bone resorption that occurred after bone grafting and peri-implant bone resorption after implant placement and prosthetic loading.[7]

Alveolar nerve transposition, augmentation using bone blocks or osseodistraction make it possible to perform implant-prosthetic treatment. At the same time, however, and on account of the number of procedures inevitably required, they significantly prolong treatment time, increase costs and post-operative pain, reduce patient comfort and involve a much greater risk of complications.[8]

Short implants (SHIs) have been proposed as an alternative choice for the prosthetic treatment of atrophic alveolar ridges, which may provide surgical advantages including reduced morbidity, treatment time, and costs.[9]

The introduction of short and ultrashort implants has given the surgeon alternatives to grafting. The recent European Consensus Conference on short implants found them to be a reliable treatment option, given the risks associated with augmentation procedures. [10]

Short implants are increasingly used for the prosthetic solution of the extremely resorbed alveolar bone areas. However, there is still no consensus in the literature on the definition of a short implant. Some authors consider 10 mm the minimal length for predictable success; thus, they consider any implant,10 mm in length as short. Others defined an implant length of 10 mm also as a short implant. [11]

Short implants are considered as a viable alternative in patients with reduced alveolar bone height to avoid more invasive surgical procedures. They simplify the implant treatment, reduce patient morbidity, shorten the duration of treatment, and make it less expensive. [12]

When short implants were compared with conventional implants in systematic reviews it was concluded that the placement of short rough-surface implants is not a less efficacious treatment modality compared with the placement of conventional rough surface implants. Evermore, short implants demonstrated a similar survival rate as standard implants. [13]

In a Systematic review with meta analyses on randomized controlled trials (RCTs) to compare clinical outcomes of short implants with lengths of 8mm or less to standard implants with lengths more than 9mm, focusing on survival, success, failure, and complications. The authors concluded that placement of short dental implants could be an alternative treatment plan as compared to standard dental implants to reduce surgical complication rates in the situations where vertical augmentation procedures are necessary. However, to enhance successful clinical outcomes, patient selection could be of paramount importance. [14]

A number of systematic reviews evaluated the survival rate of short dental implants, overall concluding that the survival rates are similar to long implants [15,16]

## MATERIAL AND METHODS

**Patient Selection:**

Fourteen completely edentulous male patients were selected from those attending the out-patient clinic of Removable Prosthodontic Department, Faculty of Dentistry-Ain Shams University to participate in the study.

**Inclusion Criteria for Patient Selection:**

·   Male patient's age ranged from 55 to 65 years with mean age of 60 years old.

·   Patients had completely edentulous maxillary and mandibular arches.

·   Only patients with good oral hygiene were enrolled in the study.

·   Patients with moderately developed ridges were selected.

·   Patients with Angle Class-I maxillo-mandibular relationship and sufficient inter-arch spaces were selected.

·   Residual alveolar ridges were covered with firm healthy mucosa, free from any signs of inflammation, ulceration or flabbiness.

**Exclusion Criteria:**

·   Patients with systemic diseases that might affect bone quality, contribute to bone resorption, increase surgical risk, delay or complicate postoperative healing.

·   Patients with any muscular or TMJ disorders and patients with parafunctional habits

·   Patients with severe cardiovascular diseases, metabolic disorders, history of previous radiotherapy and chemotherapy, osteoporosis, allergies and impaired psychological conditions.

·   Smoking patients.

Primary impressions were made using irreversible hydrocolloid impression material* in properly selected and modified stock trays and poured in dental stone to obtain study casts. Occlusion blocks were constructed on the study casts, diagnostic wax wafer jaw relation records were made at proper vertical and horizontal relations, then the casts were mounted on a fixed condylar path articulator.

Trial set-up of artificial teeth was carried out on the mounted diagnostic casts to evaluate the ridge relationship, the available inter-arch space and to ensure the presence of 10-12mm of vertical space for the lower denture. Diagnostic Panoramic radiographs were made for all patients to evaluate the presence or absence of remaining roots, impactions or any other pathological lesions that might complicate placement of dental implants inter-foraminally, locate the position of mental foramina, level of inferior alveolar canal and detection of anterior looping of mental nerve.

Patients received complete denture constructed by conventional technique and follow up was done for two weeks before surgery.

**Patient Grouping:**

Based on the final cone beam computed tomographic (CBCT) assessment patients were divided into two equal groups:

**Group (I):** Patients received conventional complete maxillary dentures opposed by mandibular overdentures supported and retained by four Mini-implants of 2.5mm diameter and 12 mm length** in the interforaminal region

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**Group (II):** Patients received conventional complete maxillary dentures opposed by mandibular overdentures supported and retained by two short implants of 4mm diameter and 8mm length** placed in the lateral-canine regions.

Broad spectrum antibiotics and anti-inflammatory drugs were administered to all patients.Patients were asked to rinse the oral cavity with chlorhexidine-digluconate (0.2%) for 1 minute prior to the surgery.

Bilateral nerve block and field block anaesthesia were given using Ubistesin Forte 4% anaesthetic solution. After the anaesthetic effect was confirmed the surgical stent was properly seated in position in the patient's mouth and a dental probe was inserted into the notches made in the stent to puncture the mucosa covering the alveolar ridge.

**For group I patients:** These punctures represented the sites of implant insertion which appeared as bleeding points. Cortical drill was used to penetrate cortical bone.A pilot drill 1.1 mm in diameter was used to drill bone up and down in a vertical direction. Light intermittent finger pressure was applied and irrigation at 800 RPM speed until the desired length was reached.The implant was picked up from the sterile vial and directly inserted into the prepared site.The implant was manually threaded until resistance was felt. It was then threaded into

final position with ratched wrench until the mark on the neck portion was no more visible,

**For group II patients:** The flap area was identified. Using bard-parker blade No. 15, two mid crestal incisions in the lateral-canine areas extending 2mm mesially and distally without crossing the midline were made at the proposed implant sites with relaxing incision extending labially from the crest of the ridge to the depth of the vestibule. A full thickness mucoperiosteal flap was reflected using a sharp mucoperiosteal elevator. The lingual mucoperiosteum was also slightly dissected. Irregularities on the crest of the ridge were smoothened using bone file. The surgical stent was seated in the patient's mouth and under copious saline irrigation, drilling started with point drill with light intermittent finger pressure and at speed of 1000 rpm and 30 N/cm torque for marking the insertion point of the implant on the alveolar ridge. (Fig. 1)

The implant was threaded into the bone in a clockwise direction under saline irrigation until its top flushed with the bone surface using the torque wrench.The abutments were then screwed into position to the fixtures,.(Fig.2)

The mucoperiosteal flaps were repositioned and sutured with 3-0 black silk interrupted sutures and patients were recalled seven days after surgery to remove the sutures.
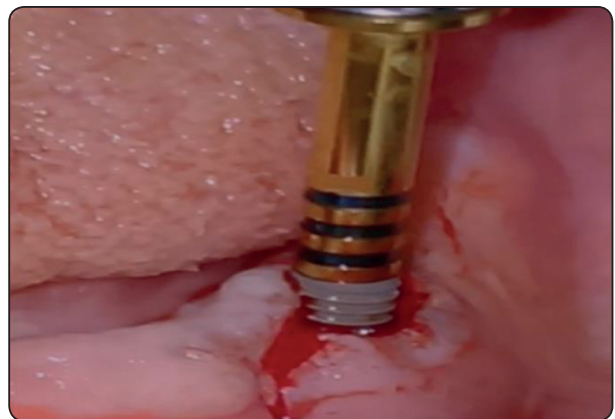


Fig. (1) Pilot drill



Fig. (2) Implant placement

One week after implants insertion the following adjustments were carried out: Prior to the pick-up of the metal housings, in both groups, block-out shim was adapted to each abutment to block out the undercut areas inferior to the ball abutments (sub-housing area), then the metal housings were placed in position. Hard denture lining material* was used for chair-side pick-up of the metal housings. The lining material bonding agent was applied into the depressions of the mandibular denture corresponding to the ball abutments sites and the denture was fully seated in the patient's mouth. With the maxillary denture in place the patient was guided to close in centric occluding relation till complete curing of the hard denture liner occurred.(Fig. 3-6)

All patients were scheduled for follow up visits to evaluate marginal bone height changes at the Mesial (M), Distal (D), Buccal (B), and lingual (L) surfaces of each implant using cone beam computed tomography (CBCT)**.

CBCT records were obtained upon Overdenture Insertion (Baseline), Six Months and Twelve Months after insertion. The Mesial, Distal, Buccal and Lingual marginal bone heights around the implants were evaluated, using the linear measurement system of the software with flat panel detector supplied by the cone beam CT.

The reconstructed 3D images were saved as Digital Imaging and Communications in Medicine



Fig. (3) The four mini implants



Fig. (4) Metal housing for mini implants



Fig. (5) Two short implants



Fig. (6) Metal housing for short implants

(DICOM) files. The three dimensional position of each implant in the alveolar bone was detected by the software*. Images were analyzed on the Multi-Planar Reformat screen (MPR) and all measures were done by single experienced radiologist. (Fig. 7)

Numerical data were explored for normality by checking the data distribution, calculating the mean and median values, evaluating histograms and normality curves and using Kolmogorov-Smirnov and Shapiro-Wilk tests.

Data were presented by mean, standard deviation (SD). Independent t-test was used for comparison between groups. ANOVA for repeated measures was used for comparison between follow up periods followed by simple main effect. The significance level was set at $P \leq 0.05$.

Statistical analysis was performed with IBM SPSS** Statistics Version 20 for Windows.
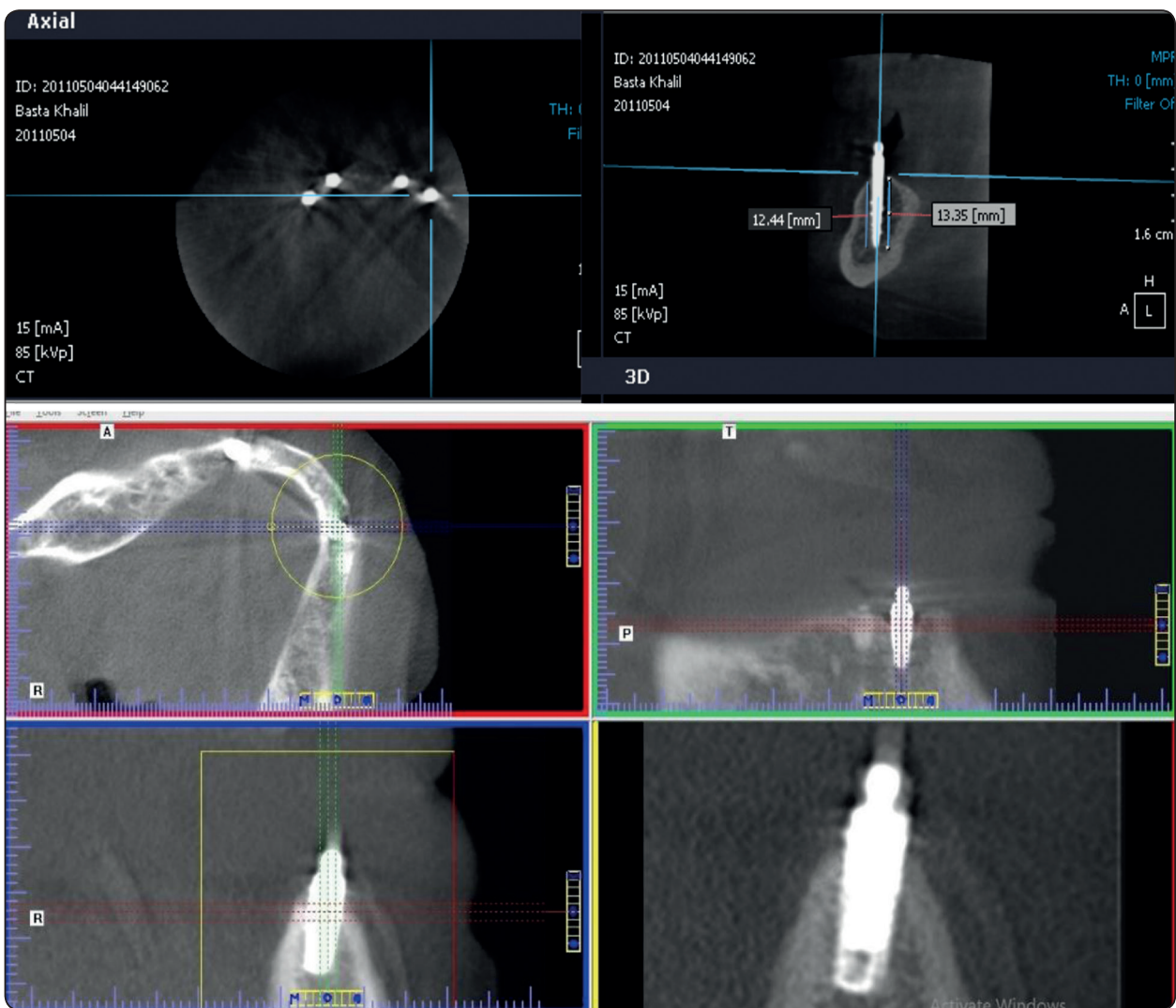


Fig. (7) CBCT analysis

*i-CATVision; iQDesk-version1.9.3.13; Imaging Sciences International LLC.1910 North Penn Road Hatfield, PA.19440. USA.

**SPSS Inc., IBM Corporation, NY, USA

## RESULTS

### I- Peri-Implant Bone Loss by Time Within Each Group.

*Group (I):*

#### Six Months Following Denture Insertion:

The calculated means of the measured bone loss for the Mesial surfaces were $0.5 \pm 0.1$ mm,for the Distal surfaces were $0.55 \pm 0.03$ mm,for the Buccal surfaces were $0.50 \pm 0.12$ mm and for the Lingual surfaces were $0.49 \pm 0.03$mm. The calculated means of the measured bone loss were statistically significant ( $P \leq 0.05$).

#### Twelve Months Following Denture Insertion:

The calculated means of the measured bone loss for the Mesial surfaces were $0.78 \pm 0.1$mm,for the Distal surfaces were $0.98 \pm 0.7$mm,for the Buccal surfaces were $0.79 \pm 0.1$mm. for the lingual surface $0.74 \pm 0.03$mm. The calculated means of the measured bone loss were statistically significant ( $P \leq 0.05$).

TABLE (1) The difference in marginal bone loss within the Mini implants group.

|  | 0-6 months | | 0-12 months | | P value |
|---|---|---|---|---|---|
|  | Mean | Std. | Mean | Std. | |
| Mesial | 0.50 | 0.1 | 0.78 | 0.1 | <0.001* |
| Distal | 0.55 | 0.03 | 0.92 | 0.7 | <0.001* |
| Buccal | 0.50 | 0.12 | 0.79 | 0.1 | <0.001* |
| Lingual | 0.49 | 0.03 | 0.74 | 0.03 | <0.001* |
| overall | 0.51 | 0.04 | 0.80 | 0.05 | <0.001* |

*Group (II):*

#### Six Months Following Denture Insertion:

The calculated means of the measured bone loss for the Mesial surfaces were $0.56 \pm 0.07$ mm, for the Distal surfaces were $0.67 \pm 0.06$ mm, for the Buccal surfaces were $0.56 \pm 0.06$ mm and for the Lingual surfaces were $0.55 \pm 0.05$mm. The calculated means of the measured bone loss were statistically significant ( $P \leq 0.05$).

#### Twelve Months Following Denture Insertion:

The calculated means of the measured bone loss for the Mesial surfaces were $0.7 \pm 0.07$ mm,

for the Distal surfaces were $0.87 \pm 0.07$ mm, for the Buccal surfaces were $0.7 \pm 0.08$ mm and for the Lingual surfaces were $0.7 \pm 0.007$ mm.The calculated means of the measured bone loss were statistically significant ( $P \leq 0.05$).

TABLE (2) The difference in marginal bone loss within the short implant group

|  | 0-6 months | | 0-12 months | | P value |
|---|---|---|---|---|---|
|  | Mean | Std. | Mean | Std. | |
| Mesial | 0.56 | 0.07 | 0.70 | 0.07 | <0.001* |
| Distal | 0.67 | 0.06 | 0.87 | 0.07 | <0.001* |
| Buccal | 0.56 | 0.06 | 0.70 | 0.08 | <0.001* |
| Lingual | 0.55 | 0.05 | 0.70 | 0.07 | <0.001* |
| overall | 0.58 | 0.006 | 0.74 | 0.007 | <0.001* |

### II-Comparison Between the Amounts of Bone loss in Both Groups.

The calculated means of the measured bone loss in the group I of mini implants were higher than group II short implants for the Mesial,distal ,buccal and lingual surfaces and over all bone loss at 6 months and the difference was statistically insignificant ( $P \leq 0.05$).

TABLE (3) The difference in bone height loss in Mini implants group versus short implant group during the follow up intervals(0-6months)

| 0- 6 months | Mini implant | | Short implants | | P value |
|---|---|---|---|---|---|
| | Mean | Std. | Mean | Std. | |
| Mesial | 0.50 | 0.1 | 0.56 | 0.07 | 0.615 |
| Distal | 0.55 | 0.03 | 0.67 | 0.06 | 0.319 |
| Buccal | 0.50 | 0.12 | 0.56 | 0.06 | 0.613 |
| Lingual | 0.49 | 0.03 | 0.55 | 0.05 | 0.611 |
| Overall | 0.51 | 0.04 | 0.58 | 0.06 | 0.553 |

The calculated means of the measured bone loss in the group I of mini implant were higher thangroup II short implant for the Mesial,distal ,buccal and lingual surfaces and over all bone loss at 12months and the difference was not statistically significant at $P < 0.05$.

TABLE (4) The difference in bone height loss in Mini implant group versus short implant group during the follow up intervals(0-12months)

| 0– 12 months | Mini implant | | Short implants | | P value |
|---|---|---|---|---|---|
| | Mean | Std. | Mean | Std. | |
| Mesial | 0.78 | 0.1 | 0.70 | 0.07 | 0.108 |
| Distal | 0.92 | 0.7 | 0.87 | 0.07 | 0.854 |
| Buccal | 0.79 | 0.1 | 0.70 | 0.08 | 0.087 |
| Lingual | 0.74 | 0.03 | 0.70 | 0.07 | 0.189 |
| Overall | 0.80 | 0.05 | 0.74 | 0.07 | 0.089 |

## DISCUSSION

### I-Discussion of Methodology

This study evaluated the marginal bone loss between Mini implants and short length implants in patients rehabilitated with implant supported and retained mandibular complete overdentures.

Patients were precisely selected and thoroughly examined in attempt to reduce human variables and eliminate any factor or habit that might adversely affect the results of this study. This was done using comprehensive medical history, clinical examination and laboratory investigations. [17]

The age of the selected patients ranged between 55 and 65 years to avoid the effect of age changes on the condition of the oral mucosa, residual ridge, muscle tone and temporomandibular joint. [18] Only male patients were selected to participate in this study to avoid the effect of sex related variations and to avoid the effect of sex related hormonal changes which were reported to contribute to mucosal changes and osteoporosis. [19] Female patients were excluded due to high prevalence of post-menopausal osteoporosis, which might result in altered bone metabolism and reduced healing capacity. [20]

Diabetic patients with uncontrolled glucose levels were also excluded, as hyperglycemia was found to cause impaired wound healing and alterations in bone metabolism. [21]

Head and neck radiation therapy was another exclusion criterion, as the failure rates of implants were reported to be higher when they were placed in irradiated bone.

This was attributed to the reduced resistance to infection, delayed wound healing and the potential for osteoradionecrosis after radiation treatment. [22]

Patients with bleeding disorders, cardiovascular impairment, advanced liver or valvular heart diseases present a high risk during any surgical procedure, were therefore eliminated from this study. [23, 24]

All patients participating in this study exhibited Angle's class I ridge relationship to avoid subjecting the implants to abnormal forces. [25]

Smoking as a significant risk factor for failure of implant therapy [26]; as it affects the condition of oral mucosa and retards the process of osseointegration, therefore smokers were excluded from the study. [27]

Patients with history of abnormal or para-functional habits as clenching and bruxism were excluded to avoid excessive load and undue concentrated forces on the implants. [28]

It has been reported that one of the main causes of osseointegration failure is lack of proper oral hygiene. Therefore, Patients with poor oral hygiene were excluded to avoid the risk of peri-implant mucositis and peri-implantitis. [29]

Standard clinical and laboratory techniques were followed for the construction of the dentures for all patients. Also, same materials were used as feasible as an attempt to eliminate any factor that might affect the results of this study. An important consideration in fabricating a mandibular overdenture is to ensure sufficient space for prosthetic components of the implant attachment system where the minimum space requirement for ball attachment is 10-12 mm. [30] Therefore, mounted diagnostic casts and trial set-up of artificial teeth were employed for assessment of arch relationship.

Diagnostic panoramic radiographs were made for all patients to evaluate the presence or absence of remaining roots, impactions or any other pathological lesions that might complicate placement of dental implants interforaminally, locate the position of mental foramina, level of inferior alveolar canal and detection of anterior looping of mental nerve. [31]

The prognosis of any implant-driven prosthetics depends primarily on successful osseointegration of the implants [32]. Accordingly, strict measures were followed along the course of this study to avoid potential factors that might increase the risk of implant failure.

The anterior mandibular region (the inter foraminal region) was selected for implant insertion where the greatest available height of bone is located in the anterior mandible between the mental foramina or anterior loops of the mandibular canal when present. In addition, this region usually presents the optimal density of bone for implant support as it entirely features thick dense cortical plates, as well as dense trabecular bone. [33]

Preoperative and postoperative medications were given to all patients to control the risk of implant failure, postoperative infection, edema and to decrease patient apprehension. Broad spectrum antibiotics and anti-inflammatory drugs were administered to all patients. [34, 35]

Broad spectrum antibiotics were administered as they were found to have a significant effect in preventing postoperative infections after implant placement and on implant survival rates. [36]

Proper control of heat generation was carefully considered for preservation of the surrounding bone cells and prevention of bone necrosis. Thus, a series of sharp drills, together with copious irrigation and intermittent pressure were carried out for osteotomy site preparation. [37]

Intermittent drilling was performed as it allows the saline solution to reach the entire length of the bony walls. In addition, it allows for the escape of bone debris and prevents clogging of the cutting edge of the drills which would decrease their cutting efficiency eventually increasing heat generation. [37]

Stresses are most evenly distributed when occlusal forces are directed at the center of the implant through its the long axis. [38,39] Therefore, it was important to avoid inclinations both in the labiolingual and mesiodistal directions, which was accomplished by the frequent insertion of paralleling tools during drilling. This was also done to avoid challenges that might be encountered during the prosthetic stage, such as difficulty in achieving a path of insertion and premature wear of attachment components. [40] The immediate implant loading protocol was followed in this study as the results of several studies revealed no significant difference between immediate and delayed implant loading by mandibular over dentures. [41-44]

The direct pick-up technique was used for connecting the ball attachments to the overdenture as this technique is simple, less expensive, requires less prosthetic elements and allows the patient to keep the prosthesis. Furthermore, direct pick-up technique eliminates inaccuracies associated with transfer impression and laboratory processing, resulting in an overdenture requiring less maintenance, less replacement of worn attachment parts and after care. [45]

## II-Discussion of results

The success of implant supported and retained overdenture for long periods of time has been well established in the literature. [46,47]

All implants used in the current study for both groups revealed successful osseointegration throughout the follow up period as manifested by (1) absence of subjective complaints such as pain, dysesthesia, or paraesthesia at the implant sites, (2) absence of recurring peri-implant infection and/or suppuration, (3) absence of perceptible implant mobility and (4) absence of radiolucencies at the implant-bone interface.

The above mentioned findings are fully consistent with implant success criteria proposed by Buser et al. [48], Smith &Zarb [49], Albrektsson and Zarb et al. [50]

The calculated means of the measured bone loss for all surfaces in **Group (I)** patients revealed a total change of 0.51 ± 0.05 mm. which was found to be statistically significant at P < 0.05.

The significant decrease of marginal bone height surrounding the mini implants in all aspects (buccal, lingual, mesial and distal) was found throughout all time intervals during this study. This bone reduction might be due to surgical trauma, bone osteotomy and healing process. This also could be attributed to the micro-damage accumulation occurring in bone after implant placement. [51,52]

Further reduction of the bone height till the end of the study period might be due to mechanical factors acting on the implants: loading and forces of mastication. [53]

The calculated means of the measured bone loss for all surfaces in **Group (II)** patients revealed a total change of 0.58 ± 0.05 mm after 6 months which was found to be statistically significant at P < 0.05. The above mentioned findings are fully consistent

The calculated means of the measured bone loss for all surfaces in **Group (II)** patients revealed a total change of 0.73 ± 0.06 mm after twelve months which was found to be statistically significant at P < 0.05. It has been observed that the maximum calculated mean of marginal bone loss for both groups was evident at the six-month interval and progressed slowly after. According to Cochran et al. [54], peri-implant bone remodeling after implant placement is more accentuated in the first 6 months after surgery. Other investigators such as Lee et al. [55], and Hartman et al, [56], likewise consider most bone loss to occur in the first 6 months, followed by gradual stabilization till the end of follow up period. Crestal bone loss could be explained by the finding that forces applied on implants are distributed on the crestal bone rather than along the entire implant/bone interface. [57,,58]

As for comparing the result of bone loss in both groups The calculated means of the measured bone loss in the group I of mini implant was higher than group II short implant for the Mesial,distal,buccal and lingual surfaces and over all bone loss  at 6months and 12 months and was found not statistically significant at P < 0.05

In another study model for implants with the same diameter but different lengths showed a substantially lower effect of length than diameter. The relation between relative stress (in percent) and implant length showed a similar trend as for the variable diameters. However, compared with the results for varying implant diameter, there was

a smaller effect of implant length on stress in the bone. The relative stress acting in the bone around the implant with a length of 17 mm was 22.9% smaller than that around the 12-mm reference implant. For the 8-mm and 17-mm long implants, there was a difference of only 7.3% The relative stress acting in the bone around the implant with a diameter of 4.2 mm was 31.5% smaller than the reference implant (diameter of 3.6 mm). Further stress reduction with the 5.0-mm implant represented an additional 16.4%. Stress reduction continued to decrease for larger diameters. The use of an implant with a diameter of 6.5 mm resulted in reduction of the maximum stress values by almost 60%. The results of this simulation study have shown that implant diameter was more important for improved stress distribution than implant length.[59] Same results in other studies indicated that stress distribution in the bone around the implant depends on the shape and the size of the implant. [60,61]

Considering the effect of implant diameter, using mini implants resulted in the highest stresses and strains both in axial and off-axial loading, when compared with both standard and short-wide implants. This might be attributed to the smaller surface area and volume of mini implants, which places more force per square millimeter against the encasing bone than larger-diameter implants. [62] This is because for every 0.5-mm increase in width, there is an increased surface area between 10% and 15% for a narrow range of diameters, and the percentage change is greater for smaller diameters and lesser for larger diameters.[63] Thus, it was concluded by Kong et al [64] that the increase in width of the implant may decrease stress by increasing the surface area, which may also reduce the   length requirement. Short-wide implants resulted in lower microstrains than mini implants both in axial and off-axial loading. The reduced strains associated with wider implants may be due to the increased structural capacity and the enlarged bone-implant contact area offered by these implants, resulting in a lower torque effect in conjunction with off-axial loading.

## CONCLUSION

Within the limitation of this study, it could be concluded that marginal bone loss around mini implants supporting and retaining mandibular complete overdenture is higher than the marginal bone loss around short implants supporting and retaining mandibular complete overdenture although the difference was statistically insignificant.

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