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RADIOGRAPHIC EVALUATION OF BAR/LOCATOR VERSUS BAR/BALL FOR IMPLANT ASSISTED COMPLETE MANDIBULAR OVERDENTURE (A5-YEAR RETROSPECTIVE STUDY)

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ABSTRACT

Objective: This study aimed to radiographic evaluation of two different bar attachments (bar/locator and bar/ball) for mandibular overdenture supported by 2 implants after 5-year period. **Subjects and Methods:** For this study, ten completely edentulous participants were selected. Each participant received two dental implants at mandibular canine regions. They were divided into two equal groups: Group I: Each patient received overdentures with bar/locator attachment. Group II: Each patient received overdentures with bar/ball attachment. The vertical marginal bone loss was evaluated using digital peri-apical radiographs over 5-year period. **Results:** There was a statistically insignificant difference between group I and group II in vertical marginal bone loss after 1 year. However, after five years follow up there was a statistically significant difference between both groups as marginal bone loss was found to be more in group I than that in group II. **Conclusion:** Bar/ball attachment offers better results in vertical marginal bone loss than bar/locator attachment. Bar locator preferred to be used with four-implants overdenture instead of two-implants to decrease bone loss around implants. It is mandatory to perform monitoring follow-up to avoid any harmful effect on implant and/or residual ridge, maintaining the prosthesis/attachment/ tissue relation to assure proper functional load distribution to avoid further bone resorption.

KEYWORDS: Implant overdenture, Bar/Locator, Bar/ball, Resorption.

INTRODUCTION

The treatment of choice for completely edentulous patients for a long time is complete removable dentures (maxillary and mandibular dentures). However, patients usually have complaints or problems which associated with of mandibular denture these problems such as lack of stability and retention. One of the most favor therapeutic approaches directed at improving oral function in elderly is the use of dental implant-assisted mandibular overdenture [(1)].

Due to these problems Implant-supported overdentures has been used as an alternative treatment option for completely edentulous patients especially in mandibular arch as implant-supported mandibular overdentures significantly enhance stability and retention compared to conventional mandibular denture [(2)].

The initial protocols favored the usage of splinted implants with bar attachment on four implants. However, some circumstances contraindicate usage

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of a sufficient number of dental implants for definite rehabilitation, including the following severe bone resorption, unfavorable maxillary mandibular relations, anatomical limitations, low bone quantity and quality in receptor site and economic factors[2]. Therefore two-implant mandibular overdenture is considered as standard of care for edentulous mandible [3].

Removable prosthesis supported by dental implants (overdentures) have many advantages when compared with fixed prostheses as it utilizes fewer implants, better cosmetic outcome, easy for care and cleaning, can be removed easily at night to reduce harmful risk of nocturnal parafunctional overload, low cost, easily repaired and can be used as a provisional or temporary prosthesis until the permanent fixed prosthesis is fabricated [4].

Mandibular overdenture prostheses can be attached to wide variety of attachments, such as bars, locators, ball and socket, magnets, and telescopic crowns. Selection of this attachment depends on many factors as anatomic ridge situation, retention level desired, oral hygiene, and economic considerations [3].

Bar attachments has advantages as it contribute to share load descended between implants. Also, locator attachments improve stabilization of prosthesis, as they have dual retention which originate from internal and external frictional flanges, that provide limited lateral prosthesis movement [5].

Moreover, overdentures with locator attachment system offer good retention, but it necessitates frequent maintenance and follow up care visits to overcome any complications observed with use of these overdenture rehabilitations [6].

The longevity and success of implant overdenture is highly dependent on integration between components of dental implant and oral soft-hard tissues. Generally, initial breakdown of interface between implant and tissue begins at the crestal region in successfully Osseo integrated endosteal implants. After the first year of function, crestal bone loss up to or beyond the first thread of titanium screw implants, characterized by "saucerization," is often noted radiographically around dental implants[7].

Bone is a dynamic tissue capable of adaptation to withstand compression or tensional forces descending upon it. Bone resorption varies from patient to patient, but in mandibular arch more significant changes are evident and observed [8].

Crestal bone loss around implant neck is still one of the most prevalent issues after implant insertion and it has an impact on the implant's long-term effectiveness and crestal bone loss, that is essential for the long-term life success of implants [9].

Therefore, the present retrospective study aimed to radiographic comparison of different attachments (bar/locator versus bar/ball) for implant assisted complete mandibular overdenture on implant marginal bone changes. The null hypothesis was that no difference will be present in peri-implant bone changes among the overdentures having either bar/ locator or bar/ ball attachments.

SUBJECTS AND METHODS

Patient selection

Ten edentate's patients were selected for recall in prosthetic department, Faculty of Dentistry, Mansoura University, Egypt on bases of availability of standardized documentation, commitment to follow up schedule, oral hygiene assessment and least 5 years' time labs since the prosthesis delivery. This study has been approved by Ethics Committee, Faculty of Dentistry, Mansoura University. All the selected participants have been notified about the treatment plan and procedures in details, in addition to the required follow-up recalls, following this, they all signed written consents.

The patients were selected based on the following criteria:

- Edentulous maxilla and mandible with moderate bone quality and quantity with healthy firm mucosa.
- Problems with retention and stability of the mandibular denture
- Mandibular bone height more than 15 mm (measured at the mandibular symphysis on CBCT) [10]
- No history of former periprosthetic surgery or traumatic injury to the mandible.
- No contraindications for surgical procedure. Such as uncontrolled diabetes, osteoporosis or hemophilia, history of chronic TMJ disorders or impaired neuromuscular control, head and neck radiation, Para functional habits like bruxism, heavy smoking, and alcoholism.

Baseline characteristics of the two groups are listed in (Table 1).

Pre-surgical procedures:

Construction of complete dentures: Mandibular and maxillary preliminary impressions were made by using irreversible hydrocolloid impression materials (Cavex, Holland, normal set). Final impressions were made from zinc oxide impression material (Cavex Outline ZOE). Then impressions were boxed and poured in dental stone to gain master casts on which record blocks were constructed, after adjusting maxillary occlusion rim its transferred to semi adjustable articulator (Dentatus) by means of maxillary face bow (Dentatus), mandibular occlusal rim was then mounted using wax intermaxillary record, then setting of acrylic artificial teeth (Viva dent) with lingualized occlusal scheme, try in was made then flasking, packing with heat cured acrylic resin and denture was delivered to patient.

All patients were subjected to CBCT, and two implants were planned in the canine regions according to available bone width and length, position of fixation screws then construction of surgical guide was done.

Implant placement surgery:

- After local anesthesia patients were asked to bite on surgical guide using maxillary denture and fixation pins were placed in their positions, drilling bone with the first drill was done then guide was removed to assure drilling sites then placed again and successive drilling were done according to instructions supplied with surgical guide, surgical guide removed, and implants (Laserlok tapered internal self -tapping dental implant, Biohorizons, USA) were fastened with torque 45 nm [12].
- Cover screws were then attached to the implants and wound closure was performed. Corresponding to the implant, the mandibular denture was relieved and relined by applying a tissue conditioning material (Viscogel, Dentsply).
- After three months of Osseo-integration period, dental implants were exposed, and healing abutments were placed for two weeks until the gingival tissue properly healed. Then open tray functional impression was made for all patients using two long transfer copings, and implant analogues were attached to the transfer coping before impression pouring.

Patients grouping

All participants were randomly classified into two equal groups:

Group I: each participants received mandibular overdentures with bar/ locator attachment.

Group II: each participants received mandibular overdentures with bar/ ball attachment.

- **Group I**: each participants received mandibular overdentures with bar/ locator attachment (Figure 1).

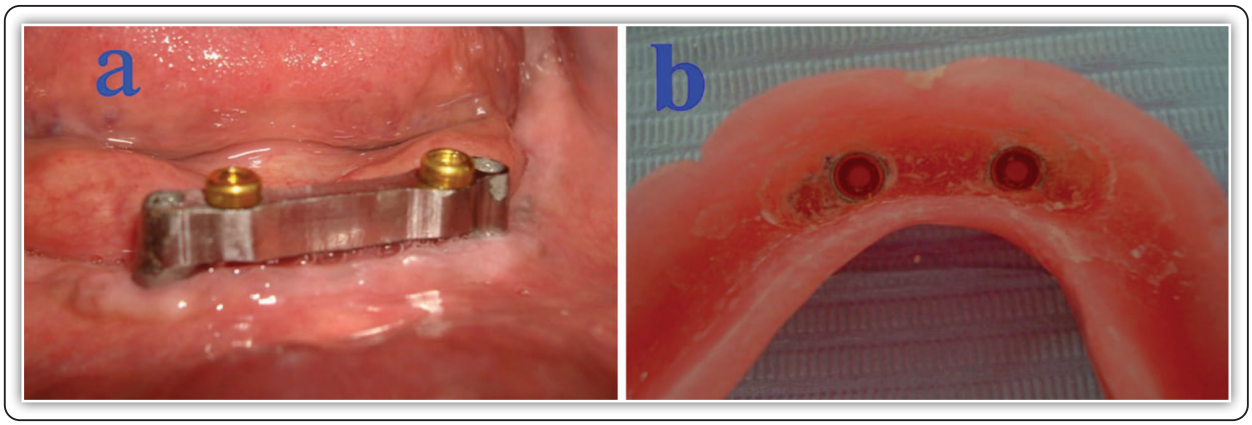

FIG (1) (a) Bar/locator intra-oral. (b) Pick up of locator attachment in intaglio surface of mandibular denture.

A custom-made milled bar was constructed with parallel walls and two threaded locator female portions were attached by drill and tap technique using 1.7 mm diameter drill mounted to milling machine and make 2 holes in the top surface of waxed bar 2.5 mm depth then investing and casting, then 2.0mm diameter tap was used to make internal threads and locator female portion was attached using special rider [13].

- **Group II**: each participants received mandibular overdentures with bar/ ball attachment (Figure 2).

A custom-made milled bar was constructed with parallel walls and two plastic ball attachments were connected to plastic bar using ball holder special design of milling machine as the ball attachments were placed parallel to each other evenly at the same vertical level then investing and casting of the bar assembly was done in CR-CO alloy.

Bars in both groups (I & II) were tried-in and new mandibular overdentures were fabricated. For group I pick up of locator male portion, metal ring was done, then pink male portion (medium retention) was used. For Group II pick up of metal cap with female housing was inserted onto ball attachment over the bar.

Calculating peri-implant marginal bone height changes:

To evaluate vertical marginal bone loss for each patient, long cone paralleling technique with customized film holder was fabricated to ensure standardized radiographic analysis and prevent any magnification errors. Vertical bone loss in (mm) was measured from the distance between implant shoulder to first crestal bone-implant contact.

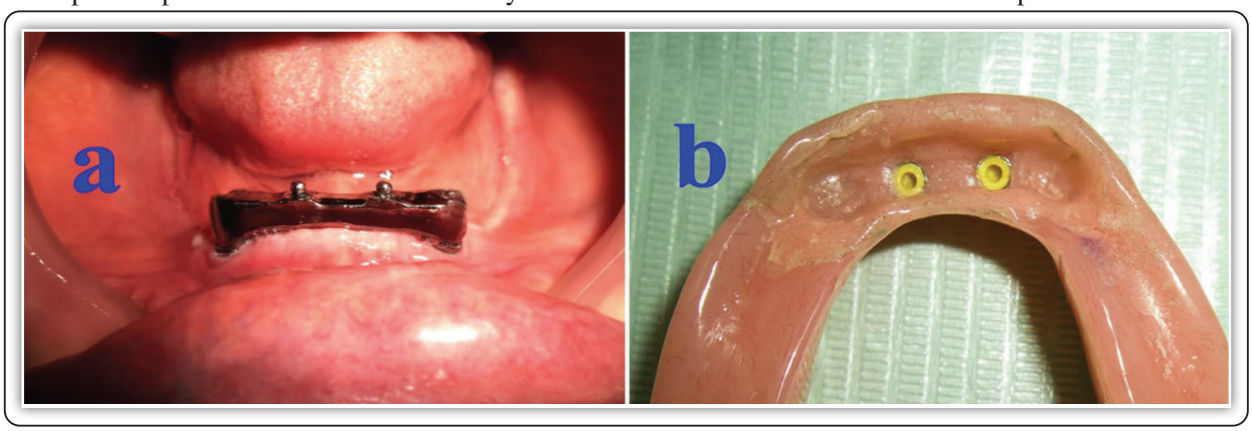

FIG (2) (a) Bar/ball intra-oral. (b) Pick up of ball attachment in intaglio surface of mandibular denture.

RINN technique was performed using XCP instruments for extension cone paralleling techniques. These instruments consist of a bite block, directing rod and a guide ring. A disposable plastic sleeve was fitted over sensor and part of cable this allowed infection control and prevent cross infection. The sensor was inserted into a slot in the bite block, to ensure accurate re-positioning of the film every time when radiograph was performed. For localizing film holder, a putty rubber base bite was constructed for each patient when he/she closed his mouth on the bite block. So, the block could be removed and repositioned exactly in the same position in the patient's mouth every time of evaluation. The radiographic tube was positioned flushing with the ring and the exposure was taken. Time and dose of exposure were standardized in all patients. After the exposure, the image was displayed on the computer screen and stored on patient card. This can be repeated for each evaluation time. [14]

Radiographs were examined by one calibrated examiner. The linear distance between the proximal crestal bone level and the implant shoulder was measured at the mesial and distal aspects of the implant (Figure 3).

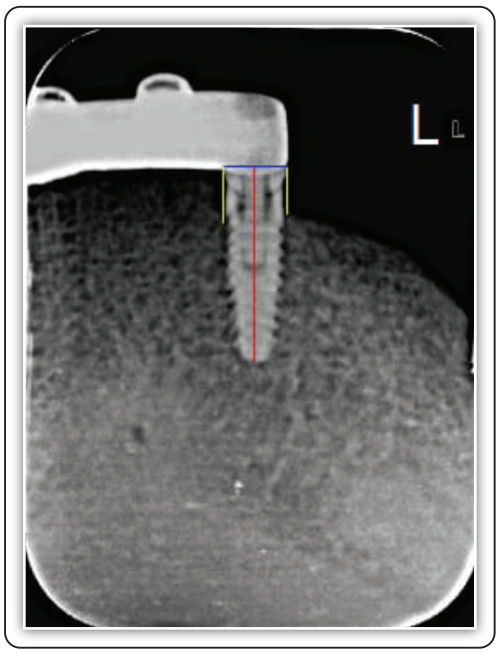

FIG (3) Radiographic reference lines for determining peri-implant vertical bone loss after 5-year of mandibular overdenture insertion.

Measurements were performed using image measurement software (CorelDraw® version 10TM, Kodak Digital Science). [15]

Radiographic evaluation of peri-implant marginal bone loss was performed immediately (T0), after 1-year (T1) and 5-year (T5) from mandibular overdenture insertion.

Statistical analysis:

Analysis of data was carried out using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 21). Shapiro test was used to test of the normality of data.

Continuous variables were presented as mean ± SD (standard deviation) for normally distributed data. The two groups were compared with independent t- test. the threshold of significance is fixed at 5% level.The results were considered significant when $p \leq 0.05$.The smaller the p-value obtained, the more significant are the results.

RESULTS

A total number of twenty dental implants with uniform (length 13 mm with diameter 3.6 mm) were inserted in ten participants.

Radiographic evaluation was performed between two current study groups for at different evaluation periods as follow: T0: immediately after mandibular overdenture insertion. T1: 1-year from mandibular overdenture insertion. T5: 5- year after mandibular overdenture insertion. (Table 2)

For marginal bone loss in (mm) at T0: there was a statistically insignificant difference between group two groups of current study (I & II), in group I, mean was 0.85 mm and S.D 0.51, in group II, the mean was 0.63 mm and S.D 0.17, the t value =0.84 and P value= 0.432. At T1: there was statistically insignificant difference between group I&II, in group I, mean was 1.76 mm and SD 0.13, in group II, mean was 1.60 mm and SD 0.14, the t value =1.85 and P value= 0.114. At T5: there was revealed

statistically significant difference between two study groups I&II, in group I, the mean was 3.13 mm and SD 0.28, in group II the mean was 2.58 mm and SD 0.13, the t value =3.63 and P value= 0.011*. (Table 2)

Annual bone loss excludes first year (4 years from T1 to T5): there was statistically significant difference between group I&II, in group I, the mean was 0.338 mm and SD 0.43, in group II the mean was 0.244 mm and SD 0.052, the t value = 2.78 and P value= 0.032*. (Table 3) and comparison of bone loss after 1 year and after 5 years after mandibular overdenture insertion. (Figure 4)

TABLE (1) Participant characteristics at base line:

Characteristic	Group I Mean ± SD	Group II Mean ± SD
Age (Y)	63.7±4.03	68.5±2.38
Male / female (n)	4/1	3/2
Bone height in mandibular canine regions in (mm)	21.9±3.15	22.3±2.22
Time elapsed from last tooth extraction in mandible (y)	6.8±4.99	7.2±3.30
Previous mandibular dentures (n)	1.8±0.96	2.5±0.58

TABLE (2) Show radiographic comparison between group I and group II at different evaluation times after overdentures insertion.

Time	T0		T1		T 5	
Groups	**Group I**	**Group II**	**Group I**	**Group II**	**Group I**	**Group II**
Mean	0.85	0.63	1.76	1.60	3.13	2.58
SD	0.51	0.17	0.13	0.14	0.28	0.13
T Test	0.84		1.85		3.63	
P Value	0. 432		0.114		0.011*	

*X: mean, SD: standard deviation, *Indicates significant difference at 5% level.*

TABLE (3) Annual bone loss exclude first year (4 years from T1 to T5)

Time / Groups	T1	T5	Annual bone loss = (T5-T1)/4	T Test	P value
	Mean ±SD	Mean ± SD			
Group *I*	1.76±0.13	3.13±0.28	0.338±0.043	**2.78**	**0.032***
Group II	1.60±0.14	2.56±0.13	0.244±0.052		

*X: mean, SD: standard deviation, *Indicates significant difference at 5% level.*

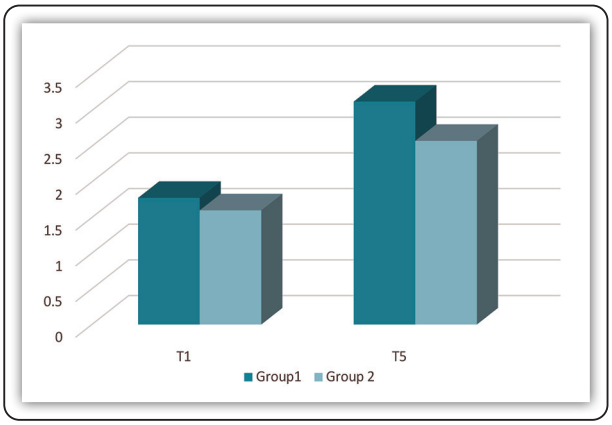

FIG (4) Comparison of Mean peri-implant bone resorption for both groups after one and five years.

DISCUSSION

Respecting radiographic assessment of bar locator versus bar ball, digital periapical radiographs were used for measuring peri-implant bone level changes, periapical radiographs, and Cone Beam Computerized Tomography CBCTs were reported to be acceptable methods [16].

In this current study, Standardized intra-oral periapical radiographs were used instead of panoramic imaging one because of its accuracy of long cone paralleling technique when evaluating peri-implant bone loss in addition to minimal radiation dose when compared with CBCTs [17].

Proximal crestal bone loss was measured with the long cone paralleling technique, which has been used in much previous research with minor modifications. To count any magnification that might have been produced and made measurement easier by radiographic grid [18].

Marginal bone loss revealed that: there was a statistically insignificant difference between group I & II after 1-year of overdenture insertion that can be explained due to normal pattern of bone loss after implant loading, these results agree with Turkyilmaz et al; [19] who declared that, observed mean implant marginal loss (1.16±0.89 mm) after 1-year of implant loading with bar retained overdenture.

Early crestal marginal bone resorption around dental implants (from implant placement to 1-year post loading) can be occurred because of many etiologies including occlusal overload, surgical trauma, micro-gaps, peri-implantitis, reformation of biologic width and implant crest module [20].

The results of crestal marginal bone resorption in current study revealed that; there was a statistically significant difference between group I and group II after 5-year of implant loading with mandibular overdenture and increase bone resorption in favor of bar/locator group I compared to bar/ball group II. That may be due to, bar/ball attachment allows some posterior play of denture base, and this result less marginal bone resorption. This in line with Hegazy et al; [21] who stated that; the bar/locator allows higher retention than bar ball attachment. Also, Hegazy et al; [22] stated that, bar/locator increasing bone resorption compared to bar ball attachment after 18 months of overdenture insertion.

These results that revealed bar/locator allow greater bone resorption this in agreement with Celik and Uludag [23] who noted that; greater peri-implant stresses with locator when compared to ball attachment.

This finding attributed to higher retention forces obtained by locator in bar locator group compared to all other attachments due to patented dual retention innovation through both external and internal mating surfaces, also, a self-aligning property that is important and helpful in guiding patients when placing their denture. [13] applying excessive pressure increases bone resorption, bone necrosis and finally non-vital bone formation occur during the healing stage [24]. when compared retention force of locator with ball attachment it was found that locator has a dual retention (inner and outer) while ball attachment has a single outer retention only

and this makes ball attachment transfers less stress than the Locator, this explained that higher rate of peri-implant bone resorption in favor of bar locator group than bar ball one [25].

In first year after overdenture delivery, the normal range of implant bone resorption about 1mm and 0.2 mm annually this in line with [26]. One the other hand, it claimed by [27] they reported that; the acceptable rate of vertical marginal bone resorption is < 0.2 mm annually after the first year of dental implant placement.

Varshney et al; [18] The authors postulated the criteria associated with successful dental implant therapy that include median marginal bone resorption during healing process is 0.5 mm followed by < 0.2 mm vertical bone resorption (annual rate of bone loss). That is assented to the results of this study which recorded higher vertical bone resorption after 5 years of overdenture insertion in favor of bar locator than bar ball regarding peri-implant bone resorption. The results are seemingly to be in harmony with this research as the authors inferred that 1.2 mm of marginal bone resorption associated with implant connected with bar attachment during entire 10-year follow-up periods. On the other hand, international team of implantology (ITI) implants reported 2.2 mm of peri-implant marginal bone loss after 10 years [28-29].

CONCLUSION

Within the limitations of this study, it could be concluded that marginal bone loss with bar/locator is more than with bar/ball. The bar/locator is not preferred to be use with two-implants overdenture.

RECOMMENDATION

More long-term studies are thus required to validate that the bar/locator preferred to be use with 4 implants overdenture instead of 2 implants to decrease peri-implant marginal bone resorption.

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