Bone reaction around early-loaded mini implants supporting mandibular over dentures with different protective occlusal schemes

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Abstract: The aim of this study was to evaluate the effect of the lingualized versus monoplane occlusal scheme on the supporting bone around early-loaded mini implants supporting mandibular over-dentures. **Patients and methods;** Fourteen completely edentulous male patients were divided randomly into two equal groups. Four mini implants were installed in each patient at the inter-foramina area. Group 1 patients received mini implant supported mandibular over-dentures with their occlusal scheme set according to the lingualized occlusal concept. Group 2 patients received mini implant supported mandibular over-dentures with their occlusal scheme set according to the monoplane occlusal concept. The early loading protocol was implemented & cases were evaluated radiographically using the Digora computerized system at the time of denture insertion (0), (3), (6) and (9) months after denture delivery. **Results;** There was no statistically significant difference between the bone height measurements of the two groups. As regards the bone density, it was decreased during the first three months in both groups. This was followed by a gradual increase with the greater increase being recorded for group 1 (lingualized occlusal scheme) followed by group 2 (mono plane occlusal scheme). There was a statistically significant difference between the two groups at the end of the study period only. **Conclusion;** A more favorable bone reaction was achieved in the ligualized occlusal scheme group than in the monoplane occlusal scheme group. **Recommendation;** Whenever possible, the ligualized occlusal scheme should be adopted than the monoplane occlusal scheme as the preferred occlusal concept of mini implant supported mandibular over-dentures if they are intended to be early loaded.

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1. Introduction

With the advent of new technologies together with the increasing demand for implant treatment, root form implants are now available in many different lengths and diameters to suit more clinical situations. Narrow diameter and *mini dental implants* are now available as therapeutic options for cases with space limitations, or when it is difficult to esthetically restore a small-sized tooth and install a standard-diameter implant on a narrow alveolar ridge without performing guided bone regeneration procedures **(Vigolo and Givani, 2000)**.

Mini implants offer several advantages. Their installation involves a flapless minimally invasive procedure with reduced bleeding, decreased postoperative discomfort (usually associated with flap surgery), shortened healing time, and decreased possibility to infection during surgical procedures. It is a preservative method of restoring patients with an atrophic mandible without any bone augmentation surgery with its possible complications (**Gibney, 2001, Campelo and Camara, 2002**).

Dental literature revealed that the ultimate success and longevity of dental implants are significantly influenced by the biomechanical aspects of occlusal design, configuration and anatomy **(Rangert *et al.*, 1989, Adell *et al.*, 1990, Misch, 1993, Kaukinen *et al.*, 1996 and Schwartz, 2000)**. As reported by **Jae-Hoon *et al.*, 2005** one of the primary disadvantages of mini implants is the reduced resistance to occlusal loading as compared to standard sized implants. This makes the selection of an occlusal scheme in an over-denture supported by mini-implants even more critical and crucial, especially if they were intended to be early loaded.

Monoplane and lingualized occlusal schemes were principally designed to minimize occlusal forces falling on the supporting structures. In monoplane occlusion, cuspal inclination of posterior teeth is eliminated and consequently horizontal forces transferred to the supporting structures are significantly reduced (**Jones, 1972**). Similarly, the lingualized occlusal concept eliminates the buccal cusp contact in centric and eccentric excursions hence provides wide occlusal freedom, reduces lateral inferences and reduces timing of force contact and directions (**Becker *et al.*, 1977, Matsumara, 2010)**.

This study was designed to assess the bone reaction around early loaded mini dental implants in edentulous mandibular arches as influenced by two different protective (lingualized and monoplane) occlusal schemes by assessing two objective measures of the supporting bone: bone height and bone density.

2. Patients and Methods

Inclusion and exclusion criteria:

Fourteen completely edentulous male patients, with an average age of 55 years, were selected from the outpatient clinic of the Prosthodontic Dept., Faculty of Oral and Dental Medicine, Cairo University. Patients were free from systemic diseases that would affect bone quality or postoperative healing. Residual ridges were of suitable height and width for implant placement and covered with healthy firm mucosa, free from severe bony undercuts or flabby tissue. Heavy smokers (>10 cigarettes per day) or patients who had received radiation to the head and neck region, as well as, patients with parafunctional habits were excluded. All patients had Angle's class I maxillo-mandibular relationship. The protocol and objectives of the study were explained to the patients. Those who accepted participation signed an informed consent.

Patient Examination:

Thorough patient examination was carried out and included past and present medical and dental history, extra and intra-oral examination, mounted diagnostic casts, as well as, radiographic examination using a pre-constructed radiographic template having metal balls that was made after tentative setting up of the anterior teeth to guide in proper implant placement.

Patient Grouping: Patients were divided randomly into two equal groups (seven patients each). Four mini-implants were placed in each patient at the inter-foramina area.

Group I: Patients received mandibular mini implant supported over-dentures with their occlusal scheme set according to the lingualized occlusal concept.

Group II: Patients received mandibular mini implant supported over-dentures with their occlusal scheme set according to the monoplane occlusal concept.

Utilized Implants:

The Dentiumimplant system (Slim One body, Dentium implant system, Dentium Co., Ltd, Korea) with sand blasted acid etched screw type one piece mini-implants, 2.5 mm in diameter and 10 mm in length were used.

Denture Construction:

Maxillary and mandibular preliminary impressions were made using irreversible hydrocolloid impression material (Chromopan-lascod B.A. sestoflorentino Firenze Italy). Final impressions were made using zinc oxide and eugenol impression material (Cavex outline B.V. Holland) after border molding. Impressions were boxed and poured in dental stone (Zeus dental stone hard type Italy) to obtain master casts on which occlusion blocks were constructed. After adjustment of the maxillary occlusion rim and proper orientation of the occlusal plane a maxillary face bow record (Whip Mix #8645 quick mount. Louisville, K.Y. USA) was made to mount the maxillary cast on a semi-adjustable articulator (Whip Mix #8500 Semi-adjustable articulator, Louisville, K.Y. USA). Centric occluding relation and protrusive jaw relation were then recorded using the wax wafer method to mount the mandibular cast and adjust the horizontal condylar path inclination respectively. This was followed by setting up of artificial teeth using cross-linked acrylic resin teeth (Acrylic teeth, Cosmo MEA, Dentsply-USA). For *group I* patients, anterior teeth were set as usual. Mandibular molar and premolar teeth were modified by widening the central fossae and reducing the buccal and lingual cusps. They were arranged with no mediolateral inclination. Maxillary molar and premolar teeth were modified to eliminate buccal cusp contact in centric relation. They were positioned with slight rotation to allow only the palatal cusps to occlude with the modified mandibular central fossae without any contact between the buccal cusps. For *group II* patients, the teeth were set according to the monoplane occlusal concept. Teeth were flattened and arranged antroposteriorly so as to be parallel to the plane of denture foundation. Mediolaterally, the teeth were positioned flat with no medial or lateral inclination. The lower second molar was kept out of occlusion to direct the forces to the bicuspid molar region. Maxillary and mandibular anterior teeth were arranged without any overlap. For both groups, the maxillary and mandibular trial dentures were tried in the patient's mouth. After patient satisfaction and carrying out all necessary adjustments, they were processed as usual using high impact heat cured acrylic resin (Meliodent, Heraeus-KulsarGmbh, Wertheim, Germany), finished and polished following the conventional technique for complete denture construction. At the delivery appointment, final occlusal adjustments were done and dentures were delivered to the patients to get use to it. The dentures were inspected few days later to perform any required adjustments before the surgical appointment.

Pre-surgical preparation:

An umbrella of antibiotics for infection control (Augmentin 625 mg) was prescribed for the patients 24 hours before surgical operation and continued for one week to guard against any possible infection. Non-steroidal anti-inflammatory medication (Ketofan 50 mg) was given to the patient postsurgically. Chlorohexidine mouth wash was used to disinfect the surgical field and reduce the liability of postoperative infection started one day before surgery and for one week three times daily.

Surgical procedure:

Bilateral mental nerve block anesthesia as well as ring infiltration anesthesia was given at the corresponding site to the surgical field using 4% articaine anesthesia. The radiographic template was modified and used as surgical stent that was inserted into the patient's mouth, to mark the sites of the four implants using a dental probe. Ridge mapping at the proposed implant sites was also done using bone caliber. A flapless technique was done by drilling through the mucosa and bone using only one guide drill, 1.6 mm. diameter and 10 mm in length, with copious irrigation to form an osteotomy smaller than the implant diameter. This was repeated for the four sites. Paralleling tools were used to confirm parallelism among the osteotomies. One mini-implant was removed from its sterile packing and carefully installed into one of the prepared osteotomy sites using the holding cap. It was then slowly rotated in a clock-wise direction with slight apical pressure. The cap becomes deformed and removed after initial placement half way into the osteotomy site. Implant insertion was then continued using a manual driver until some resistance is felt. The adjustable torque ratchet was finally used to thread the implant to its full length with its head projecting above the mucosa. Primary stability of each implant was checked using the adjustable torque ratchet to confirm that the initial stability (primary fixation) was exceeding 40N/cm, which is crucial for immediate and early implant loading. A minimum of 5mm mesio-distal distance was kept between adjacent implants. The same procedure was repeated for the other three implants (Fig.1). Antibiotics, analgesics and anti inflammatory drugs were prescribed for three days post-operatively. Chlorohexidine mouthwash was prescribed three times daily with strict oral hygiene measures. Instructions were given to each patient: not to touch the implants, to eat soft food until the next appointment, rinse with chlorohexidine mouth wash three times daily, to strictly comply with the prescribed medications, to recall in case of any pain, or exudates around the implants or any other unusual symptoms and finally to recall one week after implant placement for denture delivery and pick-up procedures.

Direct Pick-up Procedure:

Undercut areas around the mini-implant heads were carefully blocked out using wax. The rubber o-rings and metallic housing caps were placed on the mini- implants. The area opposing the housings were marked on the fitting surface of the denture. Adequate amount of resin was removed at the marked areas, until a clearance space of about 1-2mm was provided around the metallic housings. The maxillary and mandibular dentures were inserted into the patients' mouth to verify the complete seating of the lower denture without any interferences, rocking or occlusal discrepancy. Two holes were then created in the lingual acrylic flange below the artificial teeth to allow the escapement of excess material. Self-curing acrylic resin was mixed and applied in the dough stage to the relieved areas of the fitting surface. The mandibular denture was reseated in the patient's mouth. The patient was instructed to close in centric occlusion. After complete polymerization, the denture was removed from the patient's mouth picking up the metal housings and rubber O rings (Fig.2).

Radiographic Evaluation:

Each case was evaluated radiographically at the time of over-denture insertion (0 month), three, six and nine months later. Radiographic evaluation included assessment of bone density and bone height changes around the mini-implants. The Digora computerized system (Orion Corporation, Soredex Medical systems, Helsinki, Finland), the Rinn XCP (Rinn Corporation XCP instruments for extension cone paralleling technique. USA) periapical film holder and individually constructed radiographic acrylic templates were used for making standardized reproducible serial digital images for the implants by applying the long cone paralleling technique. Radiographic exposure was done using the Orix x-ray machine (Orix-Aet, ARDET, S.V.R.,Milano, Italy) at 65-kilovolt, 10-milliampere, for 0.4-seconds. Exposure parameters were fixed for all patients at the base line, as well as, during the follow up periods.

The linear measurement system supplied by the special software of the Digora system was used to assess mesial and distal marginal bone height around the mini- implants (Fig.3). Three linear measurements were recorded for each mini-implant as follows: A horizontal line was drawn perpendicular to the mini implant head. Two vertical lines were drawn mesial and distal to each mini implant extending from the first line to the alveolar crest.

The software of the Digora system was again used for evaluating the linear changes in bone density mesial and distal to the mini-implants in both groups. The measurements were as follows; three lines were drawn mesial and parallel to the implant surface. The first line extended from the crest of the alveolar ridge to the apex of the implant passing parallel to the surface of the implant (Fig.4), the second and third lines were drawn parallel to the first line, being 1mm and 2mm distal to it, respectively. Bone density along each of the three lines was recorded and then the mean value of the three readings was calculated. The same procedure was carried out distally.

Finally, for each implant, the mean value of the mesial and distal readings was calculated.

Statistical analysis:

Data were presented as mean and standard deviation (SD) values. Paired t-test was used to compare between mesial and distal surfaces. Student's t-test was used to compare between bone density and bone height in the two groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with PASW Statistics 18.0®(Predictive Analytics Software) for Windows (SPSS, Inc, Chicago, IL, USA).

Figure 1: Intra-oral view of the four mini-implants

Figure 2: The fitting surface of the mandibular denture with the picked-up metal housings and rubber O rings.

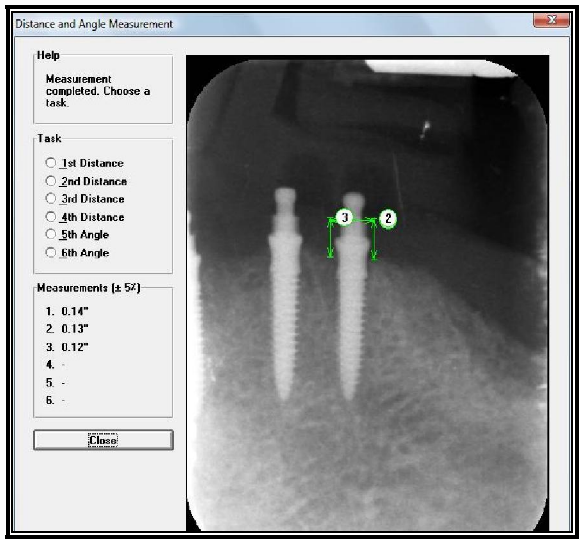

Figure 3: Linear bone height measurements

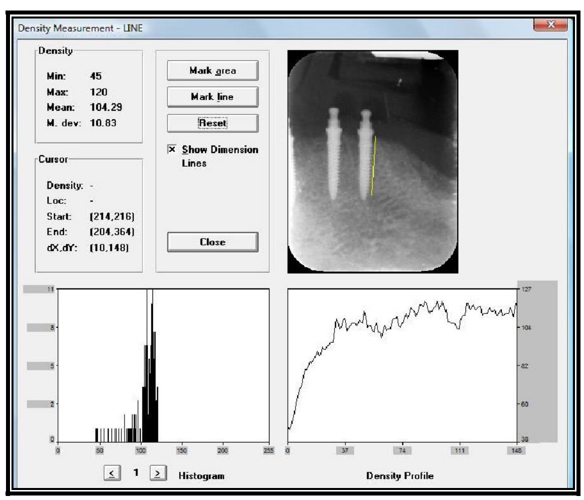

Figure 4: Linear bone density measurements

3. Results

All patients attended till the end of the follow up period and all the implants were satisfactorily anchored. All patients in both groups expressed their satisfaction to the delivered prosthesis regarding retention, stability and function. The comparison of the bone reaction parameters between the mesial and distal implant surfaces showed statistically insignificant differences between the two surfaces, so the mean of the two surfaces was used for the comparisons.

I) Radiographic evaluation of Bone height changes (in mm.)

Bone height was measured from the implant head to the crest of the ridge. Thus increase in the measured distance means reduction in bone height.
As presented in table 1 and figure 5, mean values of bone height measurements increased in the two groups; however this increase was slightly higher in group II than in group I, i.e. more bone height reduction was recorded for group II. Statistical analysis however revealed insignificant differences between the two groups at all follow-up periods.

II) Radiographic evaluation of Bone density changes

As presented in table 2 and figure 6, there was an obvious decrease in bone density in both groups during the first three months of implant loading. This was followed by a gradual increase in bone density in both groups till the end of the follow-up period. However this increase was more evident in group I than group II. Statistical analysis revealed a statistically significant difference (P=0.002) between the two groups at the end of the follow-up period (9 months) only.

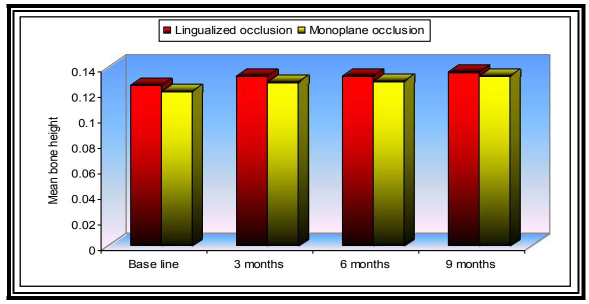

Figure (5): Effect of occlusal scheme on bone height measurements

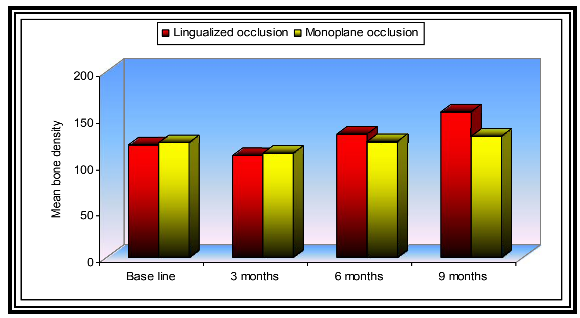

Figure (6): Effect of occlusal scheme on bone density measurements

Table (1): Effect of occlusal scheme on bone height measurements (in mm)

	Group I- Lingualized		Group II- Monoplane		
Follow-up period	**Mean**	**SD**	**Mean**	**SD**	**P-value**
0 month (baseline)	0.126	0.018	0.121	0.025	**0.756**
3 months	0.133	0.018	0.128	0.024	**0.752**
6 months	0.133	0.023	0.129	0.023	**0.826**
9 months	0.136	0.021	0.133	0.021	**0.811**

*: Significant at $P \leq 0.05$

Table (2): Effect of occlusal scheme on bone density measurements

	Group I- Lingualized		Group II- Monoplane		
Follow-up period	**Mean**	**SD**	**Mean**	**SD**	**P-value**
0 month (baseline)	120.7	8.5	123.9	7.2	**0.584**
3 months	110.1	7.1	112	5.5	**0.681**
6 months	132.4	11.4	125	3.6	**0.265**
9 months	156.2	6.4	130.5	7.7	**0.002***

**: Significant at $P \leq 0.05$*

4. Discussion

As documented in the dental literature, the magnitude of occlusal forces is influenced by several factors. Some are patient-related, while others are prostheses-related. From that prospective, it was essential to control the patient –related and prostheses-related factors, as much as possible, to ensure that the findings obtained in the present study are most probably related to the type of occlusal scheme only. To control patient –related factors, patient selection was based on certain criteria. To control the prostheses-related factors, as much as possible, all dentures were constructed in the same conventional manner using cross-linked acrylic resin teeth in both groups. Hence the type of occlusal material was the same in both groups. This was essential for the reliability and validity of the results as occlusal materials are considered one of the biomechanical factors that affect the transmission of forces to the underlying structures (**Misch, 2005*).***

Subjectively, all patients were satisfied with their restorations as regards retention, stability and masticatory function. This indicates that over-dentures supported by four mini-implants could be considered a practical and reliable treatment option. It seems that the four mini-implants were satisfactorily sufficient in providing adequate amount of retention, stability and support to the prosthesis, which was reflected in the improved masticatory function experienced by the patients. The same subjective findings were reached by **Griffitts *et al.*, 2005**, who also used four mini implants to support both maxillary and mandibular over-dentures. In fact, they reported that the overall excellent patient satisfaction, as well as, the high success rates achieved in their clinical study were so remarkable to the extent that they view this procedure as a more cost-effective and viable surgical option than two conventional implants with a bar or a ball and socket attachment. Considering that mini-implants are more affordable than traditional implants and that their surgical procedure is much simpler, less time consuming and associated with less post-operative complications, a new door is now opened in the treatment of patients who seek implant therapy but unfortunately cannot afford it.

Radiographically, both bone height and bone density measurements revealed promising results regardless of the type of occlusal scheme used. Hence, radiographic findings complement and augment the subjective findings in encouraging and supporting the use of mini-implants.

Initially speaking, and before discussing in detail the effect of the occlusal scheme on the radiographic findings, it seemed necessary to display the current study from a "loading protocol" point of view first. The early loading protocol implemented in the current study has been fairly investigated previously but with standard sized implants. These clinical studies (**Cochran *et al.*, 2001, Raghoebar *et al.*, 2003, Bornstein *et al.*, 2009*)*** revealed that high implant survival and success rates, as well as, proper peri-implant health could be achieved with early loading protocols. It is fair to say that the current study revealed that similar results could be achieved with mini-implants. This may be attributed to the fact that great care was taken in the present study to fulfill the precautions and considerations required for early loading including; selecting patients with good bone quality, under-prepartion of the osteotomy site; using an adequate number of implants; using protective occlusal schemes that minimize horizontal forces, as well as, using implants with adequate dimensions. As previously mentioned, the installed mini-implants were 10mm in length as it has been reported that such length provides sufficient primary stability for the mini-implants rendering them suitable for immediate or early loading ***(*Griffitts *et al.*, 2005).**

Returning back to the radiographic findings, promising results were achieved as mentioned before. Generally speaking, the amount of marginal bone loss recorded in both groups did not exceed 0.012mm within the 9 months follow-up period. This could be considered an outstanding result when compared to the "first-year 1.2mm" average bone loss that has been reported in the dental literature for traditional implants (**Adell *et al.*, 1981, Henry *et al.*, 1988 & Pylant *et al.*, 1992*).*** Interestingly enough, this implies that when implemented and executed properly, mini-implants could show comparable even more favorable bone reaction than traditional implants. It is worthy to mention, however that this motivating implication could be attributed to several factors. First of all, general factors such as proper patient selection, proper implant installation and surgical procedures, application of proper hygiene measures on behalf of the patients, as well as, restricting the opposing occlusion to complete dentures may have with no doubt played a role. Additionally, the non-invasive surgical procedure used for mini-implant installation may have immensely contributed to the obtained results. Soft tissue architecture, as well as, hard tissue volume at the surgical site are preserved in such flapless surgical procedures ***(*Gibney, 2001),** hence early crestal bone loss that has been usually associated with periosteal reflection ***(*Misch, 2008)** is totally eliminated with mini-implant surgeries.

All these factors may have played a role, however the remarkably low bone loss values recorded in the present study may be attributed primarily to the type of occlusal schemes used (monoplane and lingualized) as they are both considered and referred to as "non-traumatic protective" occlusal schemes.

Based on the results of numerous studies, the effect of different occlusal schemes on the supporting structures under complete dentures and implant-supported restorations seem to be comparably the same. The monoplane occlusal scheme has been preferred and favored by several researchers. **Arksornnukit *et al.*, 2011** examined pressure transmission and distribution under complete denture bases using denture teeth of different cusp angulations (0º, 20º, and 33º). Their results revealed that (0º-monoplane) teeth presented significantly lower average pressure and lower maximum pressure transmission compared to cusped denture teeth. From a biomechanical point of view, vertical forces falling on an inclined occlusal plane results in the formation of horizontal (lateral) and vertical force vectors. Moreover, the greater the cusp angulation, the greater the chance of cuspal interlocking, with further accentuation of these lateral forces. It has been well documented in the dental literature that axial (vertical) forces are much better tolerated by both natural teeth and implants than non-axial (lateral) forces that are considered destructive. It is the belief of these authors that monoplane teeth offer the beneficial advantage of limiting, if not eliminating, the formation and transmission of destructive non-axial forces, as the direction of forces is essentially vertical. Similar results were obtained with implant-supported prostheses when different occlusal schemes were compared. In the study conducted by ***Kaukinen et al., 1996***, the 33-degree anatomic denture teeth transmitted greater forces to the implant retained prostheses and supporting bone than the 0-degree teeth. The authors concluded that the occlusal configuration and cusp angulation played a significant role in force transmission and the stress-strain relationship in the supporting bone. They hence recommended that implant retained prostheses should use occlusal configurations that have shallow occlusal anatomy with reduced cusp inclinations and wide sluiceways to prevent food accumulation and thereby minimize force transmission to the prostheses and supporting bone.

As for the lingualized occlusal scheme, the buccal cusp contact in centric and eccentric excursion is eliminated and wide occlusal freedom is provided. These features in turn minimizethe destructive horizontal forces (**Becker *et al.*, 1977).** It has also been reported that in lingualized occlusion, masticatory forces are distributed towards the lingual side, hence stabilizing the dentures **(kawano *et al.*, 1990 and Inoue *et al.*, 1996).** This enhanced denture stability certainly reduces potential denture movement during function, and consequently minimizes the transmission of unnecessary forces to the supporting structures.

The comparably favorable force transmission provided by both occlusal schemes could explain the statistically insignificant differences found between the two groups as regards bone height changes. Hence both were similarly successful in preserving the crestal bone around the mini-implants. However, at the end of the study period, the total bone loss was higher in the monoplane occlusion group (0.012mm) than in the lingualized occlusion group (0.010mm).This suggests that by time, lingualized occlusion could be superior as regards force transmission and distribution to the supporting structures.

A noteworthy observation is that bone density decreased in the first three months and then increased gradually throughout the next six months. This initial decrease in bone density was somehow expected as previous studies revealed that this is a common and natural immediate bone reaction, in the form of bone remodeling following the introduction and insertion of a new prosthesis (**Misch, 2008).** The increase in bone density that followed indicates that forces applied and transmitted by both occlusal schemes were safely within the physiological tolerance of the supporting tissues, stimulating thereby bone deposition ***(*Roberts *et al.*, 2004)**. Results of effect of group (occlusal scheme) on bone density revealed a statistically significant difference between the two groups at the end of the follow-up period. This statistical result seemed reasonable considering that after 9 months, bone density increased by 29.5 % in the lingualized occlusion group, while it increased by 5 % only in the monoplane occlusion group. Such finding empowers the previously mentioned suggestion that lingualized occlusion seems to be superior as regards force transmission and distribution to the supporting structures resulting in a more favorable bone reaction. A possible explanation could be as mentioned by **Williamson *et al.*, 2004**, who explained that in the monoplane occlusal scheme, the direction of forces is essentially vertical, however in eccentric positions there is an inequity in the opposing surface area contact between working and non-working sides leading to a shift in the location of forces between the occluding teeth. They added that the frictional resistance between the wide tables of zero degree teeth may contribute some horizontal forces to the denture base. However, this is not the case with lingualized occlusion. Due to the elimination of buccal cusp contact, there is a minimum surface contact area between the lingual cusp and the opposing occlusal surface, thus denture base movement due to frictional resistance is minimized. This means that the overall direction and magnitude of forces generated during centric position and eccentric movements are more favorable when lingualized occlusal schemes used as compared to flat (0-degree) occlusal scheme.

To sum up the results, both occlusal schemes could be considered sufficiently “protective and preservative” based on the considerably low bone loss values and the increase in bone density recorded within the 9-month time-frame; hence any of the two schemes is acceptable when using early loaded mini-implant supported mandibular over-dentures. However, it is fair to say that the lingualized occlusal scheme seems to be comparably more superior as it exhibited a more favorable bone reaction. It is worthy to mention at this point that lingualized occlusion in complete dentures and implant prostheses has also been preferred from another prospective. Lingualized posterior occlusal forms were found to be significantly superior in terms of reduced pain in the mouth, reduced incidence of sore spots and ability to eat when compared to 0-degree posterior occlusal forms. Moreover, they were found to exhibit superior chewing efficiency and high levels of self-perceived patient satisfaction, similar to anatomic posterior occlusal forms **(Khamis *et al.,* 1998, Masari *et al.,* 2002, Kimoto *et al.,* 2006, Suttonand McCord, 2007)**.

Conclusions and recommendations

Generally speaking, early loading of mini-implant supported mandibular over-dentures could be considered a practical and a promising treatment modality.

Within the limitations of this study, both occlusal schemes demonstrated fairly promising results in early-loaded mini-implant supported mandibular over-dentures. However, a more favorable bone reaction was observed in the lingualized occlusion group than the monoplane occlusion group.

Whenever possible, the lingualized rather than monoplane occlusal scheme should be adopted as the preferred protective concept of occlusion in case of mini implant supported mandibular over-denture if the early loading protocol is to be followed.

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