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HARD TISSUE RESPONSE COMPARISON IN AN IMPLANT OVERDENTURE RETAINED BY LOCATOR OR EQUATOR ATTACHMENTS. A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Introduction: Completely edentulous patients usually have many problems associated with their mandibular complete dentures. Dental implants solved many of these problems. Many attachments are used nowadays to retain mandibular overdenture to dental implants. Among these attachments are the low profile locator and equator attachments. This study was conducted to study the effect of both attachments on bone level around two implants retaining complete mandibular overdenture.

Methodology: This study was conducted on 10 completely edentulous patients. Two implants were installed in the canine region bilaterally for all patients. Patients were then randomly divided into two groups where the first group received implant supported mandibular overdenture retained by locator attachment, while the other group received implant supported mandibular overdenture retained with equator attachment. The patients were then referred to oral and maxillofacial radiology department, Faculty of Dentistry, Cairo University for radiographic assessment to measure the bone height and density changes around the implant at the day of overdenture delivery and 12 months later.

Results: In the current study, bone height changes in both groups was in the clinically permissible range. Regarding bone density, it increased gradually around the loaded implants in both groups. When density is compared between the two groups, the locator attachment group showed significant increase when compared to the equator attachment group after 12 months of prosthetic loading.

Conclusions: Within the limitation of this study, both locator and equator attachments are viable treatment options to retain an implant supported mandibular complete overdenture regarding hard tissue response around the implants but more studies with more extended follow up is recommended.

KEY WORDS: Mandibular overdenture, Implants, Locator attachment, Equator attachment.

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INTRODUCTION

Mandibular implant-retained overdentures proved to be an effective treatment modality for edentulous patients particularly for those who have persistent problems using conventional mandibular denture[1,2]. Utilization of two interforaminally placed implants to support an overdentures was demonstrated to be clinically successful, economically advantageous to the patients and provides satisfactory retention for the prosthesis [2,4].

According to McGill Consensus Statement and more recently in the York Consensus Statement on Overdentures, a two-implant overdenture should become the standard of care for the edentulous mandible [5,6].

Ball and socket attachments are considered the simplest among all types of attachments for clinical application with implant supported overdentures specially the mandibular one. In comparison to other attachments used with complete overdenture, ball attachments may be less costly with less technical problems and easier in construction when compared to other types[7]. In addition it is less technique sensitive, less dependent on implant position, easier to clean and to replace as well as easier to adjust. Also ball and socket attachments are better able to distribute functional forces [8-11].

The newly developed locator and equator attachment systems has become widely applied. Though, there is no enough in-vivo or in-vitro studies concerning the evaluation of these systems and according to Kleis et al [12]., until 2010 there is no in-vivo study of this attachment system available. The locator attachment system being characterized by a low profile design, ease of seating in the oral cavity by the patient, self-locating feature to fit non-parallel implants up to 40° C divergence have been advocated as a suitable alternative to the classical ball attachment. Other studies have reported that locator attachment system possessed the highest retentive force and maintain that force up to 30 degrees tilting when compared to ball attachment [13,14].

The mandibular implant-supported overdentures is commonly retained by either stud attachments, clip on bar connecting the implants, or magnetic attachments[4]. These retentive attachments exert stresses that differ from those seen with natural teeth that are supported by periodontal ligament. If the exerted stresses exceed the physiological limit that the teeth can sustain, they may lead to several undesirable results as increased bone resorption around the implants. Also the long-term function of a dental implant system will depend on the biomechanical interaction between bone and implant [15-18].

Hence, the aim of this study was to evaluate the radiographic changes around the implants supporting mandibular overdenture retained by locator or equator attachments.

METHODOLOGY

Twelve completely edentulous patients in an age range of 55 to 65 years were selected for this study. Past and present dental and medical histories were taken from the patients. Patients with contraindications for surgical intervention were excluded from the study.

The selected patients were informed of the nature of the research. Oral and written information about the dental implant surgical and prosthodontic procedures were given to them.

A conventional complete denture was constructed for all patients following the traditional steps. The lower dentures of the patients were then duplicated into radio-opaque resin* for cone beam computed tomography to ensure the presence of adequate

* Bredent GmbH & Co. KG, Germany

bone height and width in the canine areas bilaterally to accommodate an implant of 10 mm height and 3.7mm width*.

The included patients were randomly divided into two equal groups. Patients of the first group received two interforamenal implants with locator attachments** to retain a complete mandibular overdenture, while patients of the second group received two interforamenal implants with equator attachment*** to retain a complete mandibular overdenture.

Surgical phase:

The radiographic stent was converted into a surgical one by eliminating the lingual flange opposite to the canines bilaterally to increase the accessibility. The surgical stent aided in accurate implant positioning both buccolingually and mesiodistally. After administrating local anesthesia****, crestal incision was made using bard Barker blade number 15 then Full thickness mucoperiosteal flap was reflected using a sharp mucoperiosteal elevator. Any crestal bone irregularity was corrected with a bone file. The point drill was used to determine the point of entry through the surgical stent then the manufacturer drilling sequence was followed till completing the osteotomy then the implants were installed. Covering screws were then placed and interrupted sutures***** were made. Sutures were removed after 10 days and the denture was relieved opposite to the implants and relined with soft liner to avoid overloading the implants and the patient was given the regular hygiene instructions.

Prosthetic phase:

After the healing phase of the osseointegration, the covering screw was unscrewed and replaced with the healing collars for 2 weeks. The healing collars were then removed and replaced with the locator attachment for the first group and equator attachment for the second group. Both attachments were tightened using a torque wrench at 30 N/Cm **(Figure 1).**

The fitting surface of the dentures opposite to the attachment were relieved and a through and through escape hole was made to allow for the pick-up procedure using hard liner* without interference or exerting extra pressure on the peri-implant

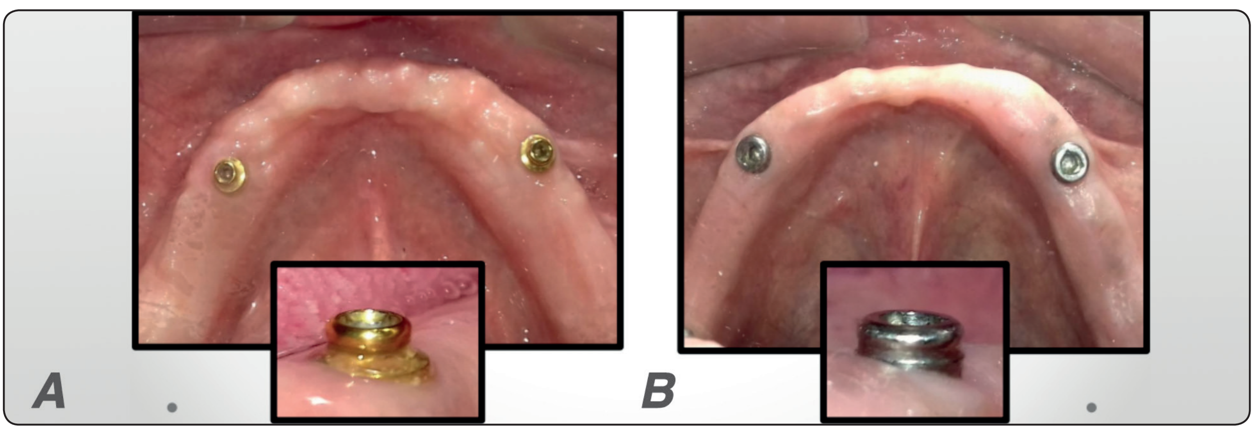

Fig. (1) A. Locator attachment and B. Equator attachment.

* DENTIS dental implant system, Korea
** IHDE Dental, Switzerland
*** OT equator screw vent, Italy.
**** Ubistesin forte, 3M ESPE AG_Germany
***** 4/0 silk black braided non-absorbable-sutures ,Assut

soft tissue. After complete polymerization of the hard liner, the denture was removed, finished and polished if needed and delivered to the patients after giving him all the necessary instructions **(Figure 2).**

Fig. (2) The denture with final nylon cap.

All patients were instructed strictly to come every 3 months for follow up and to adjust any problem that may arise.

Radiographic Assessment:

The patients were referred to the Oral and Maxillofacial Radiology Department, Faculty of Dentistry, Cairo University for radiographic assessment to measure the bone height and density changes around the implant at the day of overdenture delivery and 12 months later.

A radiographic acrylic resin stent was constructed individually for each patient to be used with the Rinn XCP periapical film holder[**] and the DIGORA™ Optime UV[***] in order to take a standardized and reproducible serial digital images for the implants using the paralleling technique.

A size 2 imaging plate was used (31 x 41 mm) for imaging of the area of interest using "Mainray"[***] dental x-ray machine with exposure parameters 70 kVp, 7 mA and exposure time of 0.08seconds.

After exposure, the DIGORA™ Optime UV laser scanner was used for scanning of the imaging plate and obtaining the digital image which was evaluated using Digora for windows2.5[***]

Measuring Alveolar Bone Height Changes:

Before linear measurements, each digital image was calibrated using object of known dimension. The calibration process was done using the length of used dental implant where two lines were drawn tangential to the top and apex of the implant and another line perpendicular to these 2 tangential lines. This perpendicular line should be equal to the length of implant.

For measuring alveolar bone height changes, a perpendicular line was drawn from the tangential line on the top of the dental implant downwards. The distance on this perpendicular line from the top of the implant to the highest point of bone- implant contact on both sides of the implant was measured **(Figure 3).**

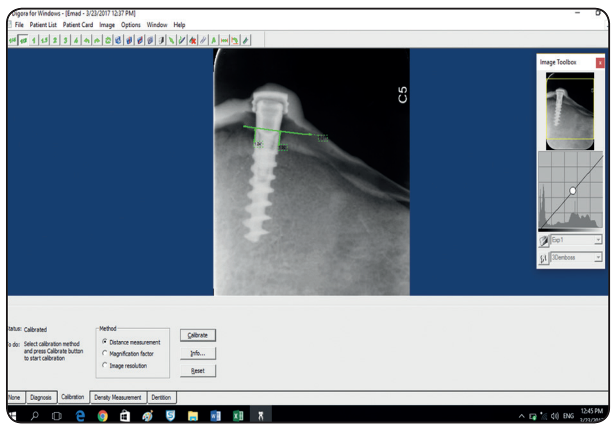

Fig. (3) Tangential line on the top of the implant and the perpendicular lines mesially and distally were drawn. The distance on this perpendicular line from the top of the implant to the highest point of bone- implant contact on both sides of dental implant was measured.

* Promedica Dental Material GmbH, Neumuenster, Germany.
** Rinn manufactures Co. Ligin, III, USA.
*** Soredex, Nahkelantie, Tuusula, Finland

Measuring Alveolar Bone Density Changes:

Three successive lines on both sides of the implant were drawn extending from the highest point of bone to the level of the implant's apex with the first line drawn tangential to the flutes of the implant, and the mean value of the three readings was calculated **(Figure 4).**

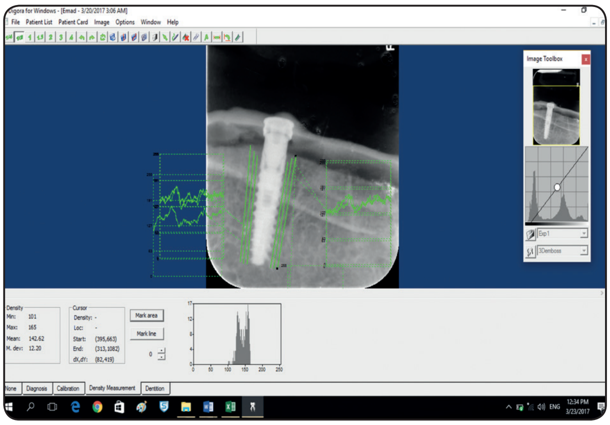

Fig. (4) Three successive lines on both sides of dental implant were drawn extending from the highest point of bone to the level of the implant's apex with the first line drawn tangential to the flutes of the implant.

RESULTS

The current randomized clinical trial started with 12 completely edentulous patients. Drop out of 2 patients occurred as one patient did not show up for the follow up while the other patient died so the study was carried actually on 10 patients. The mean and standard deviation values were calculated for each group. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests and showed parametric (normal) distribution.

Paired-samples t-test was used to compare between dependent samples while Independent sample-t test was used to compare between independent samples.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

It was found that there was no statistically significant difference regarding both bone height and density changes mesially and distally to both implants in the follow up periods. So, data was pooled for further statistical analysis.

Bone height results (Table 1 and 2) (Figure 5 and 6):

For both groups, there was no statistically significant difference in mean value of bone height change between the first follow up period (overdenture insertion) and after one year.

- **Relation between the two groups after one year:**

There was no statistically significant difference in mean values of bone height changes between {Group I} and {Group II} where (p=0.388).

The highest mean value of bone height change was found in {Group II} (1.33 ± 0.52) while the least mean value of bone height change was found in {Group I} (1.10 ± 0.49).

TABLE (1) The mean, standard deviation (SD) values of bone height change of both groups.

Variables	Bone Height Change		
	At time of insertion	After year	*P-value*
	Mean ± SD	Mean ± SD	
Group I (Equator attachment)	0.88 ± 0.46^{aA}	1.10 ± 0.49^{aA}	**0.05ns**
Group II (Locator attachment)	0.93 ± 0.58^{aA}	1.33 ± 0.52^{aA}	**0.05ns**
P-value	**0.851ns**	**0.388ns**	

Means with different small letters in the same column indicate statistically significance difference, means with different capital letters in the same row indicate statistically significance difference. *; significant (p<0.05) ns; non-significant (p>0.05)

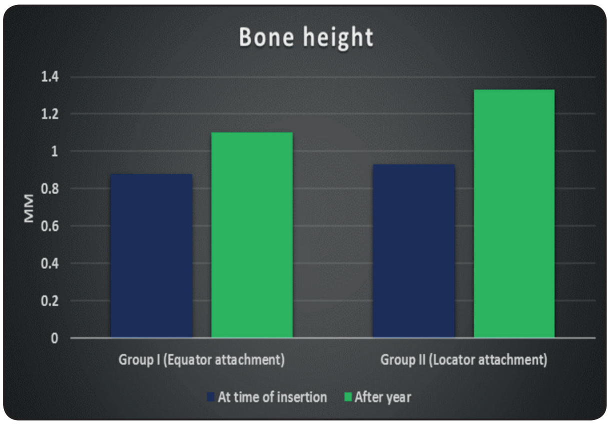

Fig. (5) Bar chart representing means of bone height change in both groups

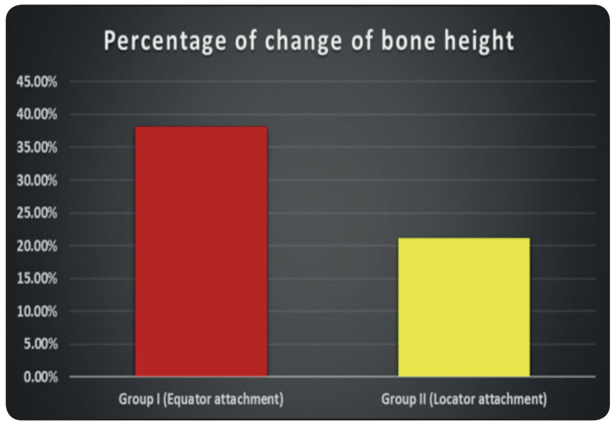

Fig. (6) Bar chart representing means of percentage of change in bone height of both groups

- **For Percentage of change:**

There was no statistically significant difference in mean value of percentage of change in bone height between {Group I} and {Group II} where (p=0.404).

The highest mean value of percentage of change was found in {Group I} (38.19%) while the least mean value of percentage of change was found in {Group II} (21.07%).

TABLE (2) The mean, standard deviation (SD) values of percentage of change of bone height in both groups.

Variables	Percentage of change of bone height
Group I (Equator attachment)	38.19 % [a]
Group II (Locator attachment)	21.07 % [a]
P-value	**0.404ns**

Different letters in the same column indicate statistically significance difference *; significant (p<0.05) ns; non-significant (p>0.05)

II) Bone density results (Table 3 and 4) (Figure 7 and 8)

There was no statistically significant difference in mean value of bone density changes between the first follow up period (at time of overdenture insertion) and after one year in the equator attachment group where (p=0.363)

On the contrary for the locator attachment there was a statistically significant difference in mean value of bone density changes between the first follow up period (at time of overdenture insertion} and after one year where (p=0.021).

- **Relation between the two groups after year:**

There was a statistically significant difference in mean of bone density between {Group I} and {Group II} where (p=0.039).

The highest mean value of bone density was found in {Group II} (136.13 ± 15.18) while the least mean value of bone density was found in {Group I} (119.79 ± 13.43).

- **For Percentage of change:**

There was no statistically significant difference in mean value of percentage of change in bone density between {Group I} and {Group II} where (p=0.989).

The highest mean value of percentage of change was found in {Group I} (17.71%) while the least mean value of percentage of change was found in {Group II} (17.49%).

TABLE (3) The mean, standard deviation (SD) values of bone density change of both groups.

Variables	Bone Density Change		
	At time of insertion	After year	P-value
	Mean ± SD	Mean ± SD	
Group I (Equator attachment)	109.79 ± 31.21 [aA]	119.79 ± 13.43 [aA]	0.363ns
Group II (Locator attachment)	118.42 ± 22.51 [aA]	136.13 ± 15.18 [bB]	0.021*
P-value	0.536ns	0.039*	

Means with different small letters in the same column indicate statistically significance difference, means with different capital letters in the same row indicate statistically significance difference. *; significant (p<0.05) ns; non-significant (p>0.05)

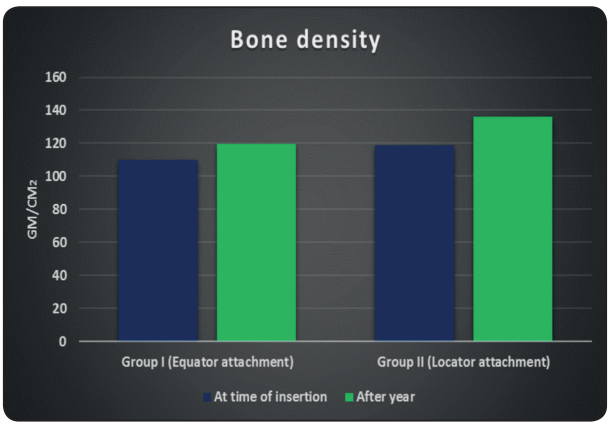

Fig. (7) Bar chart representing means of bone density change in both groups

TABLE (4) The mean, standard deviation (SD) values of percentage of change of bone density in both groups.

Variables	Percentage of change of bone density
Group I (Equator attachment)	17.71 % [a]
Group II (Locator attachment)	17.49 % [a]
P-value	0.989ns

Mean with different letters in the same column indicate statistically significance difference *; significant (p<0.05) ns; non-significant (p>0.05)

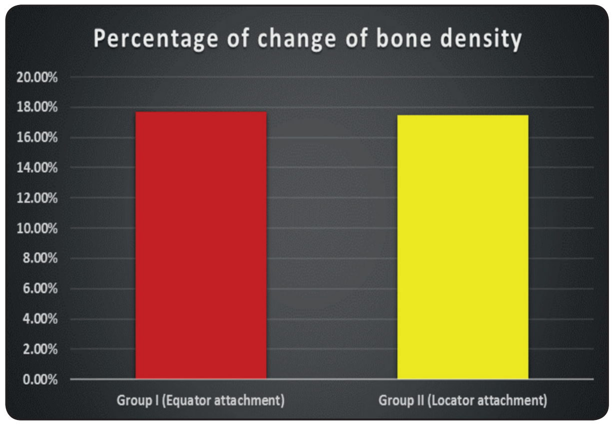

Fig. (8) Bar chart representing means of percentage of change in bone density of both groups

DISCUSSION

It is well known and agreed that bone loss around dental implants within 1.2 mm in the first year of loading is unavoidable process and considered normal and does not contradict implant success. According to the literature, this bone loss is related to many factors including amount of loading which may be related to the patient or the prosthesis itself, bone quantity and quality, implant design and dimensions as well as the opposing restoration [(18,19)].

In the current study, bone height changes was in the clinically permissible range, this may be attributed to the strict following of the biomechanical surgical and prosthetic considerations to avoid any factors that could lead to excessive bone loss. Meticulous patient selection was also another concern that was considered in this study to avoid any overloading of the implants due to any abnormal condition as bruxism or abnormal ridge relation. Also patients who had any medical problems that could have an effect on bone remodeling were excluded from the study.

Another important factor that helped in keeping the bone loss around the implants to the normal permissible range is the opposing dentition which was complete denture that allowed less load transmission on the opposing arch compared to natural dentition or fixed restorations [(15)].

Regarding bone density, it increased gradually around the loaded implants. The strength of the bone increases from the beginning of loading after surgical exposure and up to 1 year after loading. This increase may be attributed to the physiologic functional loading of the implants which transmitted physiologic stresses to the surrounding bone which enhanced bone formation and thus increased mineral content and so increased bone density.

When density is compared between the two groups the locator attachment group showed significant increase when compared to the equator attachment group after 12 months of prosthetic loading. This may be attributed to the higher retention of the attachment that was observed clinically during insertion and removal of the prosthesis as the patients of this group complained of difficulty during insertion and removal. This high retention might transmit more load to the surrounding bone which is associated with increased bone density. This observation needs another study to correlate between bone density and retention of the prosthesis.

CONCLUSIONS

Within the limitation of this study, both locator and equator attachments are viable treatment options to retain an implant supported mandibular complete overdenture regarding hard tissue response around the implants but more studies with more extended follow up is recommended that may show different results.

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