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RANDOMIZED CONTROLLED CLINICAL TRIAL OF IMPLANT OVERDENTURE RETAINED WITH ZIRCONIA BARS OR TELESCOPIC CROWNS: A 1-YEAR FOLLOW-UP

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ABSTRACT

Implant retained overdenture is a popular treatment for edentulous patients whether splinted or solitary attachments were used. The aim of the study was to examine the difference between bar and telescopic overdenture attachment fabricated from zirconia. Ten male patients were selected to receive implant overdenture retained by two implants at para-sympheseal zone. These patients were categorized into two groups based on the type of attachment used. Group (A) was the bar-connected group while group (B) was the telescopic attachment group. Both bone height and bone density were monitored, using cone beam computerized tomography, throughout the follow up periods (at loading time, three, six and twelve months). The results showed the mean values of peri-implant bone height loss of group A were less than group B with statistically significant values ($P< 0.05$). The mean values of the bone density showed higher bone density values in group A than group B with statistically significant value at ($P < 0.05$). It could be concluded that the zirconia bar-attachment overdenture showed better treatment outcomes than zirconia telescopic attachment. Accordingly, the bar-clip attachment system showed some preference in preserving peri-implant bone surround the implants.

INTRODUCTION

Implant-retained overdenture is a well-recognized treatment considered by many clinicians. It has been indicated mainly for elderly patients with limited bone volume and budget. It was also preferred by many clinicians because of its ease of fabrication and prosthetic convenience[1,2]. Accordingly, implant bar-overdentures were used successfully over many years in dental field. Whether these implants were placed and loaded immediately or with delayed concept, the survival rate of these implants has exceeded 96%. It was also recorded that implant types have no impact on their survival provided that size, implantation zone and maintenance were carefully planned [3,4]. Similarly, telescopic implant overdenture showed a high survival rate comparable to ball attachment. The clinical findings presented

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the telescopic crowns used on isolated implants as a reliable and practical line of treatment [5].

Helal et al., [6] compared screw retained and telescopic prostheses for edentulous patients. They recorded no significant bone loss between groups after one year of loading. Similarly, Keshk et al., [7] clarified that no significant difference of vertical bone loss between ball and telescopic attachments. Another study showed the active role of the prostheses type on resorption of the posterior part of the arch and they relied the cause of bone resorption in the anterior part to the relative occlusal force distribution rather than attachment type [8].

In a 10-year follow-up study, Heckmann et al.,[9] inserted non-rigid telescopic attachment with two inter-foraminal implants for overdenture stabilization. They showed promising values and urged the use of this treatment as an efficient and reliable long-term treatment modality in severely resorbed edentulous mandibles. Moreover, Nik & Nejatian [10] examined, in two years study, the clinical efficiency of one-piece telescopic implant-retained mandibular overdentures. They concluded that the treatment outcomes for prefabricated telescopic retained overdentures on one-piece implants were favorable and comparable to delayed loading cases. In addition, Krennmair et al., [5] reported that implant success and peri-implant conditions of ball attachments matched telescopic crowns used for implant overdentures. However, the frequency of maintenance was higher for ball attachments than telescopic crowns.

Gotfredsen & Holm [11] followed in prospective study the clinical and radiographic parameters of two implants with ball or bar attachment supported an overdenture in the mandible for 5 years.

Promising results were recorded with a 100% survival rate. They reported that no significant difference in crestal bone height and peri-implant mucosal health were seen between groups. However, technical complications/repairs were higher around bar than ball attachments especially in the first year of function. Furthermore, Cune et al, [12] conducted a crossover clinical trials to compare ball and socket and bar-clip attachments retaining overdentures. High patients' satisfaction with long-term results were recorded for both types of attachment. In addition, clinical and radiographic parameters revealed acceptable and healthy mucosal tissues and maintained crestal bone height respectively. However, shallower probing depth was recorded in ball and socket cases. Similarly, Kappel et al, [13] reported that the difference between locator group and bar-clip group were insignificant. They also added that prosthetic complications and aftercare measures of locator group attachment were frequent but easy to handle than bar attachment. These findings were also confirmed by Batista et al, [14] in their clinical trials. They also reported that isolated attachment as ball attachment may only differ than bar-clip in frequency of maintenance and repair. On the other hand, Alsyad & Khirallah [15] reported that non-splinted ball attachment showed a significantly higher circumferential bone loss than those associated with splinted implants after 3 years of function. In a comprehensive meta-analysis study, the data demonstrated no statistically significant differences between splinted and un-splinted attachment systems with regard to marginal bone loss, prosthetic complications and implant survival rate [16].

In an in-vitro study, Tokuhisa et al, [17] compared load transfer and denture stability of three attachment systems used to retain implant overdenture in an attempt to understand role of attachment in load distribution. The overdenture was loaded gradually at the first molar region by vertical load range between 0-50 newton. Both bending moment and overdenture movements were recorded and studied. The results showed that ball-type attachment generated better load distribution than bar-clip system. Barao et al, [18] confirmed that the use of isolated O-ring attachment minimized the stress generated at the peri-implant tissues than bar-clip system. They also added that adding a cantilever to the bar has increased the stress within the attachment components. Furthermore, Paek et al, [19] examined stress distribution of both implant and tooth supported overdenture using telescopic crowns. They examined different scenarios regarding implant positions and reported that it is crucial to minimize distance between abutment and loading position. Another study confirmed that the position of load application and attachment position is the key element in load distribution and acts to keep the stress within the physiologic limit of the tissues. The author also confirmed that the bar-clip system showed a consistent and properly distributed stress surrounding peri-implant bone especially in bilateral loading [20].

Zirconia has been used in implant dentistry to exchange the titanium and titanium alloys. It may exchange the titanium as a fixture or as an abutment. This material has some favorable characteristics as it offers superior esthetic results, especially in critical thin mucosa at the esthetic zone [21]. Moreover, zirconium showed unique biocompatibility characteristics and lower bacterial adhesion (22, 23). Although there was a doubt about brittleness of zirconia and its response under heavy occlusal forces. This doubt was declined when some reports showed no fracture under increased loading conditions [24, 25]. In addition, Zembic et al, [26] confirmed strength and fracture resistance of zirconium abutment in an 11-year follow-up study.

Consequently, the present study aimed to examine the difference between bar and telescopic overdenture attachment after exchanging metallic components of attachment with zirconia. The study parameters include radiographic examination, using cone beam computerized tomography (CBCT), to measure bone height and bone density changes over one year of function.

MATERIALS AND METHODS

Patients' selection

Ten male patients with completely edentulous arches were selected from the outpatient clinic of the faculty of dentistry, Jouf University, KSA. according to the inclusion criteria. After patients' examination and interview, all patients were aware about the treatment line selected and follow-up visits assigned to collect the research data. The inclusion criteria included the validity of these patients to receive implant retained overdenture [27]. Patients with age ranged from 55-65 years. They should be free from any medical conditions that might interfere with implant placement and/or osseointegration. They all should be non-smokers and did not receive any radio or chemotherapy treatment at any time. Patients should not be on Bisphosphonates therapy or any other drugs interfere or alter bone metabolism. In addition, some local factors as enough bone volume and a wide band of keratinized mucosa (≥2 mm) without the need to use any hard or soft tissue grafts. An informed consent was explained and signed by all patients in their language followed by some investigations and records before clinical procedures.

The following investigations and records were collected:

- Screening tests for homeostasis (Prothrombin Time (PT), Partial Thromboplastin Time (PTT), Bleeding Time, and Clotting Time).
- Screening tests for bone metabolism (Parathyroid Hormone Level (PTH), Alkaline Phosphatase Level (ALKP), and Serum Calcium Level).
- Fasting blood sugar level.
- Measuring the blood pressure.
- Mounted diagnostic casts.

Pre-operative cone-beam computed tomography (CBCT) were done to exclude the presence of any pathological condition and to check the quality and quantity of the available alveolar bone at the planned implant site.

Two endosseous implants (Protem/secure implant systemDio implant Dio corporation 1464, U-dong Haeundae-gu Busan, Korea) were planned to be placed at the mandibular canine areas. After healing period, the patients were categorized into two groups, group A was planned to receive bar-clip attachment and group B received telescopic attachment. All implants were planned to have the same length [10 mm] and the same diameter [3 mm].

STUDY PHASES

Phase 1: Construction of conventional upper and lower complete dentures:

Patients were scheduled for conventional complete denture construction. The waxed-up denture should be checked for enough thickness and proper anterior teeth position in order to have room for the proposed attachment. All patients were instructed to use their dentures for 3 weeks before surgery and any denture complain were treated spontaneously.

Phase 2: Pre-surgical radiographic planning:

The mandibular denture duplicates were fabricated from clear acrylic resin and then modified by adding 2mm diameter channels at the cingulae of the anterior teeth. Subsequently, these channels were filled with radio-opaque materials to act as guide. These denture duplicates were used during radiographing where patients bite against their opposing maxillary denture.

The CBCT machine (Scanora 3D, Soredex, Helsinki, Finland) was adjusted according to the preferred parameters. The machine parameters included field of view (FOV) (7.5 cm x 10 cm), to suit the entire dental complex need to be examined, 90 kV, 4 -12.5 m A, Scan time 10 second, isotropic voxel size 0.133 mm. The machine produced image data in DICOM format (Digital Images and Communications in Medicine).

Phase 3: Implants placement and prosthesis construction:

A. Placement of the implants:

The radiopaque guide was modified to be used as a surgical guide by clearing the radio-opaque markers from the channels. After applying local anesthesia, the surgical site was marked as bleeding points referenced by the surgical guide channels. A tissue punch was centered over the bleeding points and firmly pushed toward the tissue with some rotations to trim full thickness of the overlying mucosa. Once soft tissue removed, osteotomy was prepared as a drilling sequence using 1.2, 1.5, 2, 2.5 mm drills to the proposed implant length (10 mm). All drillings were performed at low speed with high torque handpiece by applying intermittent movement and external irrigation.

Implants were loaded by finger wrench by gripping the fixture hex then inserted in the osteotomy and manual tightening were applied till resistance was felt. The torque-controlled ratchet wrench was then used to seat the implant in the final position at 30 N/cm torque to avoid over-tightening, (fig. 1, A).

To avoid post-surgical oedema and infection some measures were taken. Patients were instructed to apply immediately cold packs for 10-15 minutes every half hour during the 6 hours post-surgery. An antibiotic (500 mg amoxicillin and 125 clavulonic acid) was also prescribed 3 times daily one day before surgery for 5 days. An analgesic and anti-inflammatory (50 mg diclofenac potassium for 5 days 3 times daily). In addition, mouthwash (Chlorhexidine Hydrochloride 125 mg/5 ml10) was prescribed. Patients were checked the day after the operation for postoperative problems, as edema or hematoma. The patients also advised for soft diet for the following week.

After 7 days of healing, final impression making was performed by addition silicone rubber base impression material considering dual impression technique. Implant analogs were assembled in place at the impression surface depending on bevel and slots of the characteristic surfaces to their corresponding impression surface, (fig. 1, B). The impression loaded with analogues was poured in extra-hard stone material. Finally, after hardening of the stone, the cast was removed from the impression carrying analogues.

The patients' casts were digitized by desktop scanner (R700, 3Shape, Copenhagen, Denmark) and the generated 3D models were collected, categorized according planned attachment and stored for desiging phase. Attachments were custom designed in the Exocad software (Exocad GmbH, Darmstadt, Germany). The telescopic crowns were designed to have two primary copings fitted and cemented by resin cement over the implant abutment and another two secondary copings fitted on the primary copings and fixed after pick-up to the fitting surface of the denture. Accordingly, the zirconia telescopic copings were milled from zirconia blocks (Cercon, DENTSPLY, USA) then the primary coping checked in the patient's mouth for fitness then finally cemented, (fig. 2, A). The secondary copings were stored after milling to the day of insertion.

Similarly, the bar attachment was designed in Exocad software as a resilient-designed bar connect two copings to be milled as one unit from zirconia blocks then cemented from both sides intra-orally by resin cement on the implant abutments (fig. 2, B).

After jaw relation and try-in using record block and trial denture base, final denture was fabricated considering enough room for attachment. The stored secondary zirconia coping was fitted intraorally and check for enough space at the opposing fitting surface. All necessary modification should be done to guaranty passive fit for the secondary coping after placing the denture. Once the fitting surface is ready to receive the coping two small holes were added to facilitate acrylic resin scape during pick-up. Finally, rubber dam is placed to block undercut beneath the copings and direct pick-up of the secondary copings is done using hard lining materials after painting hard liner adhesive. All areas secured from resin were painted with petroleum jell (fig. 3, A).

The bar attachment group will follow the same procedure while pick-up process with hard liner was done after blocking all undercut beneath the bar and the abutments. The bar clip was secured in place over the middle part of the bar to be picked with the denture base and all excess materials coming from the prepared hole facing the clip was removed (fig. 3, B).

Stage 4: Assessment and follow-up visits

a) Assessment of crestal bone loss:

Crestal bone loss were assessed at the peri-implant zone by cone beam computerized tomography (CBCT) at loading time, three, six and twelve months. The bone level was measured and recorded using OnDemand3D application software (Sordex-Scanora 3D ver.16 Soredex, Helsinki, Finland). The linear distances between the bone crest to the apex of the implant were measured in sagittal plane crossing the center of the implant to record the buccal and lingual aspects. In addition, the linear distances were measured from the coronal plane crossing the implant center to record the mesial and the distal sides. The mean value of readings were taken, tabulated and statistically analyzed [28].

b) Assessment of the relative bone density changes:

A relative Hounsfield units (HU) changes was used to represent changes in bone density at the peri-implant zone. The bone density was measured using the same software (Sordex-Scanora® 3D

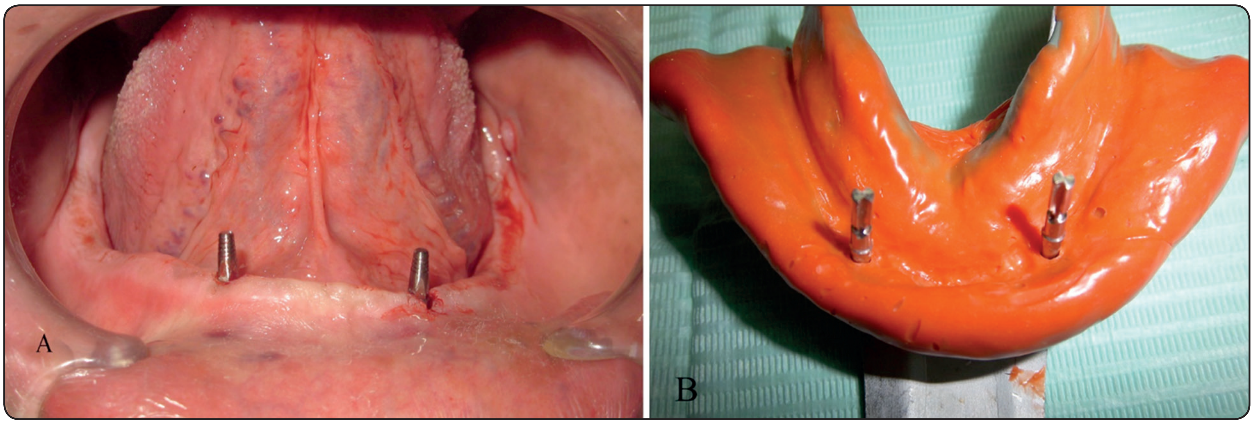

Fig. (1) Implants placed intraorally as a one-piece implant and abutment part emerged from the soft tissue, A. final impression performed by silicone rubber base material where two implant analogues were seated preciously in place, B.

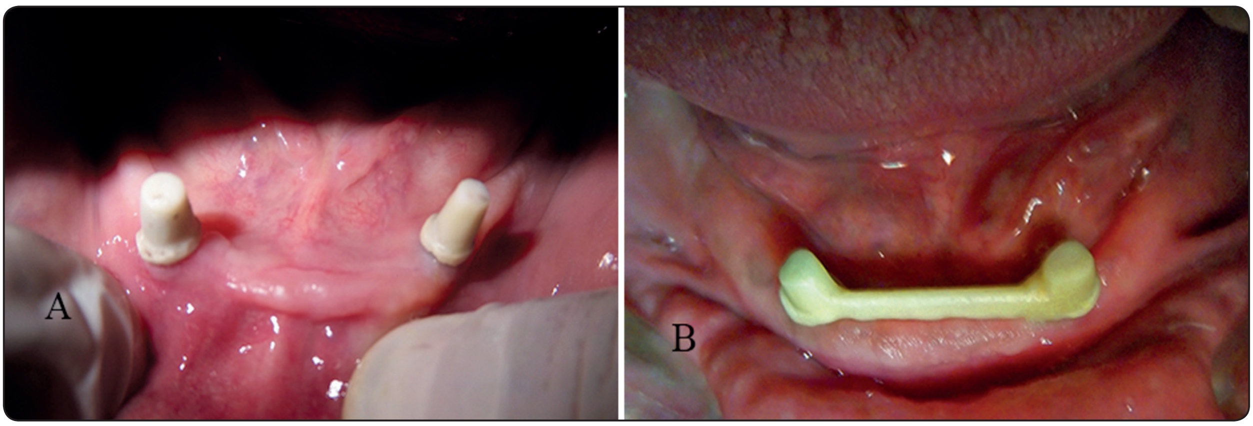

Fig. (2) Intra-oral view representing the zirconia primary coping cemented in place, A. the lower image is an intra-oral view of the zirconia bar attachment cemented as one unit over abutments.

Fig. (3) Overdenture fitting surface after picking-up the milled secondary coping of the zirconia telescopic attachment, A. The lower image showing the pick-up clip at the fitting surface of the bar overdenture group, B.

Soredex, Helsinki, Finland) at loading time, after 3, 6, and 12 months. The regions of interest (ROI) were square area (3X3) plotted 1 mm from the implant surface center to avoid the scattered radiation [28]. Considering the same cuts used in crestal bone assessments, the buccal, lingual and apical sagittal sides were recorded from sagittal cut and the mesial, distal and apical coronal from the coronal cut. The mean values of readings were recorded, tabulated and statistically analyzed using (SPSS for Windows, version 14) at significance level ($p<0.05$).

RESULTS

All measurements of both peri-implant bone height and bone density at loading time (first visit), 3 months after loading (second visit), 6 months after loading (third visit), and 12 months after loading (fourth visit) were collected, tabulated, and statistically analyzed using Post-hoc test. The value was considered significant if the P-value was less than 0.05.

Peri-implant bone height

The Mean ± Standard Deviation (SD) of buccal peri-implant bone height in bar connected group (A) throughout the four intervals or visits of study periods (at the loading time, and at 3, 6, and 12 months after loading) were 10.4±2.065, 10.21±1.91, 9.76±1.655 and 9.23±1.129mm respectively. However, the Mean ± Standard Deviation (SD) of buccal peri-implant bone height in telescopes group (B) throughout the four intervals or visits of study periods were 10±2.69, 9.68±2.566, 9.589±2.575 and 9.07±2.979mm. The mean values of buccal peri-implant bone loss of group A were less than group B with statistically significant values (P< 0.05) at the second, third and fourth visits, (Table 1, fig 4).

From the lingual aspect the mean values and standard deviations of the bone height of the studied intervals in group A were 10.664±1.975, 10.41±1.531, 10.075±1.911 and 9.95±1.59 mm respectively. Regarding group B, the means

TABLE (1): Comparison between peri-implant bone height in bar connected group (group A) and telescopes group (group B) from different sides (buccal, lingual, mesial, & distal) of the implant.

	First Visit	Second Visit	Third Visit	Fourth Visit
Buccal (group A)				
Mean	10.4	10.21	9.76	9.23
SD	2.065	1.91	1.655	1.129
Buccal (group B)				
Mean	10	9.68	9.589	9.07
SD	2.69	2.566	2.575	2.979
P value	0.052	0.033*	0.043*	0.047*
Lingual (group A)				
Mean	10.664	10.41	10.075	9.95
SD	1.975	1.531	1.911	1.59
Lingual (group B)				
Mean	10.575	10.13	10.05	9.97
SD	2.398	2.749	2.607	2.788
P value	0.064	0.042*	0.098	0.13
Mesial (group A)				
Mean	10.20	10.01	9.51	9.02
SD	1.34	1.63	1.42	1.24
Mesial (group B)				
Mean	10.01	9.89	9.22	8.88
SD	2.53	3.07	3.63	3.56
P value	0.12	0.071	0.046*	0.05*
Distal (group A)				
Mean	10.11	9.81	9.41	8.92
SD	1.72	1.51	1.33	1.39
Distal (group B)				
Mean	10.23	9.61	9.02	8.65
SD	2.73	2.90	3.31	3.88
P value	0.053	0.031*	0.002*	0.03*

** Significant at P< 0.05   SD standard deviation*

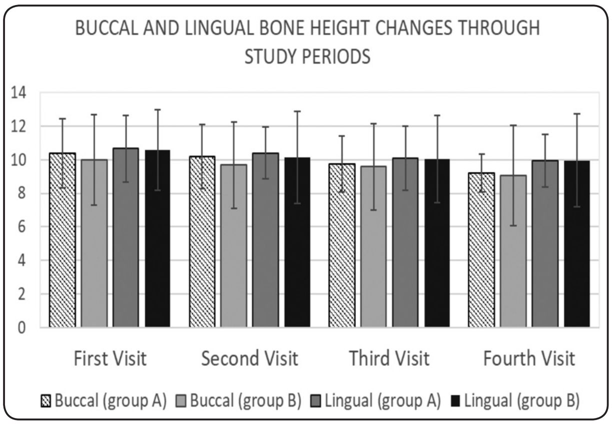

Fig. (4): A bar graph showing the mean value and the standard deviation (as error bars) of buccal and lingual bone loss of group A and B throughout the time intervals of the study.

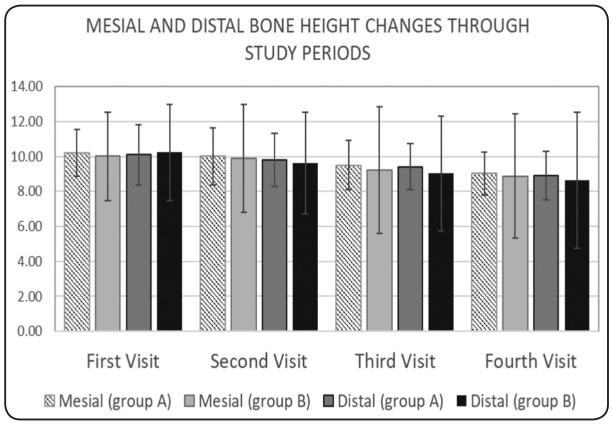

Fig. (5): A bar graph showing the mean value and the standard deviation (as error bars) of mesial and distal bone loss of group A and B throughout the time intervals of the study.

and standard deviations were 10.575±2.398, 10.13±2.749, 10.05±2.607 and 9.97± 2.788 mm. The mean value of lingual peri-implant bone loss of group A were less than group B at the first, second and third follow up intervals. However, group B showed less bone loss at the fourth interval, (Table 1, fig 4). A statistically significant difference was seen only between Group A and B at the second interval at P<0.05. All other intervals were non-significant.

At the mesial side the calculated mean value and standard deviation of the peri-implant bone height of group A during the four studied intervals were 10.20±1.34, 10.01±1.63, 9.51±1.42 and 9.02± 1.24 mm respectively. In group B, the mean value and standard deviation of the peri-implant bone height were 10.01±2.53, 9.89±3.07, 9.22±3.63 and 8.88± 3.56 mm. The mean values of mesial peri-implant bone loss of group A were less than group B with statistically significant difference was seen at the third and fourth follow up intervals. The difference in means were insignificant at the first and second intervals of the study, (Table 1, fig 5).

The peri-implant bone height at the distal aspect of group A at the studied intervals were 10.11±1.72, 9.81±1.51, 9.41±1.33 and 8.92±1.39mm respectively. In group B, the mean and standard deviation of the bone height were 10.23±2.73, 9.61±2.90, 9.02±3.31 and 8.65±3.88mm. The mean values of distal peri-implant bone loss of group A were less than group B with statistically significant difference seen at the second, third and fourth follow up intervals of the study, (Table 1, fig 5).

Peri-implant bone density

The peri-implant bone density (represented in HU) recorded from the CBCT software at the areas of interest for group A and B then the mean and standard deviation during the different visits were calculated and checked for significance at P< 0.05.

The mean and standard deviation of bone density at the buccal aspect at the four studied intervals for group A were 1692.727±929.165, 1258.183± 686.007, 1814.863±873.487 and 1848.675±534.372 HU respectively. In group B the mean and standard deviation were 1077.570±614.552, 1052.605± 626.135, 1089.044±670.142 and 1083.400±742.426 HU. The difference between bone density of group A and B were statistically significance (P< 0.05) at the first, second, third and fourth intervals, (table 2 and fig. 6).

At the lingual aspect the mean and standard deviation of bone density at the studied intervals

TABLE (2): Comparison between peri-implant bone density in bar connected (group A) and telescope (group B) from different sides (buccal, lingual, mesial, distal & apical) of the implant.

	First Visit	Second Visit	Third Visit	Fourth Visit
Buccal (group A)				
Mean	1692.727	1258.183	1814.863	1848.675
SD	929.165	686.007	873.487	534.372
Buccal (group B)				
Mean	1077.570	1052.605	1089.044	1083.400
SD	614.552	626.135	670.142	742.426
P value	0.031*	0.022*	0.001*	0.003*
Lingual (group A)				
Mean	1075.335	907.022	1081.922	1069.413
SD	665.818	695.712	585.620	806.859
Lingual (group B)				
Mean	770.895	849.015	906.763	660.810
SD	418.489	566.581	677.669	470.034
P value	0.003*	0.125	0.042*	0.023*
Mesial (group A)				
Mean	1340.014	1333.283	1292.363	1451.588
SD	479.086	406.306	515.013	221.794
Mesial (group B)				
Mean	1272.075	1147.335	1441.078	1337.690
SD	486.766	455.727	495.837	504.485
P value	0.122	0.023*	0.025*	0.089
Distal (group A)				
Mean	1548.186	1523.789	1665.419	1903.125
SD	547.654	368.452	501.619	409.285
Distal (group B)				
Mean	1442.880	1481.360	1521.278	1802.210
SD	508.176	300.804	625.300	598.614
P value	0.121	0.113	0.098	0.213
Apical S (group A)				
Mean	1191.195	1146.472	1256.863	1117.163
SD	361.923	360.203	516.305	286.603
Apical S (group B)				
Mean	1147.613	1150.081	1326.161	1458.790
SD	982.547	553.477	474.415	670.690
P value	0.425	0.652	0.136	0.045*
Apical C (group A)				
Mean	1109.132	1123.489	1249.713	1005.125
SD	317.739	342.867	470.250	318.686
Apical C (group B)				
Mean	1130.994	1185.064	1374.578	1432.130
SD	948.442	555.679	459.816	640.691
P value	0.365	0.526	0.425	0.065*

**** Significant at P< 0.05*** ***SD standard deviation***

Apical S, Apical sagittal ***Apical C, Apical coronal***

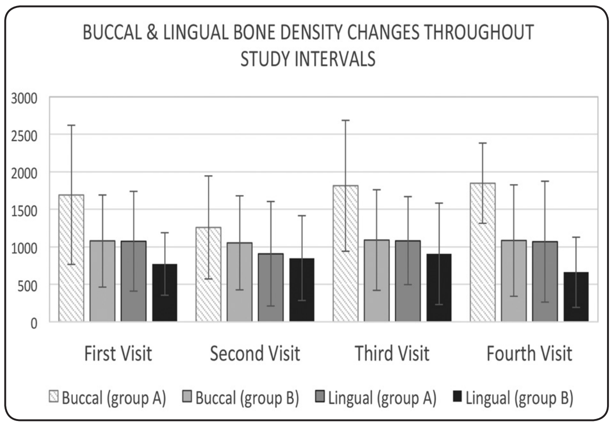

Fig. (6): Comparison of mean value and standard deviations of bone density between group A and B from the buccal and lingual side corresponding each follow-up interval.

for group A were 1075.335 ±665.818, 907.022± 695.712, 1081.922 ±585.620 and 1069.413 ± 806.859 HU respectively. In group B the mean and standard deviation were 770.895 ±418.489, 849.015 ± 566.581, 906.763 ±677.669 and 660.810 ±470.034 HU. The difference between bone density of group A and B were statistically significance (P< 0.05) at the first, third and fourth intervals, (table 2 and fig.6).

At the mesial side, group A showed mean values and standard deviation 1340.014 ±479.086, 1333.283±406.306, 1292.363±515.013 and 1451.588 ±221.794 at their respective intervals. In group B the means and standard deviations were 1272.075 ±486.766, 1147.335 ±455.727, 1441.078 ±495.837 and 1337.690 ±504.485. A statistically significant difference was seen at second and third studied intervals between group A and B at (P<0.05), see (table 2 and fig.7).

The mean values and standard deviations of the bone density of group A at the distal aspect were 1548.186 ± 547.654, 1523.789 ±368.452, 1665.419 ±501.619 and 1903.125 ±409.285 at the respective time intervals. In group B, the mean values and standard deviations during the studied intervals were 1442.880±508.176, 1481.360±300.804, 1521.278±625.300 and 1802.210±598.614 respectively. The difference between group A and B was not statistically significance at all studied time intervals, see (table 2, fig.7).

In group A, the mean values and standard deviation of bone density at the apical part (as seen in the sagittal section) were 1191.195 ±361.923, 1146.472 ±360.203, 1256.863 ±516.305 and 1117.163 ±286.603 at respective time intervals. In group B, the means and standard deviations were 1147.613 ±982.547, 1150.081 ±553.477, 1326.161±474.415 and 1458.790±670.690 respectively. The difference between group A and B was statistically significant at the fourth interval only, see (table 2 and fig8).

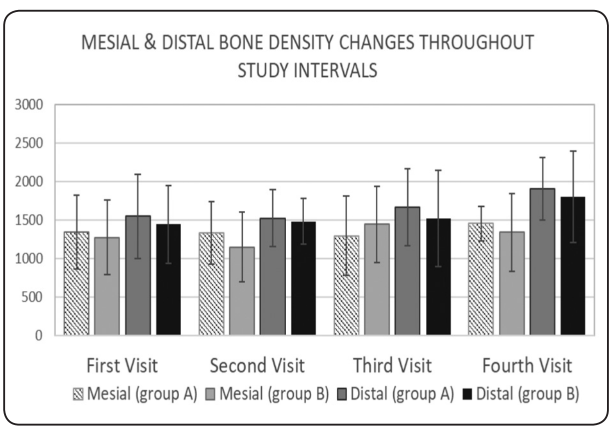

Fig. (7): Comparison of mean value of bone density between group A and B from the mesial and distal side corresponding each follow-up interval.

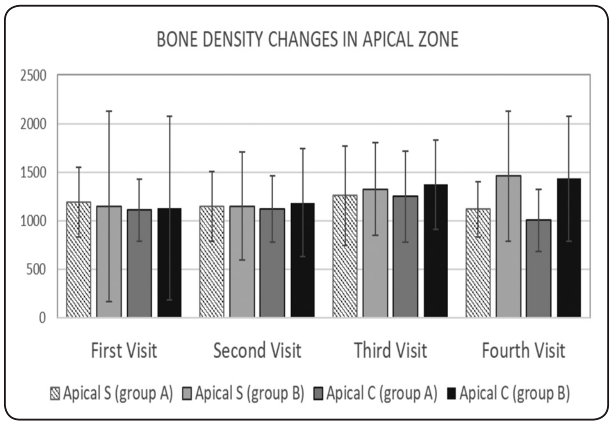

Fig. (8): Comparison of mean value of bone density between group A and B from the apical side (sagittal & coronal view).

In group A, the mean values and standard deviations of the apical bone density (as seen from coronal view) were 1109.132 ±317.739, 1123.489 ±342.867, 1249.713 ±470.250 and 1005.125 ±318.686 at the respective time intervals. In group B, the mean value and standard deviations were 1130.994 ±948.442, 1185.064 ±555.679, 1374.578 ±459.816 and 1432.130 ±640.691 respectively see (table 2, fig 8). A statistically significant difference was calculated between group A and B at fourth time interval only at $p<0.05$.

DISCUSSION

Implant-retained overdenture is a practical and convenient treatment for elderly edentulous patients. Accordingly, the use of suitable attachment system is crucial to enhance the longevity of the prosthesis and their supporting structures. Whether the attachment system used is isolated or splinted, the biological and biomechanical consideration should be realized.

The present study conducted to reveal the influence of the attachment system on the peri-implant bone of implant-retained overdentures. Zirconia was selected to fabricate both attachment systems in order to gain it's biological, mechanical and esthetic benefits [21-23, 26]. The results showed less crestal bone loss in group A (bar connected overdentures) than group B (telescopic overdentures) with a statistically significant values especially in buccal and distal sides. Similarly, more favorable relative bone density means were calculated in buccal and lingual sides mainly in the third and fourth visits. However, the other measurement areas were not able to find the same pattern.

Generally, the findings of the bone loss were within the expected bone loss at the first year of loading [1, 12, 16]. Avoiding raising flabs and considering single surgical intervention could be the key element of minimizing the bone loss at the first year of loading, where no interruption of the blood supply and their nutrient resources to the alveolar bone. Another proposed explanation might rely on the biological advantages gained by using zirconia as a fabricating material for attachment components. The value of zirconia for inhibiting bacterial adhesion and improving the surrounding environment around the peri-implant tissues was encouraged in several researches [21-23]. Accordingly, the complexity of the bar configurations with their more soft tissue coverage and liability to plaque accumulation was not able to be infused in the results. This could be claimed by the strict oral health instructions and the proper post-insertion care and follow-up. Secondly, the ability of the zirconia surface to minimize bacterial adhesion as mentioned before. However, the mechanical variations between splinted and non-splinted attachment type was expressed to favor bar overdenture over telescopic attachment. Several researches explained the force distribution and the permittivity of motions of each attachment type and how they respond to force application [1, 2]. In facts, in order to discuss the mechanical variations between bar and telescopic attachment, we should realize that each attachment type own its characteristics that governs its outcome. However, each attachment should be treated as a mechanical device that may express itself differently according to its loading situation. For example, if the location of the attachment relative to each other or to the masticatory force position changed, the proposed scenario could be changed [17-19]. The manner of load application whether unilateral to bilateral may also be important [20]. Another example in case of the bar attachment is that we may found some cases with hinge axis parallel to the bar rotational axis and may not the same for some patients. However, this suggestion could not be confirmed [1]. Simply in our study, the two-implant bar-clip overdenture acts smoothly with resilient effects and load distribution in a favorable biologic environment more than telescopic attachment has done. This means that telescopic attachment in our situation did not show sufficient resiliency in motion under mastication although they it was unconnected. The importance of these findings is that there are several parameters control the efficiency of each attachment intra-orally and each one may acts differently based on the current situation. In our study the bar-clip system was optimal for the selected cases.

The findings of our study agreed with Alsyad & Khirallah study [15]. They showed a significantly higher circumferential bone loss in non-splinted ball attachment group than the bar connected group. Similarly, Jofre et al, [29], krennmair et al, [30] and Stoker et al, [31] reported more marginal bone loss at the non-splinted attachment than splinted attachment. They valued the role of splinting to minimize the bone loss surrounding implants although some of them did not show significance. On the other hand, Cune et al, [12] and Gotfredsen & Holmes [11] showed less bone loss in the isolated attachment group than bar-connected group but no statistical differences were seen between studied groups. The majority of these studies were not able to get a consensus about the value of one system over the other. This was also in accordance with Leão et al,[16] in their meta-analysis study as the concluded that the splinted and unsplinted overdenture attachment systems showed no signicant effect on crestal bone loss, implant survival rate and prosthetic complications.

The main clinical implication of the current study is to select the attachment system that suits the patient's conditions and his ability to follow a proper hygiene system and his oral health. In this case, the use of splinting will be desirable and could be encouraged. It should also be noted that zirconia proved to have a good quality outcome and could exchange the metallic attachment successfully. However, this study had some limitations regarding the use of other clinical evaluation tools like pocket depth, mobility and crevicular fluid analysis. We also urged future researches to extend the evaluation time and incorporate the new techniques of calculating the bone volume loss and the surface typography changes in the 3D based programs.

CONCLUSION

Although both attachment systems achieved successfully as implant-retained overdenture attachment and under the current circumstances offered in this study, the bar-clip attachment system showed some preference in preserving marginal bone surround the implants.

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