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RADIOGRAPHIC EVALUATION OF THE EFFECT OF IMPLANT SUPPORTED AND IMPLANT RETAINED DISTAL EXTENSION REMOVABLE PARTIAL DENTURES ON THE SUPPORTING STRUCTURES

Ragia Saad Mohamed Kotb*, Ahmed Gamal Ahmed Hassan**, Emad Mohamed Tolba M Agamy***, *and* Gehan Fekry Mohamed****

ABSTRACT

Objective: To evaluate and compare the effect of implant supported versus implant retained removable partial denture restoring Kennedy's class I cases on the supporting structures by measuring marginal bone loss and bone density around implant.

Subjects and Methods: Twelve patients were selected from the outpatient clinic, Prosthodontics Department, Faculty of Dentistry, Minia University. Both groups were classified into two equal groups; according to the implant superstructures either dome shaped abutment -and-ball and socket attachment. Each Patient of both groups had two implants in second molar position and received removable partial denture of the same design. Patients were followed up for one year radiographically regarding marginal bone loss and bone density around each implant. Group I: Six patients received RPD supported by dome shaped short abutments. Group II six patients received RPD retained by ball and socket attachments.

Results: Results revealed that there was Significant increase in marginal bone loss in group II implant retained with ball abutment than group I implant supported with dome shaped abutment and Significant increase in bone density in group I (implant supported) than group II (implant retained)

Conclusion: The use of dome shaped abutment produce less marginal bone loss and increase of bone density than the use of ball abutment.

KEYWORDS: Implant supported, implant retained, removable partial over denture.

* Clinical Instructor at Removable Prosthodontics Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt.
** Associate Professor of Prosthodontics, Faculty of Dentistry, Minia University, Egypt.
*** Professor of Prosthodontics, and Vice Dean for Education and Student Affairs, Faculty of Dentistry, Minia University, Egypt.
**** Professor of Prosthodontics and vice President, Kantara University; Egypt.

INTRODUCTION

Treatment options for the partially edentulous patient and dental rehabilitation may involve removable partial dentures (RPDs), fixed partial dentures (FPDs), implant-supported crowns, and/or FPDs. For many of these individuals, an RPD represents a removable, economical, and conservative treatment. When RPDs are rejected, the reasons frequently include a desire for a fixed prosthesis, aesthetics, unsatisfactory retention, and increased risk of biologic complications [1]

The distal extension removable partial denture is subjected to vertical, horizontal and torsional forces that may become adverse during functional and Para functional activities. These forces, which can affect denture stability, and support are often compensated for some extent by framework and denture base design variations.[2]

Placement of dental implant in distal extension cases may be effective to enhance stability and support as Keltjens et al[3] reported on a clinical trial with 2 patients in which implants were placed beneath the distal-extension denture base of the removable partial denture to obtain stable and durable occlusion.

Brudvik [4] also stated that implant placement in the distal edentulous ridge (ideally in the second molar region) would effectively change the Kennedy Class I or II situation to Class III.

Consequently, adjunctive implant support has been proposed for mandibular Class I and II removable partial denture designs.[5,6] The evidence is that this will minimize the risk of potential problems of patient discomfort associated with prosthesis retention and stability resulting from residual ridge resorption.[7,8]

Using ball attachment and O-ring to retain mandibular removable partial denture on a bilateral single molar implants in cases of Kennedy class I cases by bilateral distal single implant helped both support and retain the mandibular removable partial denture and present accost effective treatment, they added the conversion of the mandibular removable partial denture from tooth- tissue-supported to tooth-implant-supported.[9]

The aim of the study was to compare between of two types of implant superstructures, namely dome shaped and ball attachments regarding their effect on longevity of implants in cases restored by removable partial dentures.

MATERIALS AND METHODS

The study and Sample Size: The study was a comparative study; investigators didn't know the type of Implant super structure before measuring the available bone. Sample size of 12 implants in each group.

Patient selection:

Twelve patients with partially edentulous lower arch Kennedy's class I were selected from the outpatient clinic, Prosthodontics Department, Faculty of Dentistry, Minia University. All the patients had their first or second premolar as posterior abutments and had full dentition in maxillary arch. The patients were informed by all procedures of our study. Only motivated patients who showed co-operation participated in the study and an informed consent were assigned, also approval of REC (Research Ethic Committee) of the Faculty of Dentistry Minia University was obtained.

Clinical procedures:

Stage 1: Construction of acrylic partial denture for the lower arch.

Each patient had received lower acrylic partial denture with conventional method.

Stage 2: Fabrication of surgical guide and radiographic examination.

A customized surgical guide was fabricated using CAD/CAM technology through the data obtained from the cone-beam CT (CBCT), Captured images by CBCT were imported into viewing software then sent for fabrication of the guide.

TABLE (1): Results of radiographic evaluation Marginal Bone Loss in both coronal and sagittal view in two studied groups at different periods of follow up.

	Insertion	3months	6months	12mont
Group I				
Rang	0.0-0.0	0.0-0.5	0.0-1.5	1.0-2.5
Mean	0.0	0.2	0.7	1.6
SD	0.0	0.2	0.6	0.6
P1		0.026*	0.011*	0.001*
Group II				
Rang	0.0-0.0	0.0-2.0	0.0-2.2	1.0-2.5
Mean	0.0	0.8	1.2	1.7
SD	0.0	0.8	1.0	0.6
P1		0.001*	0.001*	0.001*
P2	-	0.013*	0.013*	0.211

P 1 comparison between times of insertion with other time of follow up in the same group

P2 comparison between the two groups at the same time

P was significant if < 0.05

**** Significant difference***

N.S. Not significant

P1 value was calculated by using ANOVA test

P2 value was calculated by using student t-test

Table (2): Results of radiographic evaluation of Bone density around the implant in both coronal and sagittal view in two studied groups at different periods of follow up.

	Insertion	3months	6months	12mont
Group I				
Rang	222.0-730.0	308.0-1045.0	615.0-1813.0	649.0-1836.0
Mean	491.8	731.2	1376.4	1423.3
SD	195.2	232.1	404.8	396.8
P1		0.003*	0.001*	0.001*
Group II				
Rang	450.0-649.0	304.0-862.0	265.0-673.0	226.0-694.0
Mean	553.0	591.6	489.8	423.3
SD	64.0	199.6	144.7	181.5
P1		0.365	0.265	0.152
P2	0.211	0.072	0.001*	0.001*

P 1 comparison between times of insertion with other time of follow up in the same group

P2 comparison between the two groups at the same time

P was significant if < 0.05

**** Significant difference***

N.S. Not significant

P1 value was calculated by using ANOVA test

P2 value was calculated by using student t-test

Stage 3: Surgical procedure

The surgical procedures were performed in one step under aseptic conditions. The implants were located at the second molar site in the edentulous area of the mandible. All patients were anaesthetized by local nerve block and infiltration at the site of the surgical field. The incision was made at the crest of the ridge, crestal flap was achieved by a sharp scalpel number 15 blades. The scalpel was pressed firmly to bone and the incision was made once for clean cut or by tissue punch. Pilot drill was pointed down through the hole reaching down to the alveolar bone and punching it to make a point that acts as a guide for drilling. The sterilized surgical stent was placed securely in the oral cavity with its hole corresponding to the planed implant position. Drilling was done through the stent's hole with light intermittent finger pressure using sterile saline solution irrigation. Drilling was performed starting with the pilot drill (2.3mm) in diameter then intermediate drill (2.8mm D) was used and driven to the full depth of the planned implant, and finally with (3.5mm D). The paralleling rod was inserted into the drill hole to make sure that the implant was in its right position. The implant was removed from the sterile pack with the fixture mount and was inserted to the osteotomy till the implant collar by

hand piece then manual by using ratchet wrench. A surgical cover screw corresponding to the diameter of the implant was placed and tightened into position with hand screwdriver. A hand debridement and irrigation of the surgical site was carried out. The flap was repositioned around the implant and sutured by interrupted sutures using 3-0 silk sutures. Surgical technique was repeated for the other side either by surgical flap or by using tissue punch.

Stage 4: Prosthetic procedure

Mouth preparations

All patients had to complete phase I therapy including supra and subgingival scaling, root planning and curettage. Proper oral hygiene instructions including the appropriate brushing technique and inter-dental cleansing procedures were implemented. This phase also included minor occlusal adjustments when needed, occlusal analysis and correction for occlusal reconstruction were made either by selective grinding, obturation of carious lesions, crowning or removal of overhanging margins and uncovering the implant by removing the tissue above it using tissue punch. The surgical cover screw was removed using the screw driver and the implant abutment was screwed into the implant. Inside the patient mouth for group I they received dome shaped abutment, while group II received ball abutment (Fig 1,2).

The mouth preparations were made as the following:

- Mesial occlusal rest seat for the 1st or 2nd premolar (the main abutment) adjacent to the edentulous area.
- Canine rest or distal occlusal rest seat adjacent to the main abutment

Both groups were included for constructing the conventional Cobalt Chromium RPD after the healing period with the same design RPD with the conventional way. Maxillary and mandibular preliminary impressions, final impression, Duplication of the master cast was performed to obtain a refractory model for waxing up the partial overdenture framework., try in of metal framework. (Fig.3,4) Jaw relation registration, then partial overdenture try in was made with normal acrylic teeth then flasking, finished and polished.

- Mesial occlusal rest for the 1st or 2nd premolar (the main abutment) adjacent to the edentulous area.
- Lingual plate major connector.
- Cingulum rests on mandibular Canines or distal occlusal rests adjacent to the abutment.

For group I with dome shaped abutment (the secondary coping is a part of the metal frame work (Fig. 5), while in group II the O ring is attached to the ball abutment and connected to the frame work by direct pick up technique using self-cure-cold cure acrylic resin material (Fig.6). Partial overdenture was inserted into the patient's mouth and was checked for retention, stability and support. Instructions were given to the patient about how to use and clean the partial denture.

Radiographic evaluation

Each case was evaluated radiographically at the time of denture insertion, three, six and 12 months later. Radiographic evaluation included marginal bone loss and bone density around the implant by using CBCT

a) Assessment of marginal bone loss

For both groups, marginal bone level around the implants was examined using cone-beam CT (CBCT) at insertion time 0, after 3 month, 6, and 12 months to measure the amount of marginal bone loss around each implant.

Marginal bone level was measured using OnDemand3D Application software (Sordex-Scanora® 3D). The distance from the marginal bone to the apex of the implant was calculated in millimetres using straight line tool of the system. The mesial and distal bone heights were measured on the sagittal view screen, while the buccal and lingual bone

Fig (1). Dome shaped abutment for gp I.

Fig. (2): Ball abutment for gp II

Fig. (3): Metal framework try in for gp I.

Fig. (4): Metal framework try in for gp II.

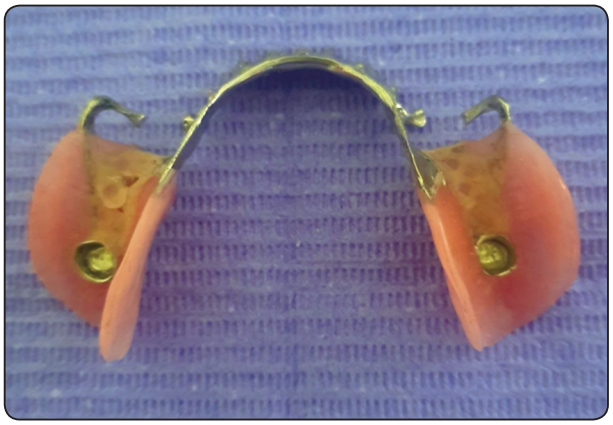

Fig. (5): The secondary coping is a part of the metal frame work for Gp. I.

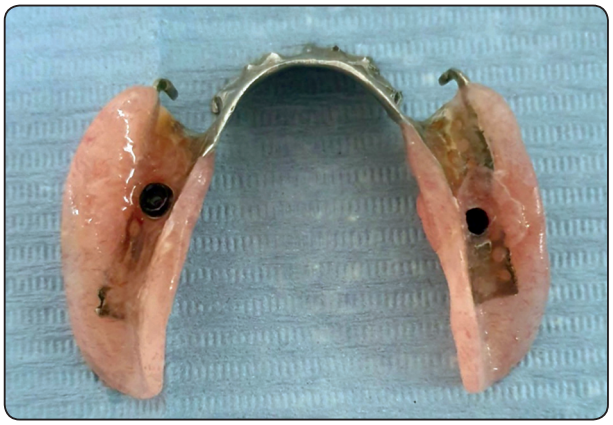

Fig. (6): The O ring connected to the frame work by direct pick up technique using selfcure- cold cure acrylic resin material for gp. II.

heights were measured on the coronal view screen using the linear assessment OnDemand3D software. The mean value of readings were taken, tabulated and statistically analysed.

b) Assessment of bone density changes

Bone density around the implants was measured using cone beam CT (CBCT) at insertion 0, after 3, 6, and 12 months. Bone density was measured using On Demand 3D Application software (Sordex-Scanora® 3D).

The bone density measurements were recorded in relative Hounsfield units (HU). The regions of interest (ROI) were square area (6X6) at the centre of implant surface to reduce the effect of the scattered radiation on the density values.

The bone densities at the buccal, lingual and apical bone surfaces are measured on the coronal view screen. While the bone densities at the mesial, distal and apical surfaces are measured on the sagittal view screen.

The mean value of readings were taken, tabulated and statistically analysed.

3. Results and statistical analysis

Data were fed to the computer using IBM SPSS software package version 24.0.

Qualitative data were described using number and percentage. Comparison between different groups regarding categorical variables was tested using Chi-square test.

Quantitative data were described using mean and standard deviation for normally distributed data while abnormally distributed data was expressed using median, minimum and maximum.

For normally distributed data, comparison between two independent population were done using independent t-test while more than two population were analysed F-test (ANOVA) to be used. The results of this study were represented by tables. The significant level was set at $P \leq 0.05$.

DISCUSSION

Selection of implant-retained overdenture treatment for the posterior edentulous mandible can provide both the patient and clinician with several advantages.[10] Mandibular implant-retained overdenture treatment has significantly increased the scores for retention and stability of the denture, masticatory function and general denture satisfaction. Furthermore, it may have favourable psychological and social effects on the patient.[11]

Preoperative Cone beam computed tomography (CBCT) Three-dimensional imaging, has made significant contributions to the planning and placement of implants. The accuracy of CBCT data can be used to fabricate a surgical guide that transfers the implant planning information to the surgical site to facilitate implant placement.[12]

Implant used in this study was placed into the second molar area, to avoid the posterior rotation of the partial overdenture on the implant's abutment as a fulcrum.[13,14]

Choosing dome shaped abutment was to reduce the load on the implant by permitting slight rotational movements.[15] while choosing O-ring ball abutment an excellent method for increasing the retention and stability of such dentures, which has several advantages, including ease of use, hygiene, and maintenance, and low cost.[16]

Results of radiographic evaluation of marginal bone loss for both groups there were significant increase in all periods of follow up, while when comparing the two groups together there were significant differences after 3 and 6 months, where group II with ball abutment showed significant increase in mean marginal bone loss than group I with dome shaped abutment, this may be related to the presence of space between the components of the resilient ball attachment, which may permit free vertical rotation of the over denture during function with concentration of diverse forces on the residual ridge and the implant. This may be also attributed

to that the presence of effective vertical implant support that may decrease the rotation potential of denture base during functional loading.[17-19]. Our results agreed with Abdou ELsyad who stated that Implant-supported partial overdentures appear to be associated with reduced posterior mandibular ridge resorption when compared to implant retained partial overdentures [20]. As well as results agreed with Turkyilmaz that stated that if the distal implants were used for retention only then its role in the distal extension denture base is to minimize the potential for dislodgement of the denture during function (indirect retention) so abutments are subjected to the same functional loads delivered by conventional RPD designs.[21]

On the other hand in supported group showed a statistically significant difference in marginal bone loss compared to the implant retained group. This may be attributed to that the presence of effective vertical implant support that may decrease the rotation potential of denture base during functional loading.[22-24] Brudivik, et al.

The marginal bone loss was statistically significant, after 12 months in both groups and insignificant between both groups. Mitrani et al, suggested that any mechanical wear may occur at the interface between the implant and the denture base will allow the opportunity for the rotation potential to occur, consequently the implant overloading may occur during function this will lead to marginal bone resorption in both groups. [25, 26]

Results of radiographic evaluation of bone density for the support group showed significant increase in all periods of follow up this was unlike in the retention group showed that there were insignificant changes in all periods of follow up, there were significant increase in bone density in group I after 6 and 12 months compared to group II. This may be due to increase of bone remodelling, under mild over load that occurred in support dome shaped abutment than the ball abutment of the retention group. This agreed with Carla M. et al who stated that This is a realistic indication that an implant assisted supported RPD treatment could better maintain an appropriate bone remodelling equilibrium, thereby preserving a healthy status of bone.[27]

The presence of posterior support that prevent vertical intrusion of the base was prevented with no additional forces that were present in retention group due to , the presence of a spacer between the components of the ball attachment that may allow for rotation potential of the free end base during function and magnifies the stresses transmitted to the abutments. These results agreed with Elkholy et al(28) who found that there was statistically significant increase of bone density after six months with implant supported removable partial and non-statistically change in the bone density with implant supported fixed partial denture.

Our results agreed with Zancopé et al, in a systematic review who concluded that using a distal implant use in partial removable dental prosthesis to convert a Kennedy class I to class III dental prosthesis increases patient satisfaction and masticatory performance and does not impair implant survival rates [29]

CONCLUSION

Within the limitations of this study, the following conclusions could be drawn:

- Significant increase in marginal bone loss in group II implant retained with ball abutment than group I implant supported with dome shaped abutment after 3 and 6 months of denture insertion
- Significant increase in bone density in group I (implant supported) than group II (implant retained) after 6 and 12 months of denture insertion.

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