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Comparison of the Effect of Using Two Different Types of Bar Overdentures on the Supporting Structures of Mandibular Edentulous Ridge Area

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Abstract: ***Statement of problem: mandibular conventional denture is no longer the most appropriate treatment approach, nowadays mandibular two-implant overdentures significantly enhances levels of patient satisfaction as compared to complete dentures Purpose: The aim of the present study was to evaluate the peri-implant supporting tissue clinically and radiographically for implant-supported overdentures in the mandible retained by two different bar attachments materials (zirconium and metallic bar) during a year period. Materials and Methods: twelve completely edentulous patients had two dental implants placed in the anterior part of the mandible. The patients divided randomly into two equal groups. Six patients received zirconium bar attachment system and the other group received metallic (Cr-co) bar attachment, Cone beam radiographs were obtained for the assessment of peri-implant bone loss and density. Results: No implants were lost from baseline to a year registration. Metallic bar attachments showed significant peri-implant crestal bone loss also there was no significant difference regarding bone density changes around the implants for both groups. Conclusion: Two implants with zirconium and metallic bar attachment supported an overdenture in the mandible for a year with a 100% survival rate. There was better marginal bone loss for zirconium bar attachment and no difference in bone density.***

Keywords: mandibular overdenture, two implants, zirconium bar, metallic bar

1. Introduction

After tooth loss, the alveolar ridge resorbs, and the stability and the retention of the denture prostheses diminished, resulting in a reduction of comfort, chewing ability, biting force and facial esthetics. These factors lead to general dissatisfaction with the mandibular prosthesis, causing the patient to seek a replacement of denture [1].

Over denture can be defined as any removable dental prosthesis that covers and rests on one or more remaining natural teeth, roots of natural teeth, and/or dental implants [2].

Mandibular two-implant overdentures significantly enhances levels of patient satisfaction as compared to complete dentures, however this level is not influenced by the type of attachment used [3].

The implant supported bar overdenture is preferred as much cheaper alternative, offers retention and stability similar to those of fixed-prosthetic implant restorations and can be removed at night. Also the right position of the implants to obtain the ideal aesthetics is not such critical as it is the case with fixed porcelain prosthesis [4].

The increasing demands for high esthetics coupled with biocompatibility and strength has resulted in an evolution of all-ceramic restorations [5]. Zirconia is the strongest and toughest ceramic material available for use in dentistry today [6,7]. It has been used to manufacture primary and secondary copings due to its good mechanical and biocompatible properties including esthetics, high wear resistance, and low both thermal and electrical conductivity as compared to Cobalt Chromium (CoCr) or Gold copings [8,9].

Full zirconium bar overdenture prosthesis in the lower jaw was constructed that was supported on two individual milled zirconium bars, each zirconium bar was supported by two implants. He found that there was no galvanism due to the metal freedom, good esthetic and good patient psychological acceptance also there was good hygienic ability due to the smooth ceramic surface [10].

Overdenture with two implants would be considered the treatment of choice in completely edentulous patients. Combining the advantages of bar attachment overdenture and zirconia as a biocompatible strong bar material, made with high precision and fit by the CAD/CAM system, a satisfactory worthwhile prosthesis will be provided.

2. Aim of the study

To compare the effect of using two different types of bar attachments in mandibular implant supported overdentures on the peri-implant supporting structures.

The mandibular overdentures were supported by two intra-foraminal implants following the delayed loading fashion and the comparison was carried out clinically & radiographically.

- In the first group the removable complete overdenture was supported and retained to the implants with metallic (Cr-Co) bar attachment.
- In the second group the removable complete overdenture was supported and retained to the implants with zirconium bar attachment.

3. Materials and Methods

Study design

A Prospective comparative study was conducted on 12 completely edentulous patients from those referred to the Removable Prosthodontic Department, Faculty of Dentistry, Minia University. For each patient an implant assisted mandibular bar overdenture was fabricated using minimally invasive flapless surgical technique.

The study was performed after gaining the approval of the research ethics committee. Patients were informed about the research procedures and follow-up examinations. Informed consent was filled out by each patient in accordance with the regulation of the Ethics Committee in Faculty of Dentistry, Minia University.

Patients selection criteria and allocation

The participating subjects in this study were selected according to the following criteria:

Inclusion criteria

Male patients age (45-65 years), sufficient residual alveolar bone quantity and quality, Maxillary and mandibular residual alveolar ridges covered with healthy mucosa, U-shaped lower ridge, Angle's class I maxilla-mandibular relation, Sufficient interarch space greater than 12 mm, Proper oral hygiene, Non smoker patients

Exclusion criteria

Local and general contra indications for surgical procedures, TMJ or neuromuscular disorders, abnormal habits, e.g. bruxism, clenching, smoking and alcoholism, Bone metabolic disorders e.g. Diabetes, History of radiation therapy in the head and neck region.

All patients who participated in the study received:

- Complete dentures before surgeries.
- Received two implants inserted at the canine region bilaterally. All implants were of the same length (13 mm) and the same diameter (3.5 mm) (Oxy implant. Via Nazonale Nord, 21A, 23823Colico LC, Italy). The twelve edentulous patients were randomly divided into two equal groups (six patients each).
- Maxillary complete denture and an implant assisted mandibular bar overdenture.

4. Methodology

1) Prior to any treatment approach, all patients were thoroughly evaluated regarding both dental and medical status therefore; a sheet record was registered for each patient.
2) Pre-operative cone-beam computed tomography (CBCT) (SORDEX 3DX. Nahkelantin 160, Tuusula. P.O. Box 148, F1-04301 Tuusula. Finland) 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.
3) Complete maxillary and mandibular dentures were fabricated for every patient according to the standardized conventional technique. Bilateral balanced occlusion was utilized for arrangement of artificial posterior teeth and was verified inside the patient's mouth.
4) The guides were fabricated using CAD/CAM technology.
5) Fabricated surgical guides were made from clear acrylic and contained 2 metal housings, over the virtually planned implants' sites that accurately fit the provided removable sleeves by the manufacturer. Three lateral cylinders were provided in each guide to allow the placement of anchor pins for fixation of the guide. (**Figure 1**)

Figure 1: Surgical guide with fixation lateral pins

Surgical stage

To allow reproducible placement of the scan template intra-orally, an interocclusal index was fabricated after remounting the complete dentures.

1) Infiltration anesthesia was injected to the buccal and lingual mucoperiosteum of the planned implant sites.
2) Three holes were drilled in the mandible, through the provided lateral cylinders of the guides, to receive the anchor pins for fixation of the guide.
3) Only intermittent drilling with low speed, high torque and internally irrigated hand piece was used to prepare the holes for anchor pins and the osteotomy. Additional external irrigation using sterile disposable syringe was performed as well. Sterile saline was used for irrigation while preparing the osteotomy.
4) After fixation of the guide, osteotomy preparations were performed at the planned implants' sites bilaterally using serial drills (2 and 3.5 mm drills respectively) to the proper depth marked on the drills.
5) After finalizing the osteotomy preparations and removal of the guide, implants were inserted as decided (Oxy implant. Via Nazonale Nord, 21A, 23823Colico LC, Italy). All implants were of the same length (13 mm) and the same diameter (3.5 mm).
6) The implants mounted on the vial caps were inserted in place by using the vial caps until resistance was felt. Then wrench system was applied to complete seating of the implants in place.
7) Cover screw was used for each implant to cover implants using screw driver.

Denture modification:

- The fitting surface of the denture was prepared opposite to the implant sites to accommodate the implant heads
- A tissue conditioning material (Alpha dent products Co., subsidiary of Wallace A. Erickson &Co. 1920N . Clybourn Ave. , Chicago,IL 60614, USA) was used to reline the mandibular denture to avoid tissue irritation or implant overloading.

Stage 3: Bar Attachment Fabrication

a) The patients were randomly assigned to 2 groups: **group 1** received Co-Cr bar joint while **group 2** received Zirconium bar joint.

For **group 1**:

- After 3 months of implant insertion, two plastic castable abutments were attached to the implant heads **(fig 2**) with fixation screws.
- A ready-made plastic bar (bar joint design) was placed between the two copings and its required length was marked and cut.
- Two slots were made in the mesial aspect of each plastic abutment using a round bur. These prepared sites guided the occlusogingival positioning of the bar pattern and facilitated its fixation into the abutments i.e. retaining slots. **(fig 2)**

Figure 2: Bar placed in the notches

- The bar was fixed in place with the two plastic abutments using burn-out self-cured acrylic resin (Duralay, Reliance Dental Manufacturing Co., Chicago, USA.) (fig3)

Figure 3: Bar attached to the plastic abutments with Duralay

- After setting of the burn-out self cured acrylic resin; the two fixation screws were removed and the whole assembly was removed as one piece.
- The two plastic abutments and bar assembly were cast as one piece into cobalt chromium alloy (Niadure, DFS Diamon, Germany) according to the commonly used casting technique. The construction was then finished, tried in the patient mouth and then polished.
- Passive fitness of the bar copings complex over the implants was checked by the tactile sense when seating the tightening screws in place without any resistance. (fig 4)

Figure 4: Metallic bar attachment intra-orally

For group B:

- The same procedures were made as group A except that:
- The two plastic abutments and bar assembly were sprayed with 3D laser scanning spray ** then suspended on a tray scan so they could be scanned with extra-oral scanner (Zirconzan, scanner SG00, ART[1] , Worldwide, An Der Ahr 7, 39030 Gais/South Tyrol, Italy) then the 3D scanned bar was milled with the milling machine (Zirconzan, Milling unit M[1] Worldwide, An Der Ahr 7, 39030 Gais/South Tyrol , Italy).
- The milled bar was larger than its actual size by approximately 25% so after milling it was placed in a sintering Zirkonofen Furnace (Zirconzan 600/v2. Worldwide, An Der Ahr 7, 39030 Gais/South Tyrol, Italy) at 1600 degree for 12 hours, this allows for the shrinkage of the milled zirconium.
- Then the bar was checked for passive fit intraorally. **(fig 5)**

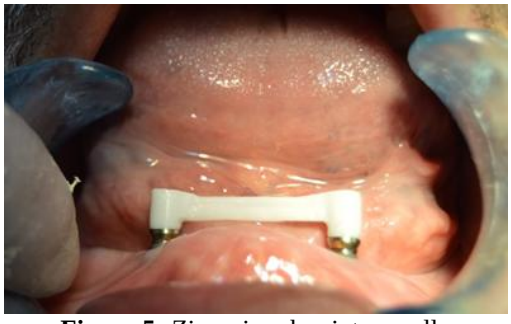

Figure 5: Zirconium bar intra-orally

Stage 3: (Stabilizing and connecting the attachments to the existing Mandibular Complete Denture):

- The clinical pick-up procedure was the same for both groups. The aim was to attach the sleeve to the fitting surface of the mandibular denture under maximum biting force.
- The nylon clip was fixed in place on top of the bar. (fig 6)

Figure 6: Plastic clip on the bar

- The denture's fitting surface opposite the bar coping complex and plastic sleeve was prepared to allow for complete seating without interference. A small window was created at the lingual flange opposite to the bar and sleeve attachment to allow for escape of excess pick-up material.
- The undercuts beneath the bar and copings was blocked out using smooth casting wax (Glattes Gusswachs, smooth casting wax 0.3mm., Ref. no. 40092, BEGO, Germany)
- Methyl metha acrylate free self-curing rebase material (Tokuyama Rebase II Fast, Tokuyama Dental Corporation, Japan) was mixed and applied in the fitting surface of the mandibular denture.
- The denture was seated in the patient mouth and the patient was asked to close in centric relation and maintain maximum biting for the period of setting of the rebase material.
- After setting of the rebase material; the denture was removed slowly then finished and polished.
- The denture was then seated inside the mouth and the final occlusal adjustments were performed.
- The patient was instructed about the care of the denture and the oral hygiene procedures.

Evaluation Phase

Radiographic evaluations for the patients were scheduled at the time of final prosthesis insertion (base line), 3, 6, 9 and 12 months after insertion.

Radiographic assessment

1) Peri- implant crestal bone loss. (Figure 7)
2) Peri- implant bone density, (Figure 8)

Figure 7: Peri-implant bone loss

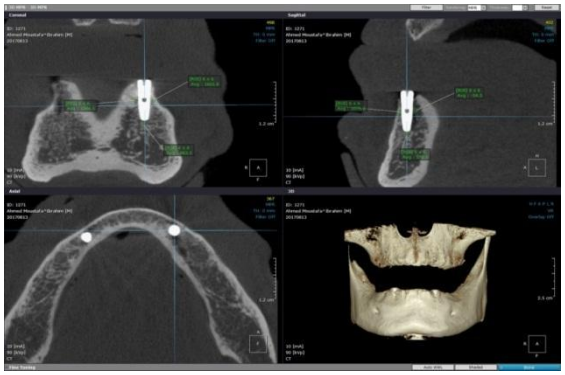

Figure 8: Peri-implant bone density

Data was collected, tabulated, and statistically analyzed

5. Results

5.1 Results of radiographic evaluation

a) Peri- implant bone level

The level of alveolar bone around each implant was evaluated radiographically immediately after overdenture insertion, 3, 6, 9 and 12 months later.

Table 1: Comparison between two studied groups regarding periimplant crestal bone loss

Bone level implant	Insertion	3 months	6 months	9 months	12months
Group I Range Mean S.D.	 0.36-0.42 0.40 0.034	 0.37-0.45 0.42 0.031	 0.39-0.46 0.44 0.027	 0.41-0.50 0.47 0.033	 0.46-0.53 0.51 0.023
Group II Range Mean S.D.	 0.35-0.42 0.41 0.031	 0.36-0.44 0.43 0.028	 0.42-0.55 0.50 0.044	 0.58-0.69 0.64 0.038	 0.6-0.71 0.67 0.036
P	0.565	0.214	0.165	0.032*	0.022*

P comparison between group I and II at the same time
* Significant at level 0.05

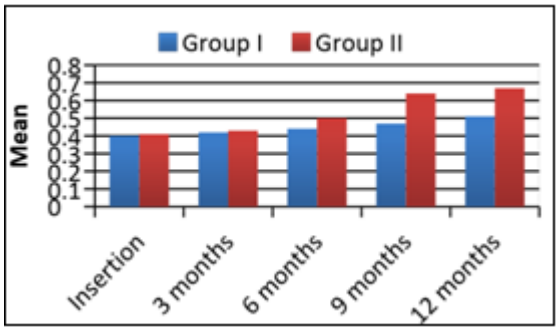

Figure 9: Comparison between two studied groups regarding periimplant crestal bone loss.

Table 1, figure 9 represent the comparison of the mean values of peri-implant bone level scores between zirconium and metallic bar attachments during all periods of follow up.

There was mild bone loss throughout the follow up periods for both groups; but it was higher around metallic than zirconium bar attachments. This increase in bone loss was statistically significant in 9 and 12 months at P≤ 0.05 (p=

0.032)*, (p= 0.022)* but there was no significant at 3 and 6 months. However, there was no statistical significant difference between mesial and distal or buccal and lingual bone loss for zirconium or metallic bar attachments.

b) Bone density

For both groups, bone density around each implant was measured radiographically, in relative Hounsfield Unit (HU), at time of implant placement and loading, and after 3, 6, 9 and 12.

Table 2: Comparison between two studied groups regarding periimplant bone density

Bone density	Insertion	3 months	6 months	9 months	12 months
Group I					
Range	868-910	875-926	880-923	884-930	882-927
Mean	898.62	904.40	908.63	908.9	909.04
S.D.	12.07	9.84	9.99	10.1	10.54
Group II					
Range	849-915	850-922	862-935	882-940	879-925
Mean	894.98	901.28	905.41	905.2	906.67
S.D.	13.67	11.97	11.74	12.1	11.10
P	0.468	0.502	0.482	0.582	0.608

P comparison between group I and II at the same time
* Significant at level 0.05

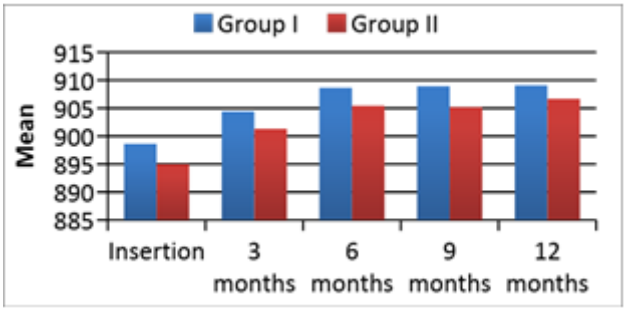

Figure 10: Comparison between two studied groups regarding periimplant bone density.

Table 2, figure 10, represent the comparison of the mean values of bone density scores between zirconium and metallic bar attachments during all periods of follow up.

Results reflected neither clinical nor statistical significant difference regarding bone density changes around the implants for both groups, although statistical analysis showed increase in the mean bone density around the implants of both groups.

6. Discussion

Two implants connected with bar were used in this study (***zirconium bar in the first group and metallic bar in the second group***).

In the present study, radiographic assessment of crestal bone loss was carried out using serial of CBCT showed that, bone loss in both groups was less than 0.7mm after 12 months; these findings confirmed that overdenture aids in preservation of alveolar bone [11,12]. But, there was a statistically significant difference of bone loss between zirconia and metal bar attachments, in favor of zirconia. This could be explained by its better biocompatibility and better clinical behavior; and matched with other studies found that zirconia contribute to the stability of the crestal bone level around the natural teeth under overdenture [13].

Also radiographic assessment of bone density was carried using serial CBCT radiographs made with a standardized technique throughout the evaluation period. Results reflected neither clinical nor statistical significance difference regarding bone density changes around the implants for both groups, although statistical analysis showed increase in the mean bone density around the implants of both groups. This was in agreement with other studies that reported that static continuous loads on implants resulted in increased bone density [14].

7. Conclusions

- Zirconium bar attachment is associated with superior clinical parameters than metal. It has lower plaque adherence affinity, better gingival index which stabilizes soft tissue.
- Both bar attachments were associated with little amount of bone loss, which is clinically acceptable, and in favor of zirconia.
- Construction of overdenture with zirconium bar attachment maintains the periodontal health of implants. However, patient selection, oral hygiene instructions, and regular check up are very important for its success in most patients.

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