EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org

Vol. 70, 3533:3547, October, 2024

Print ISSN 0070-9484 • Online ISSN 2090-2360

Fixed Prosthodontics and Dental Materials

Submit Date : 12-07-2024 • Accept Date : 05-08-2024 • Available online: 05-10-2024 • DOI : 10.21608/edj.2024.302790.3109

ASSESSMENT OF BALL VERSUS LOCATOR ATTACHMENT FOR IMMEDIATELY LOADED TWO TRABECULAR IMPLANTS SUPPORTED MANDIBULAR OVER DENTURE- ONE YEAR RANDOMIZED CLINICAL TRIAL

Mona Galal Abo El- Ezz* *and* Lamiaa Farouk Zaki Mohamed**

ABSTRACT

Aim: This in vivo study was performed to evaluate Ball versus locator attachment for immediately loaded two Trabecular Implants supported mandibular over denture.

Material and methods: From the outpatient clinic of the Ain-Shams University Faculty of Dentistry, eighteen patients with a completely edentulous mandible were selected. The patients initially received treatment with a full denture, and subsequently, two Trabecular implants were placed in the mandible at the canine region using a surgical guide. On the day of implant insertion, eighteen implants supported by an overdenture were loaded immediately based on the patient's measurements. Patients were splitted into two equal groups at random: Group A: (the control group): Using a ball attachment, two Trabecular metal implants were loaded in the canine region on the day of implant implantation. Group B: Using a locator attachment, two Trabecular Metal implants were loaded in the canine region on the same day of implant placement. This was the test group. The changes in bone height around the implants in both the vertical and horizontal planes were assessed radiographically , CBCT scanning was used to do the radiographic examination. At the time of overdenture implantation (T0), six months (T1), and twelve months (T2) after insertion, the health of the peri-implant tissue was assessed for clinical assessment at T0,T1 and T2 the modified Plaque and Bleeding Indices were utilized to evaluate the Plaque Index (PI) and Bleeding scores (BI). Pocket depth (PD) was determined by measuring the distance between the tip of the plastic periodontal probe and the marginal boundary of the peri-implant mucosa. Resonant frequency analysis was used to evaluate implant stability. Using the Osstell device instrument, the resonance frequencies were determined.

Results: There was no significant difference in the vertical bone loss between attachments at T6. In contrast to Locator attachments, ball attachments at T12 showed a significant higher vertical bone loss. There was a significant variation in the horizontal bone loss for both attachments

* Lecturer of Prosthodontics, Faculty of Dentistry, Modern University of Technology and Information
** Lecturer of Prosthodontics, Faculty of Dentistry, Ain Shams University

between time intervals. For both attachments, horizontal bone loss significantly increased from T6 to T12. Across all time intervals, Ball attachments showed a significant greater horizontal bone loss than Locator attachments. There was no significant difference in the plaque index between the T0 and T12 groups. But at T6, the ball attachment plaque index was substantially greater than the Locator attachments. The bleeding index did not significantly differ across the groups for T0, but the bleeding index for ball attachment at T12 was substantially higher than the bleeding index for Locator attachments. There was no significant difference in implant stability at T0. Locator attachments demonstrated significant higher implant stability at T6 and T12 compared to ball attachments.

Conclusion: Within the limitations of this in vivo study ,locator attachment used to retain two trabecular metal dental implant supported immediately loaded mandibular overdenture was associated with reduced vertical and horizontal bone loss around the implant and also reduced peri -implant tissue inflammation and higher implant stability than ball attachment, trabecular metal dental implants (Tantalum) show less decrease in crestal bone height and enhanced implant stability in comparison to other implant types.

KEYWORDS: Trabecular implant , over dentures , attachments

INTRODUCTION

Many studies have shown the clinical advantages of overdentures retained with two implants in terms of patient satisfaction, stability, and retention. [1] These prostheses accommodate phonetic and esthetic variables. [2] The McGill Consensus Statement on Over Dentures states that the two-implant over denture should be the minimal standard of care for treating the edentulous mandible. [3]

These prostheses are substantially less expensive to construct and easier to clean.[4] The over dentures can be secured to the implants using splinted attachments like bars or unsplinted attachments like locators, ball anchors, double crowns, and magnets.[5]

Unsplinted anchorage attachments have been suggested with implant-retained over dentures because of their ease of cleaning, reduced sensitivity to techniques, easier space requirements within prostheses, and more cost-effective incentives. The amount of tongue space available for bar constructions can also be reduced by using these attachments with a pointed jaw. [6]

Ball-socket connectors have gained a lot of popularity as a simple and cost-effective means of maintaining implant overdentures in place, especially for people with narrow jaw anatomy. Over the last ten years, locator attachments have become more and more common. These attachments are robust,[7] self-aligning, available in a variety of colors, and have dual retention. When there is insufficient inter arch space for denture insertion of ball attachments, a number of problems may occur. Over contoured prostheses, broken teeth adjacent to the attachments, an excessive occlusal vertical dimension, denture base fracture , attachment separation from the denture, and general patient dis satisfaction are some examples of these problems. In some situations, [8] locater attachments can be a useful option in place of ball attachments due of their low profile.

The current implant surface treatment appears to promote osteoblastic activity at the implant surface and hence enhance implant-bone contact, resulting in lower peri-implant bone loss, even if it does not considerably increase the surface area or bone ingrowth inside the implant. Much of the original Osseo-integration theory by Branmarke is still valid in spite of this. The development of PTTM (Porous Trabecular Tantalum Metal) technology aimed to create a three-dimensional scaffold to support bone ingrowth surrounding dental implants. The center area of the end-osseous titanium multi-threaded self-tapping dental implant was coated with the PTTM substance. Greater mechanical properties, a porous structure that resembles real bone, and exceptional biocompatibility set PTTM-enhanced titanium dental implants apart from the competition.In theory, these advantages surpass those of other implant designs, particularly improved osseointegration or osseoincorporation. [9]

Titanium dental implants are extensively used, nevertheless, case studies have indicated that modern dental implant surface treatment may advance. For example, patients with diabetes, [10,11] osteoporosis, irradiated bone, [12,13] or extensive tobacco use may benefit from this type of advanced implant surface treatment if they have poor tissue recovery.

PTTM has shown satisfactory healing of grafted tissues when there is a lack of either in freshly transplanted bone or in the residual bone structure that needs concurrent bone augmentation. The increased surface area and improved functioning of the PTTM collar may result in faster and more durable Osseo-integration in subjects with Type 3 or Type 4 bone or those with systemic problems that limit wound healing

When implants are immediately loaded with overdentures, the biomechanical effects of the implant's design and attachment method on the surrounding bone become increasingly significant.

A shorter healing period may be required in the majority of dental implant situations.. It is well known that porous materials for PTTM implants, which resemble trabecular bone in both structure and rigidity, work incredibly well to bond prosthetic implants to the skeletal system.

Immediate occlusal loading of implants has several advantages it provides to dentists. These benefits include lowering the need for a removable provisional prosthesis, providing psychological support to patients awaiting tooth extraction, improving bone healing [14, 15], making it easier to shape soft tissues, and eliminating the risk of premature implant exposure a problem that is often associated with wearing a removable denture during the healing process [16].

A decrease of crestal bone height surrounding the implants in all aspects (buccal, lingual, mesial and distal) was found throughout all time intervals during follow up periods in pervious clinical researches, this bone reduction might be due to surgical trauma, bone osteotomy and healing process. Also it might be considered an immediate bone reaction after insertion of the prosthesis which attributed to the healing and reorganization following trauma to the bone and periosteum combined with remodeling due to functional stresses following prosthesis connection .Crestal bone loss could also be explained by the finding that forces applied on implants are distributed on the crestal bone rather than along the entire implant/bone interface.

The selection of cone beam computered tomography (CBCT) for measurement of the peri-implant bone height loss, during the follow-up period, was due to the fact that it is a precise and fast method which can be used to assess with high resolution digital images representing the trabecular structure in detail, allowing a three-dimensional reconstruction of the bone structure to be achieved. Moreover, it has a significantly reduced radiation exposure to the patient, is devoid of superimpositions and has a high resolution level with accurate linear measurements Compared to conventional or multislice CT [17] . Compared to conventional panorama or multislice CT, CBCT has a number of advantages, such as faster scanning times, and lower costs.[18, 19]

Accordingly this study aimed to investigate crestal bone height loss and clinical parameters around two trabecular dental implant supporting immediately loaded mandibular over denture in both locator and ball attachment through one year follow up period, the null hypothesis for this research that there will be no significant differences in both radiographic and clinical finding between the two attachments.

MATERIALS AND METHODS

Assessing and choosing patients

Eighteen completely edentulous patients with a maladaptive history of wearing mandibular dentures were selected from the prosthodontic department's outpatient clinic at Ain Shams University. A power analysis was performed using computer software (G* Power) to determine the appropriate sample size based on the findings of a prior study (20), in which the authors found a significant difference in vertical bone loss between two attachments used to retain mandibular 2-implant overdentures using a similar study design. - Using the independent samples t-test, the sample size calculation results in a total of 18 patients (9 samples/group).

The sample size calculation details are as follows:

1. Size of effect: 1.24 mm 2. Alpha (α) equals.050 3. Power (β) is equal to.80.

Patients who fulfilled the following criteria were allowed to participate in the study: total absence of teeth in maxillary and mandibular arch. Maxillomandibular connection in Class I systematically free Inter-arch space that is available. sufficient bone volume to receive implants (at least 10 mm long and 3.75 mm in diameter), Patients with radiographic bone density ranging from 850–1250 Hounsfield units (D2) were included in the study.

The standards for exclusion: Patients with poor dental practices or poor oral hygiene patients who are hysterical smokers or alcoholics. Individuals suffering from metabolic disorders, hematologic illness patients, Patients will receive chemotherapy or radiation treatment. Changes that could impact implant therapy include smoking, corticosteroid therapy, and diabetic mellitus. The Clinical Research Ethics Committee of the Faculty authorized the research protocol, and all participants were provided with comprehensive written information on the surgical and prosthetic procedures prior to obtaining a written consent.

Patient grouping:

The patients were received treatment with a full denture, and subsequently, two Trabecular implants were placed in the mandible at the canine region using a surgical guide. On the day of implant insertion, eighteen implants supported by an overdenture were immediately loaded based on the patient's measurements.

Patients were splitted into two equal groups at random using simple random method with random numbers created in excel sheet:

Group A: (the control group): Using a ball attachment, two Trabecular metal implants were loaded in the canine region immediately on the same day of implant implantation.

Group B: Using a locator attachment, two Trabecular Metal implants were loaded in the canine region on the same day of implant placement. This was the test group.

Clinical practices:

All patients were given new maxillary and mandibular dentures and instructed to wear them for at least two months before implant surgery in order to maximize neuromuscular adaptation to the new dentures. Both the lingalized idea of occlusion and acrylic resin teeth(Vita-pan acrylic teeth, Vita Ban Sackingen- Germany) were utilized. A metal radio-opaque marker was positioned at the anticipated implant locations on a clear acrylic duplicate of the mandibular denture, which was intended to serve as a radiography template. CBCT radiograph were employed for the preoperative assessment of implant locations in order to measure the optimum implant length and measure bone height, width, length and dentistry.

The radiological template was then converted into a surgical template by attaching metal tubes to the recommended implant placements.

Surgical techniques:

Before the procedure, the patients were instructed to maintain good oral hygiene, rinse their mouths three times a day with Antiseptol—a 0.12% chlorhexidine mouth wash—from Kahira Pharm. & Chem. Ind. Co., St. Victoria SQ. Shoubra-Cairo, Egypt, and take an oral antibiotic—Augmentin 1 gm—from GlaxoSmithKline Ltd., 980 Great West Road, Brentford, TW8 9GS, United Kingdom—two days prior to the procedure. The surgical stent was inserted intraorally and properly seated in place after inferior alveolar nerve block anesthesia was administered using 4% articaine (Ubistesin forte, 3M ESPE AG_Germany).

Two implants (Trabecular Metal Dental Implant, Zimmer, Germany) were placed in each patient's canine region of the mandible with minimal flap reflection and no vestibular extension to minimize postoperative swelling. (fig 1) For group I patients were received mandibular over denture retained to the implant by ball attachments (control group) and group II patients received mandibular over denture retained to the implant by locator attachment (test group) for both groups abutments were linked immediately following surgery and the mucoperiosteal flap was carefully modified to wrap the healing abutments using interrupted sutures. The same day, matrices for both groups were picked up using cold-cure acrylic.

For both groups the denture's fitting surface had enough relief created in it to make room for the attachments. To seal off the undercut areas during the pick-up procedures, a rubber dam sheet was cut into small squares, punctured in the middle, and then placed over the attachment's neck. Subsequently, the male attachment's component was fitted with the metal housings that contained nylon liners. (fig 2)

Direct pick-up of the attachments was done using a chairside hard relining material (GC Hard Denture Liner, GC America INC. ALSIP, IL 60803 U.S.A.). (fig 3)

The patients were told to eat a soft diet, not take out their dentures while eating for a week, and rinse their mouths three times a day for fourteen days with mouthwash containing 0.12% chlorhexidine. Two weeks later, the sutures were removed. (fig 4)

Radiographic results (primary outcomes):

The changes in bone height around the implants in both the vertical and horizontal planes were assessed radiographically. At time of implant insertion, six and twelve months following the implantation of the overdenture, CBCT scanning was used to do the radiographic examination. The i-CAT imaging system was used to do CBCT scanning.

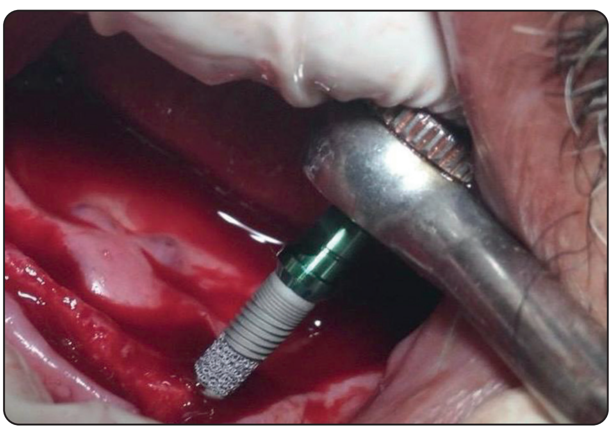

Fig. (1) Trabecular Metal Dental Implant were placed in patient's canine region

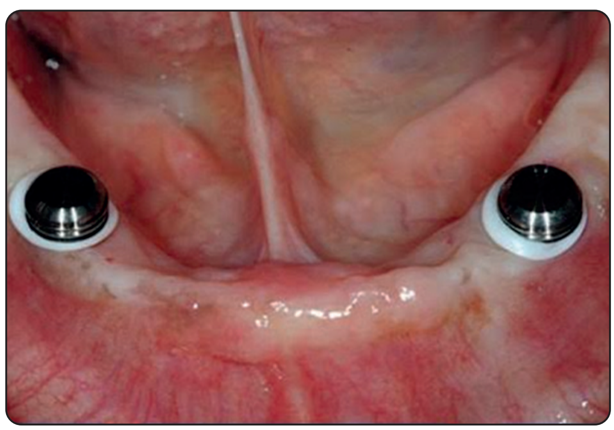

Fig (2) Rubber dam sheet was cut into small squares, punctured in the middle, and then placed over the locator attachment's neck

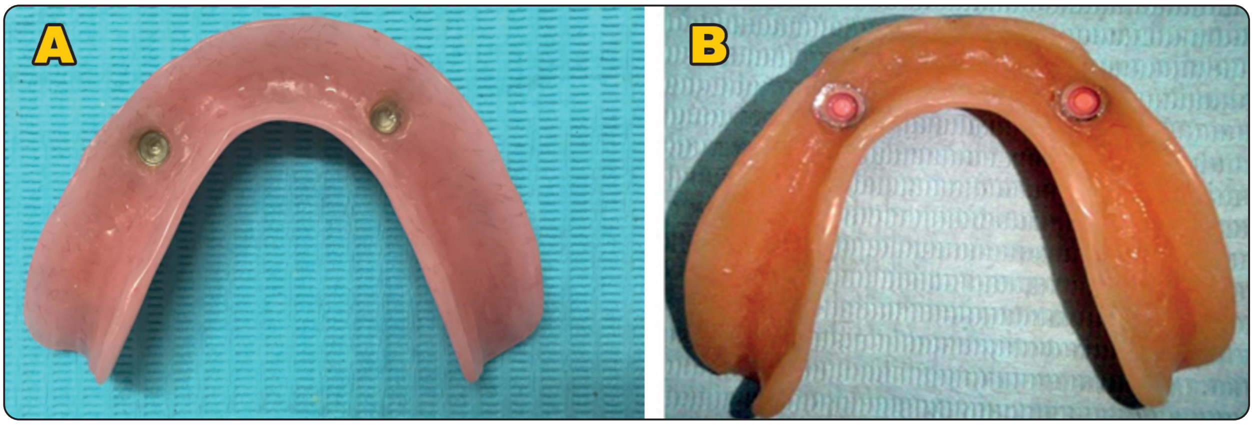

Fig (3) Matrices for ball (A) and locator (B) attachments were picked up using cold-cure acrylic.

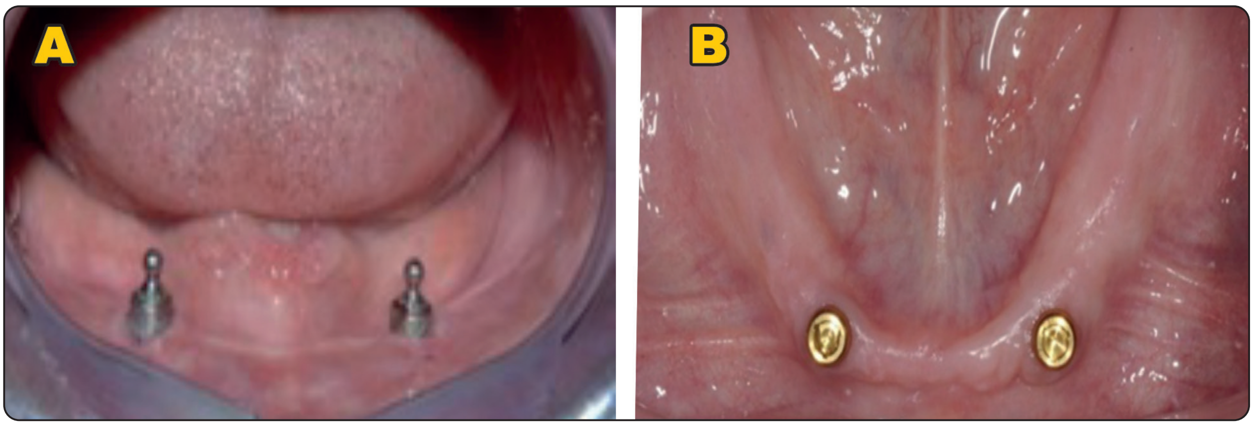

Fig. (4) Ball attachments (a) and locator attachments (b) intraoral after 2 weeks surgery

The patients were made to sit while their heads were immobilized with the use of chin cups to aid in mandibular stabilization and head bands to keep the heads steady against the head rest. Following the manufacturer's recommendations, vertical and horizontal alignment beams were used to make the mid-sagittal plane perpendicular to the horizontal plane. In the vertical plane, the height of the bone was measured between two reference positions. The implant platform was the first point. On the other hand, the first bone implant contact is the second at T0, T6 and T12 time interval by subtracting readings at T6 from reading at T0 to obtain the amount of bone loss after 6 months and T12 from T6 to obtain amount of bone loss after one year follow up period. While the labial and lingual bone height changes were assessed using cross sectional images, the bone height at the mesial and distal aspects of the implants was measured from the panoramic view. (Fig. 5)

The measurement of horizontal bone loss was done between two reference points; the surface of the implant was the first point. On the other hand, the alveolar crest's greatest level is the second. While the labial and lingual bone alterations were assessed using cross sectional images, the horizontal bone loss at the mesial and distal aspects of the implants was measured from the panoramic view.

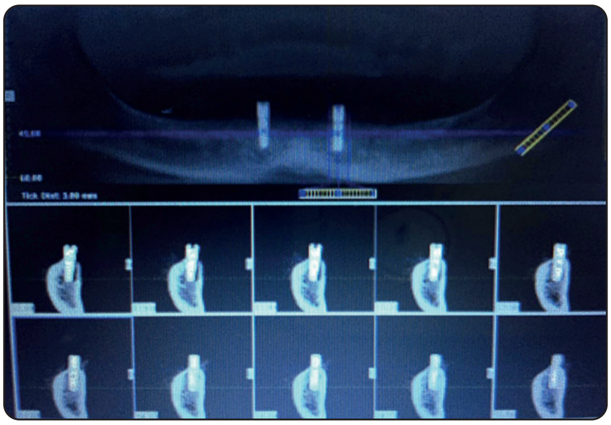

Fig. (5) CBCT used to measure the height of the bone between two reference positions.

Clinical results (secondary outcomes):

At the time of overdenture implantation (T0), six months (T1), and twelve months (T2) after insertion, the health of the peri-implant tissue was assessed. Clinical assessment. The Modified Plaque and Bleeding Indices [21] were utilized to evaluate the Plaque Index (PI) and Bleeding scores (BI). Pocket depth (PD) was determined by measuring the distance between the tip of the plastic periodontal probe (Kerr, Rastatt, Germany) and the marginal boundary of the peri-implant mucosa [22].

Resonant frequency analysis was used to evaluate implant stability. Using the Osstell device instrument, the resonance frequencies were determined, and the results were reported in terms of ISQ (implant stability quotient in kHz). Using a mounting tool, the SmartPeg was screwed into the implant fixture's internal threads. Without being physically attached to the SmartPeg, the measurement probe magnetically stimulated it. The ISQ scale starts at 1:100. The implant is more stable the higher the ISQ score. Three measurements were made, and a statistical analysis was conducted on the mean. The average of the patient's left and right implant readings was subjected to statistical analysis.

Statistical analysis

The SPSS® software version 22 (SPSS Inc.) was used to analyze the data. The Freidman test was used to compare the plaque and bleeding indices across time periods, and the Wilcoxon signed ranks test was used for multiple comparison. The Repeated Measures ANOVA test was used to compare Pocket depth and implant stability across time intervals, and the Bonferroni test was used for multiple comparison. The paired t test was used to compare the amount of vertical and horizontal bone loss over different time periods. Using the Mann Whitney test, the bleeding and plaque indices between the groups were compared. Using the independent samples t-test, groups' differences in pocket depth, implant stability, and vertical and horizontal bone loss were compared. A significance level of $p < .05$.

RESULTS

Plaque and bleeding indices

Outcomes Indexes of bleeding and plaque (Table 1) compares the bleeding and plaque indices for various attachments and time intervals. The plaque index varied significantly between time intervals for both attachments. Plaque indices showed a considerable increase over time ($p<.001$ for ball attachment and $=.002$ for Locator attachment, according to the Friedman test). Table 1 and (Fig. 6) offer many comparisons between each of the two time intervals. Between each of the two observation intervals, there was a significant difference for both attachments (Wilcoxon signed ranks test, $p<.05$. There was no significant difference in the plaque index between the T0 and T12 groups. But at T6, the ball attachment plaque index was substantially greater than the Locator attachments (Mann Whiteny test, $p=.017$).

The bleeding index varied significantly between time intervals for both attachments. According to the Friedman test, the bleeding indices rose significantly over time (p<.001 for ball attachment and =.001 for Locator attachment). Table 1 and (Fig. 7) offer many comparisons between each of the two time intervals. Between each of the two observation intervals, there was a significant difference for both attachments (Wilcoxon signed ranks test, p<.05. The bleeding index did not significantly differ across the groups for T0. But according to the Mann-Whiteny test (p=.009 at T6 and.011 at T12), the bleeding index for ball attachment at T12 was substantially higher than the bleeding index for Locator attachments.

TABLE (1) Comparison of plaque and bleeding indices between attachments and time intervals

	T0 **M (min-max)**	**T6** **M (min-max)**	**T12** **M (min-max)**	**Freidman** **P value**
		Plaque index		
Ball attachment	0.00 a (0.00-1.00)	1.00 b (1.00-2.00)	2.00 c (1.00-3.00)	<.001*
Locator attachments	1.00 a (0.00-1.00)	1.00 b (0.00-1.00)	1.00 c (1.00-2.00)	.002*
Mann Whitney (P value)	.439	.017*	.136	
		Bleeding index		
Ball attachment	.00 a (0.00-1.00)	1.00 b (1.00-2.00)	2.00 c (1.00-3.00)	<.001*
Locator attachments	.00 a (0.00-0.00)	.00 b (0.00-1.00)	1.00 c (1.00-1.00)	.001*
Mann Whitney (P value)	.146	.009*	.011*	

* ***P is significant for independent samples -t-test At 5%. T0 is the prosthesis insertion time; T6 is the prosthesis insertion after six months; and T12 is the prosthesis insertion after twelve months. Similar numbers revealed no significant change, whereas different letters in the same raw indicate a significant difference across observation periods (Wilcoxon sign ranks test, p<.05).***

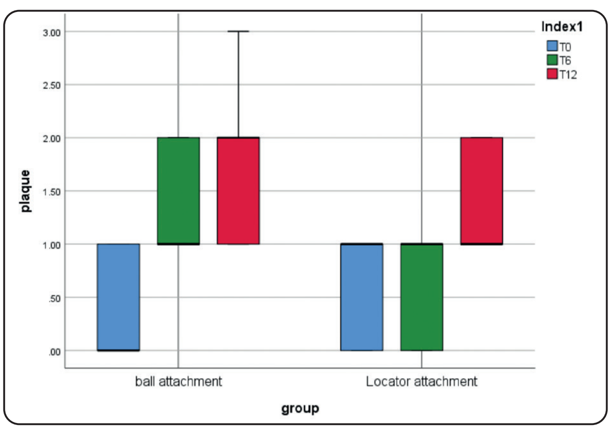

Fig. (6): A comparison of the plaque index for both groups across observation times was displayed in the Fig boxplot graphic.

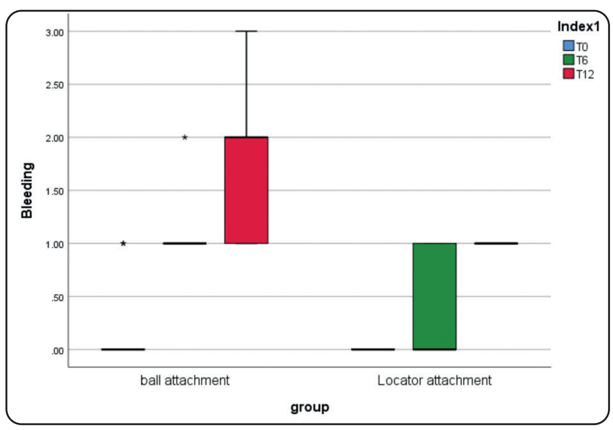

Fig. (7) : A comparison of the bleeding index between the two groups' observation times was displayed in the Fig boxplot chart.

Examining implant stability and probing depth:

Table 2 compares implant stability and probing depth across attachments and time intervals. The probing depth varied significantly between time intervals for both attachments. Over time, the probing depth rose significantly (Repeated measures ANOVA, p<.001 for both attachments).

Table 2 and (Fig. 8). offer a multiple comparison between each of the two time intervals. Between each of the two observation intervals, there was a significant difference for both attachments (Bonferroni test, p<.05. The probing depth did not significantly differ across the groups for any observation. There was a notable variation in implant stability between time intervals for ball attachment alone.

On the other hand, there was no significant difference in Locator attachment between observations. Implant stability for ball attachments dramatically declined over time (Repeated measures ANOVA, p<.001). Table 2 and (Fig. 9) offer a multiple comparison between each of the two time intervals. There was a statistically significant difference in Ball attachments between each of the two observation times (Bonferroni test, p<.05.

TABLE (2) Comparison of pocket depth and implant stability quotient between attachments and time intervals

	T0 X±SD	T6 X±SD	T12 X±SD	Repeated measures ANOVA P value
		Pocket depth		
Ball attachment	.13±.02 a	1.63±.24b	2.37±.20 c	<.001*
Locator attachments	.15±.02a	1.75±.04 b	2.45±.02c	<.001*
Independent samples -t-test (P value)	.201	.175	.403	
		Implant stability quotient		
Ball attachment	74.21±.80 a	68.72±.75 b	67.62±.87 c	<.001*
Locator attachments	74.98±.50 a	74.85±1.70 a	74.45±1.83 a	.225
Independent samples -t-test (P value)	.25	<.001*	<.001*	

****P is significant for independent samples -t-test At 5%, T0 represents the period of prosthesis insertion; T6 denotes the 6-month mark; and T12 denotes the 12-month mark. A significant difference between observation times is indicated by different letters in the same data (Paired samples t test, p<.05), whereas comparable numbers indicate no significant difference.***

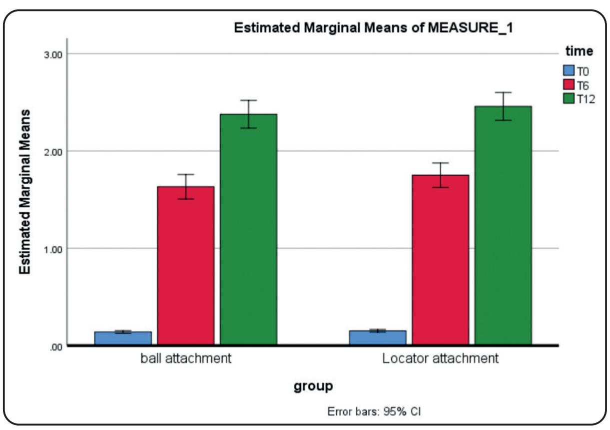

Fig (8) Bar chart showed a comparison of probing depth between observation times for both groups

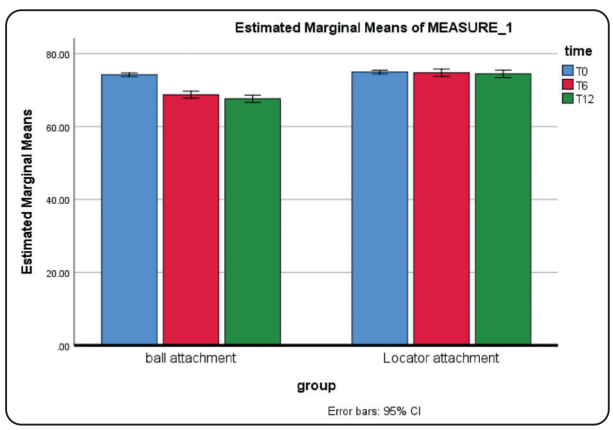

Fig (9) Bar chart showed a comparison of implant stability quotient between observation times for both groups

Between groups, there was no significant difference in implant stability at T0. Locator attachments demonstrated significant higher implant stability at T6 and T12 compared to ball attachments (independent samples t-test, p<.001).

Vertical and Horizontal bone loss

Comparison of vertical and horizontal bone loss between attachments and time intervals is presented in table 3 (Fig.10) . For both attachments, the amount of bone lost vertically varied significantly over time. For both attachments, vertical bone loss increased considerably between T6 and T12 (paired samples t-test, p<.001). There was no significant difference in the vertical bone loss between attachments at T6. In contrast to Locator attachments, ball attachments at T12 showed a significant higher vertical bone loss (independent samples, p=.004). There was a significant variation in the horizontal bone loss for both attachments between time intervals (Fig 11) . For both attachments, horizontal bone loss significantly increased from T6 to T12 (paired samples t-test, p<.001). Across all time intervals, Ball attachments showed a significant greater horizontal bone loss than Locator attachments (independent samples, p=.007 for T6 and.002 for T12).

TABLE (3). Comparison of vertical and horizontal bone losses between attachments and time intervals

	T0 X±SD	T6 X±SD	T12 X±SD	Paired samples t-test P value
Vertical bone loss				
Ball attachment	-	.55±.07 a	1.21±.15 a	<.001*
Locator attachments	-	.53±.06a	.97±.14 a	<.001*
Independent samples -t-test P value	-	.55	.004*	
Horizontal bone loss _				
Ball attachment	-	.56±.07 a	1.23±.15 a	<.001*
Locator attachments	-	.46±.05 a	1.00±.09 a	<.001*
Independent samples -t-test P value	-	.007*	.002*	

P is significant at 5%. T0 represents the period of prosthesis insertion; T6 denotes the 6-month mark; and T12 denotes the 12-month mark. A significant difference between observation times is indicated by different letters in the same data (Paired samples t test, p<.05), whereas comparable numbers indicate no significant difference.

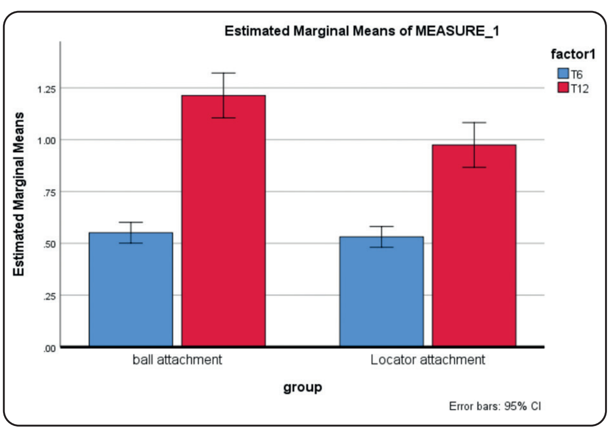

Fig (10) bar chart showed a comparison of Vertical bone loss between observation times for both groups

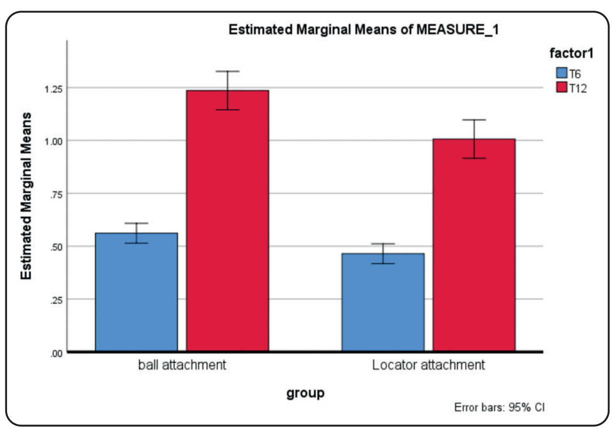

Fig (11) bar chart showed a comparison of Horizontal bone loss between observation times for both groups

DISCUSSION

In this study selection of cone beam computered tomography (CBCT) for measurement of the peri-implant bone height loss, during the follow-up period, was due to the fact that it is a precise and fast method which can be used to assess with high resolution digital images representing the trabecular structure in detail, allowing a three-dimensional reconstruction of the bone structure to be achieved. Moreover, it has a significantly reduced radiation exposure to the patient, is devoid of superimpositions and has a high resolution level with accurate linear measurements Compared to conventional panorama or multislice CT. [17]

In an attempt to reduce the amount of time, money, and surgeries required for treatment, immediate loading was urged. [23, 24]. Many clinical investigations have documented high success rates for the immediate loading [25,26] of different implant-supported restorations. In the event that the inclusion and exclusion criteria are met, the survival rates will resemble those of early or traditional loading was the same which has been verified by the findings of multiple systematic reviews. [27, 28]

In this Research annual bone resorption following abutment connection was less than 1.5mm, Although these results are in line with some previous systematic reviews, the studies did not reveal a statistically significant difference in the rates of marginal bone loss around immediately loaded implants and delayed loading of implant . [24], which can be explained that the initial healing process of implants used for immediately loaded mandibular overdentures can be influenced by the degree of mobility of the restoration, the manner in which the abutment is linked, and early contact to oral germs.[29,30]

The absence of second-stage surgery in the immediate loading procedure and the early mechanical strain may be the reason of this. Overdentures are thought to provide mechanical stimulation that promotes osteogenesis and increases bone density. Early on the bone-implant interface, mechanical stress application has been demonstrated to favorably impact the early stages of bone regeneration.[31, 32]

A multitude of prosthetic components and attachment systems can impact the general health of the tissues surrounding dental implants. With the ball attachment, the study found a 1.21 mm vertical bone loss; with the locater attachment, the loss was 0.97 mm. The horizontal bone loss was also measured with the ball attachment at 1.23 mm and the locator attachment at 1.00 mm. According to Albrektsson et al. [33], annual resorption following abutment connection must be less than 1.5 mm. These measurements meet their success requirements. Because the masticatory stress exerted on the posterior portions of the overdenture creates an adverse torque on the abutments, it may be a factor in bone loss. Two implants operate as a fulcrum with two lever arms when supporting a mandibular overdenture; one arm extends from the fulcrum to the denture's distal extension, while the other arm extends anteriorly to the incisal edge.

In contrast to the ball attachment, the implant supporting the locator attachment had reduced marginal bone loss surrounding it. This is explained by the denture rotating around the two attachments having different matrix patrix relationships. [34] In group II, the locator attachment was utilized. The locator's supra-radicular design moved the fulcrum point closer to the fixture, which decreased torque and lever arm and permitted less crestal bone resorption. [35] A locator attachment's special design, which offers 0.2 mm of vertical resilience and 8 degrees of hinging in all directions, contributes to its advantages. The attachment can move both vertically and along the hinge axis thanks to this design. Furthermore, the locator has the ability to evenly disperse stresses throughout the long axis of the implant. [36]

The results of this study showed that, in comparison to other implant types, trabecular metal dental implants (Tantalum) show a less significant loss in crestal bone height. The greater functional surface area of contact between the implant and the bone that trabecular metal dental implants (Tantalum) give makes sense in light of this. According to the study, because it provides a larger area for osseointegration, changing the implant surface may have an effect on osseointegration success. [37]

Studies on histology have shown that bone ingrowth can occur with pores as small as 100 µm, but the development of osteons requires pores larger than 150 µm in a porous substance. For vascularized bone ingrowth to occur, pores bigger than around 300 µm are required. [38] This may account for the little decrease in detectable bone loss that was seen in individuals undergoing rehabilitation using a trabecular metal dental implant (Tantalum).

On the other hand, ball attachments cause greater bending moments, which exacerbate the peri-implant bone loss that is seen.[39] This study found that there was a significant variation in the bleeding and plaque indices throughout different time periods. In both groups, plaque scores showed a notable increase over time. Similar increases in plaque ratings were also observed in earlier research for ball and locator attachments. [40, 41]. This is because the durability of these attachments permits denture motions, food particle accumulation, and plaque accumulation. Furthermore, patients' oral hygiene habits may be impacted by a decline in consciousness brought on by age. [42]

Compared to balls, locators showed significantly lower plaque scores after a year of follow-up. Comparing overdentures supported by ball attachments versus those supported by locator attachments, numerous clinical trials have shown that overdentures supported by ball attachments had greater problems and required more frequent maintenance. This is explained by the regular necessity to activate and deactivate the matrix component to ensure appropriate retention.[43]

Moreover, the locator attachment is less likely to cause denture base fracture than other attachment systems, making it appropriate for usage in situations where there is restricted inter-arch space. The pocket depths in both groups increased significantly over time [44, 45]. The growth of soft tissues surrounding the implant and the gradual vertical bone resorption surrounding it may be the causes of this increase in pocket depths. [41, 42].

The findings of this study on pocket depth for ball and locator attachments showed no statistically significant changes. On the other hand, less peri-implant tissue alterations were seen in locator attachments. Similar results were observed by Shady et al. as well. [46]

Only for ball attachment, there was a considerable variation in the Implant Stability Quotient (ISQ) values, indicating a significant variation in implant stability over different times. The continuous remodeling of the bone that occurs following loading is the cause of the decline in ISQ values, since it results in a decrease in the anchoring between the implant and the bone. [47] Furthermore, increased micromovements and slight bone loss may arise from the study's initial loading of non-splinted implants, which could compromise the stability of the devices. [48].

After a year, the locator attachment in this investigation proved to have greater implant stability than the ball attachment. According to the study's findings, there might be a difference because of the ball attachment's higher rate of vertical bone loss than with the locator attachment.

In this study the biocompatible material tantalum has exceptional corrosion resistance, according to this research, the porous tantalum trabecular metal (PTTM) assures stable implantation and has remarkable osteointegration properties.[49]

Bone can develop inside the pores because to the improvement of osteointegration provided by a porous surface coating. Both the amount and quality of bone development are significantly influenced by the number and size of holes on the surface of the implant.(50)

Enhancement of the implant surface is made possible by the PTTM, which encourages both bone ingrowth and ongrowth. The "osseoincorporation" phenomenon, which is made possible by the structure of PTTM, allows for neovascularization and the direct production of new bone within the implant.(51, 52) Moreover, the PTTM promotes both bone ongrowth and ingrowth by improving the implant surface, which aids in osseoincorporation. Because of its special design, PTTM allows new bone to grow inside the implant and undergo neovascularization.

The limitations of this study were the small patient sample size, short follow up period, lack of measuring other clinical outcomes like patient satisfaction and occlusal bite force. And also comparing between more types of attachment which may recommend for future studies and investigations

CONCLUSION

Within the limitations of this in vivo study ,locator attachment used to retain two trabecular metal dental implant supported immediately loaded mandibular overdenture was associated with reduced vertical and horizontal bone loss around the implant and also reduced peri implant tissue inflammation and higher implant stability than ball attachment, trabecular metal dental implants (Tantalum) show less decrease in crestal bone height and enhanced implant stability in comparison to other implant types.

RECOMMENDATION

Locator attachment is recommended with PTTM implant than ball attachment for both enhanced crestal bone loss, peri implant tissue health and implant stability.

REFERENCES

1. MacEntee MI, Walton JN, Glick N: A clinical trial of patient satisfaction and prosthodontic needs with ball and bar attachments for implant-retained complete overdentures: three-year results. J Prosthet Dent 2005;93:28-37.
2. Elsyad MErrabti HMustafa, Ali Hamed EL Shoukouki, Resilient liner vs. clip attachment effect on peri-implant tissues of bar-implant- retained mandibular overdenturem, Clin. Oral Impl. Res. 21, 2010 / 473–480
3. Feine JS, Carlsson GE, Awad MA, et al: The McGill Consensus Statement on Overdentures. Montreal, Quebec, Canada. May 24–25, 2002. Int J Prosthodont 2002;15:413-414.
4. Naert I, Alsaadi G, Quirynen M: Prosthetic aspects and patient satisfaction with two-implant-retained mandibular overdentures a 10-year randomized clinical study. Int J Prosthodont :2004;17:401-410
5. Bernhart G, Koob A, Schmitter M, et al: Clinical success of implant-supported and tooth-implant supported double crown-retained dentures. Clin Oral Investig 2012;16:1031-1037.
6. Spiekermann H: Implantalogy. In Rateitschak KH, Wolf HF (eds): Color Atlas of Dental Medicine. New York, Theme Medical Publishers, 1995, pp.164.
7. Nguyen CT, Masri R, Driscoll CF, et al: The effect of denture cleansing solutions on the retention of pink Locator attachments: an in vitro study. J Prosthodont 2010; 19:226-230
8. Lee CK, Agar JR: Surgical and prosthetic planning for a two-implant- retained mandibular overdenture: a clinical report J Prosthet Dent 2006;95:102-105.
9. Langer A.: Telescope retainers for removable partial dentures. J prosthet Dent.,1981, 45:37-47.
10. Morris J.C. , Khan Z. , &Vonfraunhofer J.A.:Palatal shape and the flexural strength of maxillary denture bases. J Prosthet Dent., 1985, 53: 670-75.
11. Wennerberg A., Albrektsson T., Andersson B,& Krohl G.G.: A histomorphpmeteric and removal torque study of screw-shaped titanium implants with three different surface topographies. Clin Oral Impl Res., 1995, 6: 24-30.
12. Albrektsson T.& Wennerberg A.: Oral implant surfaces: part2 review focusing on clinical knowledge of implant surfaces. Int J Prosth., 2004 17: 544-64.

13. Abrahamsson I., Berglundh T., Linder E., &Lang N.P.: Early bone formation adjacent to rough and turned endosseous implant surfaces: An experimental study in the dog. Clin Oral Implant Res., 2004 15: 381–92.

14. Thomason JM, Feine J, Exley C, Moynihan P, Müller F, Naert I, et al.: mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients--the York Consensus Statement. Br Dent J, 2009,207:185-6.

15. Doundoulakis JH, Eckert SE, Lindquist CC, Jeffcoat MK.:The implant-supported overdenture as an alternative to the complete mandibular denture. J Am Dent Assoc, 2003,134:1455-8.

16. Locker D. Patient-based assessment of the outcomes of implant therapy: a review of the literature. Int J Prosthodont, 1998,;11:453-25.

17. Gupta S, Patil N, Solanki J, Singh R, Laller S. Oral Implant Imaging: A Review. Malays J Med Sci. 2015;22(3):7-17..

18. Razavi T, Palmer RM, Davies J, Wilson R, Palmer PJ. Accuracy of measuring the cortical bone thickness adjacent to dental implants using cone beam computed tomography. Clin Oral Implants Res 2010;21:718-25.

19. Shiratori LN, Marotti J, Yamanouchi J, Chilvarquer I, Contin I, Tortamano- Neto P. Measurement of buccal bone volume of dental implants by means of cone-beam computed tomography. Clin Oral Implants Res 2012;23:797-804.

20. Elsyad et al, The effect of implant diameter on strain around implants retaining a mandibular overdenture with Locator attachments: An in vitro study ,Dental Materials Journal 2016; 35(6): 938–945.

21. Mombelli A, van Oosten MA, Schurch E Jr, Land NP. The microbiota associated with successful or failing osseointe- grated titanium implants. Oral Microbiol Immunol. 1987;2:145–151.

22. Elsyad MA, Shoukouki AH. Resilient liner vs. clip attachment effect on peri-implant tissues of bar-implant-retained mandibular overdenture: a 1-year clinical and radiographical study. Clin Oral Implants Res. 2010;21:473–480.

23. Polizzi G, Grunder U, Goené R, Hatano N, Henry P, Jackson WJ, et al. Immediate and delayed implant placement into extraction sockets: A 5-year report. Clinical implant dentistry and related research. 2000;2(2):93–9

24. Mura P. Immediate Loading of Tapered Implants Placed in Postextraction Sockets: Retrospective Analysis of the 5- Year Clinical Outcome. Clinical implant dentistry and related research. 2012; 14(4):565–74

25. Agliardi EL, Tetè S, Romeo D, Malchiodi L, Gherlone E. Immediate function of partial fixed rehabilitation with axial and tilted implants having intrasinus insertion. J Craniofac Surg. 2014;25(3):851–5

26. Crespi R, Capparè P, Gastaldi G, Gherlone E. Immediate Occlusal Loading of Full-Arch Rehabilitations: Screw-Retained Versus Cement-Retained Prosthesis. An 8-Year Clinical Evaluation. Int J Oral Maxillofac Implants. 2014;29(6):1406–11

27. Schrott A, Riggi-Heiniger M, Maruo K, Gallucci G. Implant Loading Protocols for Partially Edentulous Patients with Extended Edentulous Sites—A Systematic Review and Meta-Analysis. Int J Oral Maxillofac Implants. 2014; 29:239–55

28. Papaspyridakos P, Chen C-J, Chuang S-K, Weber H-P. Implant Loading Protocols for Edentulous Patients with Fixed Prostheses: A Systematic Review and Meta-Analysis. Int J Oral Maxillofac Implants. 2014; 29:256–70

29. Kronstrom M, Davis B, Loney R, Gerrow J, Hollender L. A Prospective Randomized Study on the Immediate Loading of Mandibular Overdentures Supported by One or Two Implants; a 3 Year Follow-Up Report. Clin Implant Dent Relat Res. 2014;16(3):323–9.

30. Naert I, Gizani S, Van Steenberghe D. Bone behavior around sleeping and non-sleeping implants retaining a mandibular hinging overdenture. Clin Oral Implants Res. 1999;10(2):149–54

31. Vandamme K, Naert I, Geris L, Sloten J Vander, Puers R, Duyck J. Histodynamics of bone tissue formation around immediately loaded cylindrical implants in the rabbit. Clin Oral Implants Res. 2007;18(4):471–80.

32. Qi M chun, Zou S juan, Han L chi, Zhou H xiao, Hu J. Expression of bone-related genes in bone marrow MSCs after cyclic mechanical strain: implications for distraction osteogenesis. Int J Oral Sci. 2009;1(3):143–50.

33. Albrektsson T, Zarb G, Worthington DP , Worthington DP, Eriksson RA.. The long-term efficiency of currently used dental implants. A review and proposed criteria of success. Int J. Oral maxillofac. Implants1986; 1:11-25.

34. Celik G, Uludag B. Photoelastic stress analysis of various retention mechanisms on 3-implant retained mandibular overdentures. J Prosthet dent 2007; 97:229-235.

35. Jingade RK, Rudraprasad IV, Sangur R. Biomechanics of dental implants: A FEM study. J. Indian Prosthodont.Soc. 2005; 5:18-22.

36. Schnneider AL. The use of self aligning low maintenance overdenture attachment. Dent Today 2000; 19: 24-26.

37. Bencharit, S.; Byrd, W.C.; Altarawneh, S.; Hosseini, B.; Leong, A.; Reside, G.; Morelli, T.; Offenbacher, S. Development and Applications of Porous Tantalum Trabecular Metal-Enhanced Titanium Dental Implants. Clin. Implant Dent. Relat. Res., 2013, 16, 817–826.

38. Cohen R. A porous tantalum trabecular metal: basic science. Am J Orthop., 2002 Apr;31(4):216–217.

39. Meijer HJ, Starmans FJ, Steen WH, Bosman F. Locationof implants in the interforaminal region of the mandible and the consequences for the design of the superstructure. J Oral Rehabil 1994; 21:47-56.

40. Assad AS, Abd El-Dayem MA, Badawy MM. Comparison between mainly mucosa-supported and combined mucosa- implant-supported mandibular overdentures. Implant Dent. 2004;13:386–394.

41. Elsyad MA, Elsaih EA, Khairallah AS. Marginal bone resorp- tion around immediate and delayed loaded implants support- ing a locator-retained mandibular overdenture. A 1-year randomised controlled trial. J Oral Rehabil. 2014;41:608–618.

42. Elsyad MA, Al-Mahdy YF, Fouad MM. Marginal bone loss adjacent to conventional and immediate loaded two implants supporting a ball-retained mandibular overdenture: a 3-year randomized clinical trial. Clin Oral Implants Res. 2012;23:496–503.

43. Budtz-Jorgensen E. Prosthodontics for the Elderly: Diagnosis and Treatment. Chicago: Quintessence Publishing Co. Inc.; 2001.

44. Elsyad MA, Errabti HM, Mustafa AZ. Mandibular denture base deformation with Locator and ball attachments of implant-retained overdentures. J Prosthodont. 2016; 25: 656–664.

45. Liu W, Zhang X, Qing H, Wang J. Effect of LOCATOR attachments with different retentive forces on the stability of 2-implant-retained mandibular overdenture. J Prosthet Dent. 2020;124:224–229.

46. Maha M, Shady Abo, Eltorky Ibrahim R, AbdEaal Zeinb M. Comparative study of two types of attachments for mandibular implant-retained single complete overdenture. Tanta Dental Journal. 2016;13:157–161.

47. Pae A, Kim JW, Kwon KR. Immediate loading of two implants supporting a magnet attachment-retained overdenture: one-year clinical study. Implant Dent. 2010;19:428–436.

48. Ingman T, Kononen M, Konttinen YT, Siirila HS, Suomalainen K, Sorsa T. Collagenase, gelatinase and elastase activ- ities in sulcular fluid of osseointegrated implants and natural teeth. J Clin Periodontol. 1994; 21:301–307.

49. Brentel AS, Vasconcellos LMR, Oliveira MV, et al. Histomorphometric analysis of pure titanium implants with porous surface versus rough surface. J Appl Oral Sci, 2006, 14:213–218.

50. Bobyn JD, Pilliar RM, Cameron HU, Weatherly GC. The optimum pore size for the fixation of porous-surfaced metal implants by the ingrowth of bone. Clin Orthop Relat Res., 1980, 150: 263–270.

51. Karageorgiou V, Kaplan D. Porosity of 3D biomaterial scaffolds and osteogenesis. Biomaterials, 2005, 26: 5474–5491.

52. Bobyn JD, Stackpool GJ, Hacking SA, Tanzer M, Krygier JJ. Characteristics of bone ingrowth and interface mechanics of a new porous tantalum biomaterial. J Bone Joint Surg Br., 1999 Sep;81(5):907–914.