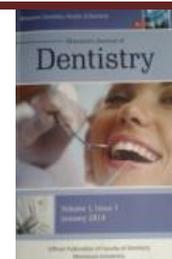




The Metabolic Activity of Bone around Mini-implants Splinted with Cantilever Bar for Mandibular Complete Overdenture



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Abstract:

Objectives: This study aimed to evaluate metabolic activity of bone around mini-implants splinted with cantilevered bar supporting mandibular complete overdenture.

Methods: Six healthy completely edentulous male patients were selected for this study. Each patient received four mini-implants of 14 mm length and 3 mm width in inter-foraminal region using one stage flapless surgical technique. The patients were randomly classified into two equal groups, Group A: patients with mandibular complete overdenture assisted by four splinted mini-implants with cantilevered bar extension and Group B : patients with mandibular complete overdenture assisted by four splinted mini-implants without cantilevered bar extension. Biochemical evaluation of mini-implant stability using the levels of GAG and C4S in the bone and soft tissues adjacent to mini-implants has been performed. Evaluations were performed at 3 stages: 1 month, 3 months and 6 months after bar fixation and insertion of definitive overdenture.

Results: The means of glycoaminoglycans (GAG) and chondratine-4-sulphate (C4S) levels were significantly decreased in the two groups in all intervals of study. When comparing between the means of GAG and C4S level of each two intervals (1st month - 3rd month, 1st month - 6th month and 3rd month - 6th month) in each group, a statistically significant difference was found. When comparing between the two groups, the means of GAG and C4S levels in group (A) were significantly higher than those in group (B) at the end of first month of study. When comparing between the two groups, the means of GAG and C4S levels in group (A) were significantly less than those in group (B) at the end of 3rd month and 6th month of study.

Conclusions: Despite that both groups provided sufficient decreasing in GAG and C4S with the time, mandibular overdenture assisted by four mini-implants splinted with cantilever bar is considered a promising prosthesis regarding retention and metabolic activity compared to bar without cantilever prosthesis.

Keywords: Bone, Mini-implants, Cantilever Bar, Complete Overdenture.

Introduction

Implant assisted overdentures have been widely used to improve the low retention and stability of complete dentures. Attachment of the prosthesis to the implants improves its stability and function and increases patient's satisfaction [1]. For approximately 20 years, Mini-dental implants have been used for transitional and provisional purposes [2], but nowadays they are used for both ongoing and long term applications. Proposed advantages to the use of mini-dental implants include; reduced bleeding, decreased post-operative discomfort, shorter healing time, placement in narrow ridges and immediate loading [3].

Bar structure supported by interforaminal implants are one of the most common treatment modalities used in oral implantology to rehabilitate the edentulous mandible [4]. One benefit of splinting implants (ie, bar restoration) is the potential distribution of the forces to more osseointegrated surfaces, thereby sharing the load. Another primary reason for splinting is to enable the laboratory to compensate for significantly malaligned or poorly positioned implants by fabricating a custom substructure with common path of insertion [5].

A custom-fabricated bar could be accurately milled to develop guide planes that allow accurate adaptation for the denture base to the bar providing stability and resistance against rotational and lateral forces [6,7]. Custom-made

bars are likely to follow the ridge shape when pronounced ridge curvatures are encountered, without invading the tongue space [8].

The placement of cantilevers on bar anteriorly or posteriorly has proven useful for adequate support of the posterior occlusion and esthetics [9]. Mericske-stern stated that the main advantages of placing cantilevers on bars include; adequate occlusal support in posterior segments, improved retention, higher stability, relief of foramen mentale in atrophic jaws, and the cost effectiveness [10]. This study aimed to evaluate metabolic activity of bone around mini-implants splinted with cantilevered bar supporting mandibular complete overdenture.

Patients and methods

Six healthy completely edentulous male patients were selected from the outpatient clinic of Prosthodontic Department, Faculty of dentistry, Mansoura University according to the following criteria: all patients have maxillary and mandibular residual alveolar ridge covered with healthy firm mucosa, sufficient mandibular residual alveolar ridges verified by digital panoramic x-ray and ridge mapping, one year at least after last extraction, no previous denture experience, Angle's class I maxillomandibular relation, sufficient inter-arch space. Exclusive criteria were parafunctional habits, smoking,

alcoholism, systemic disorders affecting bone as diabetes, TMJ or neuromuscular disorders.

For each patient, conventional acrylic maxillary and mandibular complete dentures were constructed and inserted and follow up was done weekly for one month till no complain. Radiographic-surgical template was fabricated for each patient to determine the implant sites. After local anesthesia (Mepecaïne, Alexandria Pharmaceutical Co., Egypt) Four mini-dental implants 9 MDIs (mini-dental implant) Dentium Co. USA.) of 3mm diameter and 14mm length were surgically inserted in interforaminal region of the mandibular residual alveolar ridge using one stage flapless surgical technique. An acrylic bur was used to hollow-out the marked locations on the denture fitting surface where metal copings would positioned. The created spaces were filled with tissue conditioning material 9 Lynal® Tissue Conditioner and Temporary Reliner, Patterson Dental Corporation, USA) then inserted into patients mouth.

After setting of the tissue conditioning material, the denture was removed from the patient's mouth and excess flashes were removed using sharp scalpel. After one week, rubber base impression was made to fabricate metal copings that opposing MDIs as follow; Inject light body of poly vinyl siloxane elastomeric impression material around MDIs then fill the stock tray with heavy body impression material and make overall impression. The impression poured with extra hard stone to fabricate metal copings. Check the passivity of metal copings over MDIs with pressure indicating paste, without causing pressure on gingival tissues around them. While the metal copings in their places on MDIs rubber base impression was made with stock tray for construction of Doldar bar wax pattern which will be used to splint metal copings then will be cast according to cast metal processing technique .

While the metal copings in their places on MDIs rubber base impression was made with stock tray for construction of Doldar bar wax pattern which will be used to splint metal copings then will be cast according to cast metal processing technique. equal groups :-

Group A: Patient with mandibular complete overdenture assisted by four splinted mini-implants with cantilevered bar extension (Fig.1).

Group B: Patients with mandibular complete overdenture assisted by four splinted mini-implants without cantilevered bar extension (Fig. 2).

The tissue conditioner was removed and after blocking of the undercuts beneath the bar intraorally, the soft liner (Softliner handmix PROMEDICA company. Germany) was used to retain the overdenture and adjustment of occlusion.

Evaluation of metabolic activity

Biochemical evaluation of peri-implant tissues were done at 1 month,3 months and 6 months after bar fixation and insertion of definitive overdenture by measuring the glycosaminoglycan (GAG) and Chondratine-4-sulphate (C4S) levels in peri-implant sulcular fluid (PISF) as follow:

A standard procedure was devised, in which PISF sample was collected from each clinically stable implant according to the method described by Beck et al. [11].

Any unstable implant was excluded from the study. Each site was gently dried for 30 seconds with compressed

air, isolated from saliva with cotton rolls and gauze, and then air-dried again. In the event of any slight bleeding during collection, the collection was interrupted until the bleeding subsided and was then restarted. Fluid was collected a traumatically for 5 min in a capillary tube of known length (32 mm) and diameter (capacity 2 ml) (Microcaps, Drummond Scientific Co., PA, USA). Each tube was separately labeled and stored at -70 C prior to analysis.

- Under these conditions, the samples can be kept without risk of degradation of the GAG content. Separation of glucoseaminoglycans by cellulose acetate electrophoresis of peri-implant sulcus fluid.
- Chondrotine assay by ELIZA.

Results

Table 1 Shows comparison of the means total (GAG) and (C4S) level between Group A and Group B after 1 month ,3 months and 6 months of bar fixation and insertion of definitive complete overdenture. It was revealed that, there was a statistically significant difference between both groups after 1 month ($P=.002$ and $t=4.083$), ($P\leq 001$ and $t=7.646$), there was statistically highly significant difference between both groups after 3 months ($P\leq 001$ and $t=5.408$), ($P=.004$ and $t=3.577$) and there was a statistically significant difference between both groups after 6 months ($P=.045$ and $t=2.237$), ($P\leq 001$ and $t=12.667$).

Discussion

The result of this study revealed that; the means of glycoseaminoglycans (GAG) and chondaratine-4-sulphate (C4S) levels were significantly decreased in the two group in all intervals of study. This may be due to the increased enzyme activity caused by the inflammation during the initial period after implant insertion and immediate loading resulting either from the post-surgical risk of bacterial infection or micro-movements on the bone-implant interface. Sorsa et al. [12], have been suggested that PISF volume, together with enzyme activity, to be elevated during inflammation. This also may be due to localized remodeling in the peri-implant alveolar bone during the initial functional occlusal loading of implants. This is in agreement with the operation of Wolff's Law; full functional occlusal loading of implants by prostheses is expected to bring about localized remodeling. Such effects would be expected to be moremarked initially, but to have reached equilibrium in longer-serving functional implants. This was in accordance with a study performed by Last et al. [13].

When comparing between the means of GAG and C4S level of each two intervals (1st month - 3rd month, 1st month - 6th month and 3rd month - 6th month) in each group, a statistically significant difference were found. This may be attributed to the surgical process and prosthetic loading which accelerate bone loss in the 1st -3rd months, while bone remodeling decrease the bone loss in the 3rd - 6th months. Roberts et al. [14] explained that the surgical process of the implant osteotomy preparation, implant insertion and prosthetic loading cause a regional accelerated phenomenon of bone around the implant-bone interface resulting in crestal bone loss during the first 3 months

.Bone remodeling from mechanical strain does not only repair damaged bone but also adapts to its new biomechanical situation.

Turkyilmaz et al. [15] mentioned that after 6 months of loading bone formation affect implant stability positively and thus counteracted the effect of bone resorption . When comparing between the two groups, the means of GAG and C4S levels in group (A) were significantly higher than those in group (B) at the end of first month of study. This may be due to the resiliency of mucosa cover the ridge distal to the posterior implant which may lead to denture rotation around cantilever which act as a fulcrum causes high stresses on the implants . This is in agreement with Brosky et al. [9] who mentioned that the posterior of the implant-retained overdenture is the area to which most of the load is transferred. The mucosa distal to the lateral implants is resilient; therefore masticatory forces are mainly subjected to the cantilever extensions.

When comparing between the two groups, the means of GAG and C4S levels in group (A) were significantly less than those in group (B) at the end of 3rd month and 6th month of study. This may be due to post insertion adjustment procedure which allows denture settling. This adjustment prevent hard acrylic denture base from direct contact with cantilever extension which completely covered by resilient liner, Therefore masticatory forces were widely distributed between the implants and the ridge.

Soft liner act as shock absorber and decrease trauma to peri-implant tissues and also apply an intermittent pressure that increase blood supply to peri-implant tissues and have a role in conditioning these tissues without traumatization. This conditioning influence would decrease bleeding and improve gingival health [16].This appeared to be logic as the presence of soft liner around bar abutments decreased

plaque accumulation. Also, soft liner has cushion effect which absorbs and distributes masticatory forces thus decreasing stresses around implants and reduces peri-implant bone loss. Moreover, The cushion effect of the soft liner conditioned the marginal gingival tissues without undue trauma that may lead alveolar bone loss and break of epithelial attachment to implants [17].

Conclusion

Within the limitation of this study regarding patient number and study time, it can be concluded that:

Despite that both groups provided sufficient decreasing in GAG and C4S with the time, mandibular overdenture assisted by four mini-implants splinted with cantilever bar is considered a promising prosthesis regarding retention and metabolic activity compared to bar without cantilever prosthesis.



Figure 1: Four mini-implants splinted with cantilever bar.

Table 1: Comparison between the means of total (GAG) and (C4S) level in group (A) and group (B) at all intervals of study.

Intervals	The means of GAG and C4S levels in group (A)	The means of GAG and C4S levels in group (B)	t-test	P
1 st month	149.71±17.17	119.75±9.31	4.083*	.002
3 rd month	54.42±6.11	70.28±4.78	5.408*	≤.001
6 th month	42.14±6.86	49.28±4.92	2.237*	.045
1 st month	117.28±7.18	95.14±2.67	7.646*	≤.001
3 rd month	52.75±5.68	64.43±6.68	3.577*	.004
6 th month	25.71±2.98	42±1.36	12.667*	≤.001



Figure 2: Four mini-implants splinted without cantilever bar.

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