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IMPLANT SUPPORTED VERSUS RETAINED MANDIBULAR DISTAL EXTENSION REMOVABLE PARTIAL OVERDENTURE-A PRELIMINARY STUDY OF IMPLANT AND ABUTMENT MARGINAL BONE HEIGHTS

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ABSTRACT

Purpose: This study was aimed to investigate and compare the effect of implant supported versus retained mandibular distal extension removable partial overdenture (RPOD) on the abutment and implant marginal bone height changes.

Materials and methods: 20 healthy male patients were selected with mandibular bilateral distal extension ridges against edentulous maxilla .One osseointegerated self taping implants was installed distally in the area of the second mandibular molar of each side. Patients were divided into two equal groups; Group I: received maxillary complete denture against implant supported RPOD, and Group II : received maxillary complete denture against implant retained RPOD. Digital panoramic radiographs were recorded for each patient immediately, 6 and 12 months after denture insertion to measure the abutment and implant marginal bone height changes.

Results: The mean tooth abutments marginal bone loss was statistically significant in both groups after 6 and 12 months of the study. However, this marginal bone loss was statistically significant between both groups after 12 months of the study. The mean implant marginal bone loss was statistically significant within and between both groups along the periods of the study.

Conclusion: Regardless the implant RPOD designs concept (supported or retained), abutment tooth and implant marginal bone were significantly reduced. However, this study recommended periodic monitoring of ridge base relation to preserve the supporting structures.

KEY WORDS: implant, distal extension RPD, supported or retrained overdenture, alveolar bone resorption

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INTRODUCTION

Patient lacking mandibular posterior teeth (class I and II Kennedy classifications) are frequent occurrence in dental clinics, requiring a constant search for rehabilitating prosthetic solutions [1]. Due to the dual nature of support, teeth and mucosa with different resilience, rehabilitation with class I conventional removable partial denture (RPD) is complex .The base is subjected to vertical, horizontal and torsional forces that may cause adverse effects during functional and para-functional activities. These forces affect denture retention, stability and support [2, 3].

Many investigators suggested different approaches to balance the loads distributed among the teeth and ridge mucosa such as making functional impressions, using a wide prosthetic base with a physiologic lining, periodic rebasing of the prosthetic seat, use of stress releasing clasps or attachments and splinting of distal support abutments [4, 5]. In the last few decades, a strategically placed distal implant combined with distal extension RPDs was used as an alternative to the conventional RPDs. The implant stabilizes the saddle vertically, enhances masticatory efficiency, reduces prosthetic complications, improves patient satisfaction, provides cost effective treatment modality [6, 7], reduces residual ridge resorption, reduces the effect of the reciprocal arm of a conventional RPD, improves the fulcrum line position and eliminates unaesthetic clasps in the esthetic zone [8, 9].

Two main design concepts were suggested for mandibular distal extension removable partial overdenture (RPOD) combined with distally placed osseointegrated implants; namely implant supported and implant retained RPODs. However, the prognosis of implant and natural tooth abutments as regards to both design concepts is not clearly investigated. This study is aimed to investigate and compare the effect of implant assisted mandibular distal extension RPD design concepts (supported and retained) on the implant and abutment tooth marginal bone height changes.

MATERIALS AND METHODS

20 healthy partially edentulous male patients (mean age 55 year) were selected from the Prosthodontic Department, Faculty of Dentistry, Mansoura University. All patients had completely edentulous maxillary arches against partially edentulous mandible with first premolars and six anterior teeth remaining. The posterior residual alveolar ridges were of suitable height (minimum of 10 mm exists above the mandibular canal as verified by panoramic radiographs). Patient's exclusion criteria included systemic diseases related to bone resorption or contraindicate for surgical procedures and chronic abnormal habits as (smoking, bruxism or clinching) .

Pre-surgical and surgical procedures:

Maxillary complete and mandibular partial acrylic resin dentures were made for all patients. A clear acrylic resin replica of mandibular partial denture with stainless steel wires fixed on the buccal flanges corresponding to implant sites was constructed and used as a surgical-radiographic template. For every patient, a preoperative panoramic radiograph was taken with the template in place **(Fig.1)**, processed and scanned on a digital scanner (Vuego Scan. Brista). The scanned radiograph was traced using a computer program (Corel Draw 10). The distance between the mandibular alveolar bone crest and the mandibular canal was assessed by calculating the magnification errors from the true lengths of the wires on the replica and their radiographic image [10]. Suitable implant length was selected according to the measured distance.

Fig. (1) Pre-surgical digital panoramic radiograph with the surgical stent

Two implants (Dyna Dental Engineering, Bergen op Zoom, Netherlands) were inserted parallel to each other in the 1st molar area of mandibular distal extension ridges of each patient using standardized 2-stage surgical approach procedure. Post operative panoramic x-ray film was made to verify position and orientation of fixtures on both sides. All patients were instructed to avoid denture wearing for 2 weeks, and then the fitting surface of the temporary prosthesis was relived for 2mm and relined with tissue conditioner. Relining was replaced weekly during the three months of the osseointegration period. The implants were surgically exposed after the submerged period, and healing abutments were screwed into the fixtures.

Prosthetic procedures

Mandibular irreversible hydrocolloid impression were recorded to construct mandibular diagnostic cast. After surveying, the necessary mouth preparations were done. A final mandibular rubber base impression was recorded and poured to construct a master cast. Metallic frame work was constructed to include RPA direct retainer on 1st premolar, cinglum rests on the canines as indirect retainer ,lingual bar major connector and two meshwork extensions covering the anterior two thirds of the distal edentulous ridges.

The metal framework was used to record a functional zinc oxide euginol impression of the distal extension ridges. A circular hole was prepared in the impression corresponding to the healing abutment. The impression transfer copings were screwed into the fixtures and picked up to the tray using auto-polymerized acrylic resin. After removing the impression, the implant analogs were screwed into the copings and the distal extension areas of the master cast were sawed and removed away. The metal framework with the impression was carefully seated on the sawed cast and poured to construct an altered cast. After jaw relation records, semi-anatomic acrylic resin teeth were selected and arranged for balanced occlusal contacts, then the waxed up trial dentures were tried in the patient mouth. The finished dentures were verified, adjusted and delivered in the patient mouth.

According to the design concept of RPOD, patients were classified into two equal groups as follows: ***Group I:*** where healing abutments were used to provide only vertical contact with the saddle to support the RPOD (**Fig 2**). Any lateral contacts was eliminated by means of disclosing wax [11]. ***Group II:*** where ball abutment and smart matrix (Dyna Dental Engineering, Bergen op Zoom, The Netherlands) were used to provide retention of the RPOD. A rubber spacer and a circular rubber sheet were seated on the top and around the bottom of the ball abutment respectively to pick up the smart matrix into the mandibular denture fitting surface using autopolymerized acrylic resin (**Fig 3**).

The patients were instructed to follow a regular home care and proper oral hygiene. The ridge base relation was monitored every three months by using irreversible hydrocolloid wash on the denture base fitting surface.

Fig. (2) Implant supported RPOD case and final mandibular denture

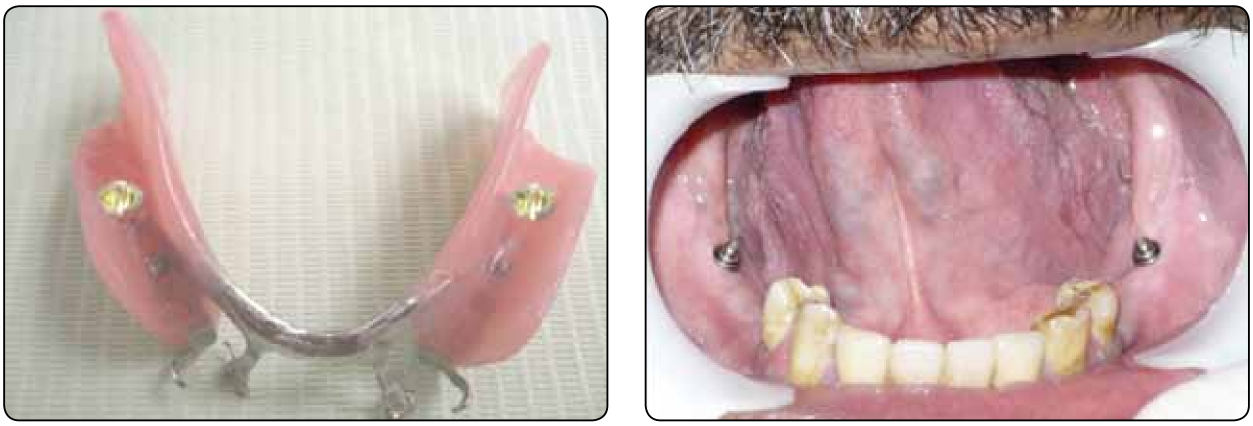

Fig. (3) Implant retained RPOD case and final mandibular denture

Radiographic evaluation of marginal bone height changes

For every patient, a panoramic radiograph was taken immediately, 6, and 12 months after denture insertion, processed and scanned on a digital scanner. The scanned radiograph was traced using a computer program (Corel Draw 10). Radiographic evaluation of marginal bone height changes were made for both abutments and implants according to **Mehdizadeh et al, (2006)** [11] **and Heckmann et al, (2006)** [12] as follows (**Fig 4**);

A) For tooth abutments

The mesial (A-C) and distal (B-D) radiographic distances were measured, were A & B points representing the level of mesial and distal cemento-enamel junction respectively and C & D points representing the level of mesial and distal inter-dental alveolar bone crest level respectively. The mean radiographic alveolar bone height changes = (A-C) distance + (B-D) distance/2.

B) For implants

The mesial (A-C) and distal (B-D) radiographic distances were measured, were A & B points representing the level of mesial and distal top of implant collar respectively, and C & D points representing the level of mesial and distal first contact marginal alveolar bone level respectively. The mean radiographic alveolar bone resorption= (A-C) distance + (B-D) distance/2.

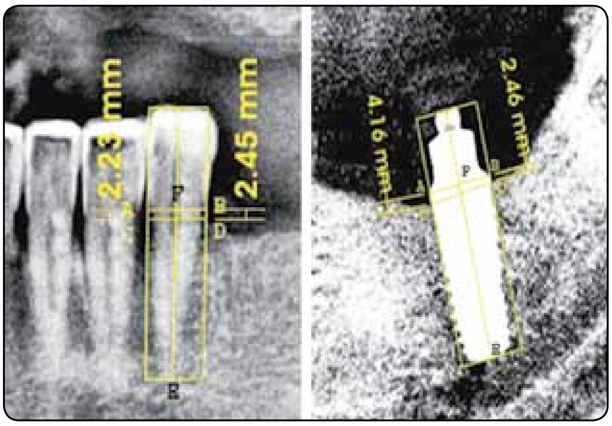

Fig. (4) Tracing of the marginal alveolar bone height for tooth and implant abutment.

For both abutments and implants, the actual mean alveolar bone loss was measured from the formula (Actual length = magnification error × radiographic length).

Statistical analysis

Data was independently and concurrently collected by 3 examiners to minimize single examiner errors. The mean radiographic differences were detected within groups in different periods using student *t*.test and between the groups in different periods using paired T test and 5% level of significance was considered as a valid test.

Marginal bone resorption for teeth abutments (table 1)

The mean abutment tooth marginal bone resorption was statistically significant after all periods of the study for ***Group I*** (p=0.006*, 0.011*and 0.004* respectively) and for ***Group II*** (P=0.009*, 0.000*and 0.001* respectively).

Comparing the mean abutment tooth marginal bone resorption between both groups, statistically insignificant differences were found after the 1st and 2nd 6 months periods, while a statistically significant difference was found after 12 months period (p= 0.017*).

Implant marginal bone resorption for abutments (table 2)

The mean implant marginal bone resorption was statistically significant after all periods of the study for ***Group I*** P=0.004*, 0.006*, 0.001* respectively) and for ***Group II*** (p=0.003*, 0.003*, 0.000*respectively).

Comparison the mean implant marginal bone resorption between both groups, statistically insignificant differences were found after the 1st sex months and 12 months periods. While a statistically significant difference were found after the 2nd six months (p= 0.026*).

TABLE (1) The mean abutment tooth marginal bone resorption after 1st 6 months, 2nd 6 months, and 12 months after denture insertion in both groups

	1st 6 months	**2nd 6 months**	**All 12 months**
Group I	**0.3100±0.1659**	**0.4283±0.2656**	**0.7383±0.3669**
T	**4.577**	**3.950**	**4.929**
P	**0.006***	**0.011***	**0.004***
Group II	**0.8817 ± 0.5177**	**0.6350±0.1678**	**1.5167± 0.5247**
T	**4.172**	**9.271**	**7.080**
P	**0.009***	**0.000***	**0.001***
Paired t.test	**P= 0.062**	**P=0.158**	**P=0.017***

N=20=number of implants in each group. **=Significant when p≤ 0.05*

TABLE (2) The mean implant marginal bone resorption after in 1st 6 months, 2nd 6 months, and 12 months after denture insertion in both groups:

	1st 6 months	2nd 6 months	All 12 months
Group I	**0.4717±0.2297**	**0.3817±0.2039**	**0.8533±0.2641**
T	**5.029**	**4.585**	**7.915**
P	**P=0.004***	**P=0.006***	**P=0.001***
Group II	**0.2983±0.1405**	**0.7567±0.3386**	**1.0550±0.2816**
t	**5.202**	**5.473**	**9.176**
P	**P=0.003***	**P=0.003***	**P=0.000***
Paired t.test	**P= 0.089**	**P=0.026***	**P=0.280**

N=20=number of implants in each group. *=*Significant when p≤ 0.05*

DISCUSSION

Kennedy class I partial denture has long drawn attention been a controversial treatment (1 - 3, 13, 14) and represents a true difficulty in terms of preserving abutments (15- 17).

The obvious situation in which a single implant can make a major contribution to the success of a removable partial denture is in the distal extension partial denture (47). The partial denture connection to the implant may be either designed to provide vertical support or retention through the use of any attachment system (28, 48). Many literatures reported this treatment modality (22- 26) but scarce studies discussed the implant RPOD in the form of different categories as implant supported or retained (27- 30). However, to justify this prosthetic treatment and to ensure that it is beneficial to the patient, assessment for such treatment must be established (41). This study used a strategically placed distal implant to support or retain distal extension RPD. The height of supporting alveolar bone around the distal natural abutment tooth and the implants were evaluated and compared. (7, 8, 18 - 21).

The digital panoramic x-ray was used in this study. It was agreed that it provides increased image quality and convenience of the patients with standardization of the x-ray and ease of withdrawing data in a software form without scanning, so it provides direct repeatable predictable available practical bone level measuring method (31- 33).

In this study, the mean marginal bone resorption of the abutment teeth in the ball retained group was statistically significant after all periods of study. It was agreed 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 (34). However, the presence of a spacer between the components of the ball attachment may allow for rotation potential of the free end base during function and magnifies the stresses transmitted to the abutments. On the other hand, the implant supported group showed a statistically insignificant abutment marginal bone resorption 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 [28,-30].

The mean implant marginal bone loss after one year was statistically significant in both groups. However, the resorption values in both groups could be considered as being accepted regarding the generally accepted values for implant marginal bone resorption in the first year which range from 0.5 mm to 1.2 mm [35- 41].

Marginal bone loss was statistically significant after first six months in both groups. However this loss was statistically insignificant between both groups, this may be attributed to the early marginal bone loss usually occurs in this period. It is related to a multi-factorial etiology includes; healing of alveolar bone, bone remodeling, bone response to primary loading, etc. [43, 44]. The early period of implant loading subject it to functional forces so the bone near the implant is subjected to direct short rang forces due to mastication, and long range forces due to jaw flexure [45].

Marginal bone loss was statistically significant after second six months in both groups. This loss was statistically significant between both groups; this may be attributed to the effect of RPOD designs. In other words, implant supported RPODs transmitted less harmful forces to the implant during function compared to the ball retained group which may be subjected to lateral movement in function. This was in contrast to the opinion of **Li-Ching Chang, et al, (2007)** how stated that in implant retained RPOD most supportive forces were born by the teeth and mucosa, whereas the implants provided mainly retention, so that overloading was less likely [46].

The marginal bone loss was statistically significant, after one year in both groups. This loss was statistically insignificant between both groups; this may be attributed to the change in the contact relationship between the denture base and dome shaped abutment. **Mitrani et al, (2003)** suggested that a mechanical wear may occur at the interface between the implant and the denture base [49, 50]. However, any change in the contact relation 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 and calls for higher marginal bone resorption in both groups.

CONCLUSION

Within the limitation of this study, it could be concluded that

1. Regardless of the implant RPOD concept, the implant and tooth abutment marginal bone were reduced after one year of denture insertion.
2. Maintenance of implant supported groups must be started six months after insertion.

RECOMMENDATION

Although results of this study revealed that the prognosis of implant and distal abutments are not favorable within the short period of this study a further longitudinal investigation is recommended for periodic monitoring of implant and abutment supporting structures and the residual alveolar ridge.

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