

COMPARATIVE STUDY BETWEEN TWO DIFFERENT TYPES OF ATTACHMENTS RETAINED IMPLANT MANDIBULAR OVER DENTURE ON THE ANTERIOR MAXILLARY BONE RESORPTION

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ABSTRACT

Aim: This study was conducted to evaluate and compare the effect of using two different types of attachments (Locator and ball); to retain implants mandibular over denture on the anterior maxillary bone resorption.

Material and methods: Fourteen completely edentulous male patients with problematic existing mandibular dentures, received two implants in the canine region of the mandible. New maxillary complete dentures and mandibular overdentures were fabricated for all patients, following conventional clinical and laboratory techniques. Patients were divided randomly by closed envelopes into two groups; Group I: Patients received implant retained overdenture by locator attachment, while Group II: patients received implant retained overdenture by ball attachment, four months after implant placement. Traced rotational tomograms were used for measurements of maxillary alveolar bone loss. The proportional value between bone areas and reference areas not subject to resorption was expressed as a ratio R. Change in R for all patients were evaluated immediately before insertion overdenture (T0), and after two years (T2) later, and calculated for anterior maxillary area.

Results: During the two years; within each group, during the two years the follow up period showed a significant decreasing change in R in the anterior maxillary area. By comparing groups together, group II (ball attachment) showed a significant change in R more anterior maxillary ridge resorption than group I (locator attachment) ($P = 0.011$).

Conclusion : Within the limitation of this study and consideration of the small sample size, it could be concluded that; Ball attachments for implant retained mandibular overdentures are associated with more maxillary ridge resorption than locator attachments.

KEY WORDS: Bone resorption, Ball, Locator attachments, Implant, Overdenture.

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INTRODUCTION

Kelly's syndrome, which outlines a number of specific oral changes in patients with a maxillary complete denture opposite to mandibular Kennedy class I removable partial denture, the remaining natural anterior teeth will often result in premature anterior occlusal contact and cause extensive tissue damage⁽¹⁻³⁾. Kelly⁽¹⁾ considered the early bone loss in the anterior maxilla to be the key to the other changes and noted that as resorption of the premaxilla progressed, further tissue damage and denture instability followed proportionately.

Many patients suffer from total edentulism and need treatment with prosthesis supported exclusively by mucosa, characterizing a traditional complete denture. The common reasons for dissatisfaction in patients using dentures are pain, areas of discomfort, poor denture stability, and difficulties in eating as well as lack of retention capability.⁽⁴⁾ It generates a great impact on quality of life and well-being. Subsequently; a tendency toward using dental implants to support dentures was advanced to overcome denture instability and looseness.⁽⁵⁾

The majority of patients adapted with two implant-retained overdentures expressed a high level of overall satisfaction and increased quality of life, and provide easier access for oral hygiene.⁽⁶⁻⁸⁾ This clinical situation was proposed to develop a risk for severe resorption in the anterior maxilla in individuals wearing mandibular implant-retained overdentures, which was supposed to create anterior hyper-function or combination syndrome⁽⁹⁻¹²⁾.

The attachment mechanism in the implant overdenture provides enhanced retention and stability compared with the conventional denture. The support is gained from both the intraoral tissues and dental implants. The connection should minimize denture movement without increasing the stress on the implants.⁽¹³⁻¹⁵⁾

The implant-retained removable denture in an edentulous jaw can be attached to different anchorage systems of splinted attachments as bars, or non-splinted attachments as ball and socket, magnetic and double crowns⁽¹⁶⁾. Unsplinted attachment systems require less space within the prosthesis, are easier to clean and more economical, as well as less technique sensitive when compared to splinted designs⁽¹⁷⁾. The choice of the attachment is dependent upon the retention required, anatomy, jaw morphology, oral function, and patient compliance for recall⁽¹⁸⁾.

The characteristic feature of locator attachment is the unique dual retention with combined internal and external retentive features.^(19,20) This is supplied in different colors with different retention values^(15,21), and they are available in different vertical heights, resilient, and repair and replacement are fast and easy.⁽²²⁾

Ball attachments efficiency is well-documented and much described for implant-retained overdentures because of effectiveness and simplicity^(23,24). Moreover, the mucosal hyperplasia reportedly is more easily reduced with ball attachments⁽²⁵⁾. It was also reported that the use of the ball attachment may be advantageous for implant-supported overdentures with regard to optimizing stress around implants⁽²⁶⁾. However, their high-profile is considered disadvantageous.

Some researchers reported negative effects of two implant retained mandibular overdentures to produce anterior occlusal loading on anterior maxillary edentulous ridge^(12-27,28,29). However, locator attachments appear to function reasonably well, there is a lack of clinical studies on the effect of Locator system⁽³⁰⁾ for mandibular implant overdentures on bone resorption of opposing maxillary edentulous. Therefore, the present study was prepared to compare retrospectively between, the effect of locator and ball attachments for two-implant retained mandibular overdenture on anterior maxillary bone resorption.

MATERIALS AND METHODS

Fourteen complete edentulous male patients complaining from functional difficulties of their conventional mandibular dentures were selected from outpatient clinic of the Department of Removable Prosthodontics, Faculty of Oral and Dental Surgery, Misr University For Science and Technology, with their age ranging from 60 to 69 years (mean age 64.5 years). The selected patients exhibited Angle class I ridge relationship, patients had either rounded or U-shaped alveolar arches, adequate inter arch space, no history of parafunctional habits, they also had no temporomandibular joint disorders. Clinical and radiographic evaluation (using CBCT) revealed that the residual alveolar ridge exhibited adequate height between (14:20 mm) and width about (6 mm) and was covered with firm fibrous mucoperiosteum. Patients with poor oral hygiene, abnormal jaw relationship, or those having a medical problem that may affect the oral environment as diabetes, immune deficiency were excluded. All patients participating in this study were rehabilitated by mucosa supported maxillary complete denture and implant retained mandibular over denture by two implants installed in the canine region.

After explaining the study design, an informed consent was obtained from each patient before commencement of the study.

Patients grouping: Patients were divided randomly by closed envelopes into two groups; Group I: Patients received implant retained overdenture by locator attachment, while Group II : patients received implant retained overdenture by ball attachment.

Surgical and prosthetic procedures: For all patients, two endosseous implants (3.7mm in diameter and 13mm in length, TioLogic, Dentaaurum, Germany); were inserted in the canine region of the mandible, following the standardized two stage submerged surgical protocol.

New mandibular overdentures and maxillary complete dentures were constructed following conventional clinical and laboratory procedure and lingualized occlusion using modified cross linked acrylic denture teeth. Patients were recalled for follow up 24 hours after denture wearing, 3 days and one week later. Four months after implant placement, Overdentures were retained to the implants by either locator (Group I, **Fig1**) or ball and socket (Group II, **Fig2**) attachments.



Fig. (1) Two- implant retained mandibular overdenture with Locator attachment.



Fig. (2) Two- implant retained mandibular overdenture with Ball attachment.

The locator attachment for (**Group I**) consisted of: Locator abutment (The female component, medium (M), gingival height 3mm), Locator matrix (metal base with inner retention male insert, attached to the fitting surface of the overdenture), Locator black processing insert, and Retention male inserts (nylon inserts, fitted to the locator matrix,

available in different colors according to the degree of retention, (in this study was pink (low retention; 1.365 g). While; the ball and socket attachment for (**Group II**) consisted of: Ball abutment (The male component; medium (M), gingival height 3mm; ball diameter 2.25 mm), and the outer matrix (The female components, Matrix UnorEcco Au / Pt standard), positioned and tightened with the abutment driver to the implant fixtures and attached to the fitting surface of the overdenture.

The fitting surface of the denture was hollowed directly above the implants to provide enough space for the attachments. For both studied groups the outer matrices were picked up intraorally to the fitting surface of mandibular overdentures with cold-cure acrylic resin. For Group I, pink nylon inserts, were fitted to the locator matrix instead of the locator black processing inserts. The new dentures were delivered to the patients and 6-months regular recall visits for adjustments and radiographic evaluation were scheduled during the study period. Post-insertion instructions were given to the patient regarding its maintenance, nutrition and hygiene.

Radiographic evaluation:

Digital panoramic radiographs were taken in the radiology department, Misr University for Science and Technology. Using the same machine with exposure parameters of 69 KV, 5-12 mA and total filtration of 2.5 mm Al / 80 IEC-522 with intensifying screen HI plus regular speed, and Kodak films X-OMAT RP pan DF 75. Standardization was proven using custom clear acrylic occlusal stent attached to the mouth portion stabilizer of the machine. Two rotational tomograms for each patient taken immediately before overdenture insertion (T0), and 2 years after overdenture insertion (T2), were taken during routine examination.

Evaluations, tracing and calculation of radiographs area, were performed by experienced professional radiologist (one operator), and a software expert both was calibrated. Anterior maxillary bone resorption was evaluated based on proportional area measurements, as used in other

recent studies ^(28,29,30,32). Radiographs were included only if the reference points were clear and if there was no gross distortion of the images. The landmarks (reference points and lines) were traced on the images and then digitized, using assisted drawing computer program (Autocad 14/ Autodesk), the panoramic images were stored on a computer disc.

Reference areas on the right. Bone areas are shown on the left.

The following reference points, lines and areas (Figure 3), used for the evaluations. The anterior nasal spine S and the two lower most bony margins of the orbit O right and O left form the 'central triangle'. The line o joins O right and O left. The intersection between a line and o line, perpendicular to o line through S, is point P. The point R divides the distance (PO) into two-thirds and one-third. This value was determined experimentally so as to divide the maxilla in anterior and posterior regions. r is a line perpendicular to o through R. u is a line parallel to o through S. u and r meet at the point U. P' was marked by measuring the distance (SP) starting from S. R' was marked by measuring the distance (UR) starting from U. The line *i* connects R right and R left. T is the most inferior point of the articular tubercle. The line t joins S and T. The line a joins T and R'. t meets r at point V. VR'T form the 'lateral triangle'. X divides the distance VT into two equal halves. z is a line perpendicular to t through X. z meets with a at point Y. 1 is the intersection of the alveolar crest with p, 2 is the intersection of the alveolar crest with r, and 3 the intersection of the alveolar crest with z. The reference area remains unchanged.

Anatomical and reference areas on the right and left sides were averaged, and a ratio (R) was calculated as follows: R= experimental /reference area. The change in anterior maxillary residual ridge resorption was calculated by subtracting the ratio at the baseline (T0) from the ratio at two year (T2). Radiographic measurements of maxillary bone resorption for both groups were performed at time of overdenture insertion and two years later.

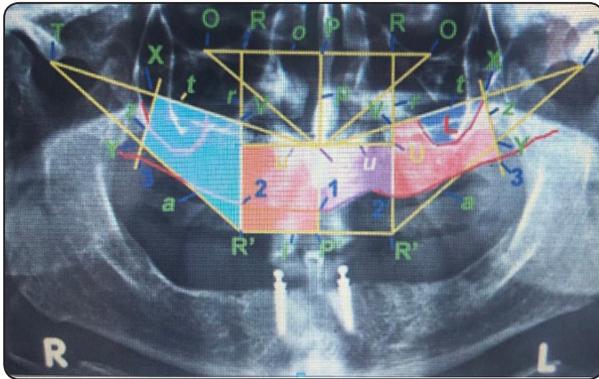


Fig. (3) Tracing of panoramic radiograph with reference points and lines.

Statistical analysis

All data were analysed with SPSS program version 22 Statistical Packages for Social Science (SPSS Inc., Chicago, IL, USA). The data were normally distributed. The mean differences in R were compared between two studied groups using paired t-test. A multiple regression analysis using a stepwise procedure was also performed to test if there was a relation between R and the potential confounding factors: group attachment type, age, years of edentulism, number of worn dentures, initial ridge height of the mandible. *P* is significant if $\leq .05$ at confidence interval 95%.

RESULTS

All patients attended the follow up recall visits. The descriptive statistics of the study population at the beginning of the study are shown in **Table(1)**. Independent sample t-test showed no significant difference at the base line between two studied groups regarding age, years of edentulism, number of previously worn dentures and initial height of the mandible ($P > 0.005$).

The change in anterior maxillary resorption ratio was calculated for each patient by subtracting the ratio value at (T0) years from the ratio value at (T2). Therefore, a negative difference indicated resorption, and a positive difference indicated an increase in area or apposition of bone.⁽³⁴⁾

Results of change in R (between time of overdenture insertion and 2 years later), for maxillary anterior areas in both groups are shown in **table (2)**. There was a significant difference in change in R between the two groups and between areas. By comparing groups together, group II (ball attachment) showed a significant change in R more anterior maxillary ridge resorption than group I (locator attachment) ($P = 0.011$).

Multiple linear regression analysis of change in R for anterior areas with potential confounding factors is presented in **table (3)**.

TABLE (1): The descriptive statistics of the study population at the beginning of the study

	Age Mean±SD	Years edentulous Mean±SD	No. of dentures worn Mean±SD	Initial height of md in mm Mean ±SD
Group I	53.30 ±2.74	4.20 ±0.632	1.00 ±1.05	17.90 ±1.440
Group II	52.60 ±2.85	5.30 ±0.849	1.34 ±1.26	17.10 ±0.994
Independent t-test				
	0.810 (NS)	0.910 (NS)	0.451(NS)	0.160(NS)

SD: Standard deviation, N.S. Non-significant difference between groups at 5% level of significance

TABLE (2): Comparison between mean change in R between studied groups and between areas

Group	Maxillary anterior area	Independent T test
Group II (locator) M ± SD	-0.052 ±0.015	0.002*
Group I (ball) M ± SD	-0.071 ± 0.014	0.001*
Independent t-test	$P=0.011^*$	

M: Mean, SD: Standard deviation, significant at 5% level of significance*

TABLE (3): Multiple linear regression analysis of all factors over 2 years for maxillary anterior area.

Variable	Standard error (SE)	Coefficient (Beta)	<i>t</i>	<i>P</i>	95% Confidence interval (CI)
Group (attachment type)	0.005	0.594	3.893	0.002*	0.008 to 0.029
Age	0.001	0.027	0.153	0.881	-0.002 to 0.003
Years edentulous	0.003	-0.278	-2.286	0.410	-0.012 to 0.000
No of dentures	0.002	-0.121	-0.860	0.406	-0.006 to 0.003
Initial md height	0.002	-0.256	-1.588	0.138	-0.009 to 0.001

* *Significant at 5% level of significance*

DISCUSSION

In clinical practice panoramic radiographs are widely used and are part of many recall programs. Therefore in large numbers of patients, the investigation of ridge resorption with these radiographs is workable^(12,29). The proportional measurements are suitable and dependable for the assessment the residual resorption in the maxilla than absolute measurements⁽³²⁾ as it minimize the problems related to magnification and distortion inherent in rotational tomograms^(11,28) and compensate for head positioning errors⁽¹²⁾. Several previous studies^(12,29,30,33) investigating maxillary bone resorption recommended the use of proportional measurements. Therefore this procedure was chosen for the present study.

In the present study, within each group, during the two years the follow up period showed a significant decreasing change in R in the anterior maxillary area. Similar finding was observed in another study⁽³⁵⁾, which perform on patients wearing maxillary conventional dentures opposing implant retained overdentures with ball and telescopic attachments. The increased maxillary anterior bone resorption may be indicated to the increased masticatory forces transmitted to the mandibular residual ridge via the tissue-supported posterior area of

the overdentures which may result in a continuous tilting and settling of the overdenture, and undesirable loading of the anterior region of the edentulous maxilla⁽³⁶⁾ with subsequent increased bone resorption^(9,29,30,37). Also the increased retention and stability of mandibular overdentures in both groups (locator and ball attachment); make the patients place their mandibles forward to take advantage of the created occlusal forces which may increase transmission of masticatory force to the anterior maxillary ridge^(39,40). As a result, extensive anterior occlusal forces produced before initiation of periosteal mechanoreceptors adjacent to the dental implant which favors resorption of the anterior maxillary ridge^(9, 30, 34).

Also, according to Närhi et al.⁽²⁷⁾, the weakest part of the upper arch to resist stress is the anterior part of the maxillae and when using implants in the edentulous mandible, or when lower anterior teeth occlude anterior to the basal support, trauma is unavoidable. The anterior maxillary ridge resorption was proposed to be a result of the posterior mandibular ridge resorption, both conditions being symptoms of the combination syndrome. However, Tymstra et al.⁽³³⁾ found no correlation between the posterior mandibular residual ridge resorption and the anterior maxillary residual ridge resorption. So their study could not confirm the proposal that the

combination syndrome may occur in conventional maxillary dentures opposed by an implant retained mandibular overdenture.

Comparing between the groups together, ball attachment group (II), showed a significant change in R maxillary ridge resorption more than Locator attachments group (I). The increased bone resorption with ball attachments may be due to these abutments act as a fulcrum during functional loading of mandibular overdenture⁽³⁰⁾. This fulcrum may be due to ball attachments used in this study are supplied in form of ball and sockets which consists of titanium ball and platinized gold sockets. The ball and socket contact each other without space. Therefore it does not permit vertical movement of the prostheses due to absence of vertical resiliency, which may be responsible for transmitting high occlusal forces to the opposing maxillary ridge with associated increase in bone resorption. In contrast locator attachments have a vertical resiliency. Therefore, the Locator attachment allows movements of the prosthesis in both the vertical plane and the hinge axis due to the resiliency of nylon inserts. The resiliency is also achieved with the design of the black processing patrix, which insert is 0.2mm taller than the standard retention inserts, so it maintains the overdenture in the upper limit of its vertical resiliency during pick up of the attachment intraorally. When the processing patrix is replaced by the definitive nylon patrix, a space of 0.2 mm is created to allow for vertical resiliency and 8° hinging in any direction.^(41, 42) Therefore locator attachments not act as a fulcrum during functional loading of mandibular overdenture but permit the denture to move in vertical direction and decrease occlusal forces to the opposing maxillary ridge with associated bone resorption.

In contrast to the finding of this study, Rutkunas, et al.⁽⁴³⁾ in a systematic review, reported that there is no evidence that maxillary ridge resorption is accelerated with certain types of two-implant retained mandibular overdenture attachments.

However in the present study ball attachments were associated with more maxillary ridge resorption than locator attachments.

CONCLUSION

Within the limitation of this study and consideration of the small sample size, it could be concluded that; Ball attachments for implant retained mandibular overdentures are associated with more maxillary ridge resorption than locator attachments.

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