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azhar.dent.j@azhar.edu.eg
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COMPARATIVE STUDY FOR THE EFFECT OF TWO DIFFERENT TYPES OF ATTACHMENT ON SUPPORTING STRUCTURES IN IMPLANT RETAINED MANDIBULAR COMPLETE OVERDENTURE

Ahmed Sherif Sayed *, Ahmed Abd-Elwahed Yossef Shaaban **, Mohamed Reda Zaki El-kholy***

ABSTRACT

Objective: To compare between implant retained overdenture with two different attachments (Magnet and locator) by measuring the following: Retention. Bone changes by radiographic evaluation. **Materials and Methods:** Eight completely edentulous patients were selected from the Outpatient Clinic of the Prosthodontic Department; Faculty of Dental medicine, Al Azhar University and classified into two equal groups. Each patient in two groups received two implants placed in the mandibular canine-premolar region bilaterally. **Group (1):** four patients received two implants with using locator attachments. **Group (2):** four patients received two implants with using magnet attachments. **Results:** Results revealed that, there was no statistically significant difference in bone loss between locator and magnet during the follow up period, and there were no statistically significant mean retention values in the two groups at base line and after 3 months. But 6 months; Magnet attachment showed statistically significantly lower mean retention values than Locator attachment. By time there was a statistically significant decrease in mean retention values of magnet rather than locator attachment. **Conclusion:** The use of locator and magnet attachments with two implant supported mandibular overdentures leads the same amount of bone resorption around the implants. At the beginning the two attachment have the same retention quality by time magnet attachment loss some of its retention rather than locator attachment due to poor corrosive resistance of magnets within oral fluid requires encapsulation within a new hybrid material.

KEYWORDS: Dental Implants, Overdenture, Attachment, Retention

INTRODUCTION

Edentulism is considered a poor health outcome and may compromise quality of life. The prosthetic management of the edentulous patient has long been a major challenge for dentistry [(1)]. The classical treatment plan for the edentulous patient is the conventional complete removable maxillary and mandibular denture. However, this treatment has several drawbacks specially that of the lower denture [(2)]. Treatment of edentulous patients with implant-retained removable prostheses has been shown to provide a predictable and successful outcome that overcomes the functional deficiencies that are associated with conventional dentures [(3)].

Recently the most basic restoration for the edentulous mandible should be an implant retained overdenture with two implants placed in the anterior mandible. In completely edentulous patients,

* Masters Candidate, Ministry of Health.
** Associate Professor of Removable Prosthodontics Faculty of Dental Medicine Future University.
*** Professor of Removable Prosthodontics Faculty of Dental Medicine, Boys, Cairo Al Azhar University
• ***Corresponding author*:** mody808@gmail.com

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implants can be used in conjunction with attachments to enhance the retention and stability of the overdentures. To improve support and or retention of the removable prosthesis, implants are advocated [4] and minimal number of implants are used [5,6]. Implant retained supported mandibular overdentures have saved many problems for complete denture patients and allowed authors to consider it as the quality of standard for the edentulous patient [7]. Several types of attachments are employed for implant overdenture, such as splinting (bar-clip constructions with various bar-shape designs, compared with various ball-type attachments, magnet attachments, and attachments with telescopic copings). Splinting by bar-clip is most common, but ball and magnetic attachments have more advantages compared with bar-clip attachments, such as decreased procedure time, easier cleaning, and lower component costs [8].

Attachments used in conjunction with implants were found to enhance the retention, the stability and support of overdentures together with the implants, thus extending their longevity [9]. According to retentive means the attachments can be classified into frictional, mechanical, frictional and mechanical, and magnetic attachments [10]. Magnetic attachment, basically consist of one magnet attached to the denture and another to the implant. They constitute a simple and comfortable system for the patient as magnet attraction guides the denture insertion. On the other hand, they have a weaker lateral stability and retention in comparison with mechanic attachments as ball or bar devices. In addition, they are susceptible to corrosion by saliva, explaining why they are clinically less often used [11].

The aim of the study was to compare between implant retained overdenture with two different attachments (Magnet and locator) by measuring the following: Retention. Bone changes by radiographic evaluation.

MATERIALS AND METHODS

Sample Size: A sample size of 8 patients in each group has an 80% power to detect a difference between means of 6.79 with a significance level (alpha) of 0.05 (two-tailed) [12].

Patient selection: Eight completely edentulous male patients, age ranging from40-60 years (with an average of 55.3 years) were selected from the Outpatient Clinic of the Prosthodontic Department, Faculty of Dental medicine, Al Azhar University. 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 was signed, also approval of REC (Research Ethic Committee) of the Faculty of Dental Medicine Al Azhar University for Boys was obtained.

Construction of radiographic stent: Trial setting-up of the artificial teeth was carried out and tried in the patients' mouth. The mandibular trial denture was then processed into transparent acrylic resin in order to construct a radiographic template. The radiographic stent was modified to accommodate metal balls at the canine regions by preparing two recesses 5mm in depth. Metal balls (4mm in diameter) were fixed into these recesses using sticky wax. Radiographic assessment was performed using cone beam computed tomography (CBCT). Bone height, density and the bucco-lingual width at the proposed implant sites were measured and assessed.

Prosthetic procedure**:** Complete denture construction for all selected patient's maxillary and mandibular conventional complete dentures were constructed before the surgical procedures for implant placement.

Surgical procedures

Surgical stent: The metal balls were removed from the radiographic stent and holes were drilled at the proposed implant sites (canine region) to be used as a surgical stent. The stent was modified by reducing the occlusal and labial surfaces at the corresponding implant sites leaving the lingual

surface intact. The surgical stent was then immersed in an antiseptic solution 30 minutes before surgery. Radiographic assessment was performed using cone beam computed tomography (CBCT). CBCT scans were taken while the patients wearing their radiographic templates, bone height, density and the bucco-lingual width at the proposed implant sites were measured and assessed.

Phase I surgical procedure: Bilateral nerve block and ring infiltration anesthesia was given at the corresponding site to the surgical field using Mepivacaine hydrodrochloride 2% with Adrenaline 1:100000. The surgical stent was removed from the disinfectant, washed with saline then seated in the patient's mouth. The position of the proposed implant sites was marked on the mucosa using a dental probe over the crest of the ridge to indicate the antero-posterior length of the flap at each implant site. The surgical stent was then removed. A semilunar flap was done at implant site using a surgical blade No.15, down to the middle length of the buccal vestibule and a sharp periosteal elevator was used to reflect the mucoperiosteum lingually. The definitive position of the implant was confirmed by a depression using a rosette surgical bur. The drills were attached to a contra angle hand piece which in turn was connected to a physio-dispenser. Initial bone drilling of each implant site was started with the pilot drill (2.3 mm in diameter) using a reciprocating in and out motion. Finally, the screw – vent finishing drill (3.4 mm in diameter) was used to widen the prepared osteotomies to less than full depth. The sites were then irrigated with sterile saline followed by suction, to be ready to receive the implants. The implant was then removed from its sterile packing and installed into the prepared osteotomies using the hex instrument. Ratchet was then used to slowly rotate each implant in a clockwise direction with continuous irrigation. The installation was continued until resistance was felt given an indication that crestal bone level was reached. Adequate irrigation was carried out and excess soft tissue was removed then the cover screws were tightened to the implants. The flap was finally secured by interrupted sutures.

Phase II surgical procedure: Second stage surgery was carried out four months after implant placement. Surgical stent was used to relocate implant sites under infiltration anesthesia. A punch of 4.2mm was used to punch the mucosa over the implants, the cover screws were then removed by the aid of a hex instrument and the locator and magnet abutments were screwed on the implant (Fig. 1). The area opposing the implant keeper were marked on fitting surface of the denture, adequate amount of resin was removed at the marked areas, until a clearance space about 1-2 mm was provided around the attachment. The pick- up procedure started by blocking out the undercut areas around the attachment using rubber ring to facilitate the pickup procedure and preventing the prosthesis lock in the undercuts. The attachment was then placed over the implant keeper and the mandibular denture was inserted into the patient's mouth to verify its complete seating without any interferences or rocking. Two holes were then created in the lingual acrylic flange lingual to the artificial teeth. Self-cured acrylic resin was mixed and applied in the dough stage to the relieved areas of the denture. Patient was instructed to close in centric occlusion. After complete polymerization, the denture was removed from the patient's mouth with the picked attachments in the fitting surface of the denture.

Evaluation of denture retention: Retention was measured by digital force meter which is capable of measuring both pushing negative values and pulling positive values force up to 20 kg. It consists of a universal sensing heads to which different adapters (flat, cone, chisel and hook) can be attached either directly or through an extender. The device is also supplied by an LCD display that indicates the readings in gram, ounces and Newtons. The display is connected to apart that contains zero buttons, unit section switch, fast/slow response, selection switch a fast response indicator and off/on peak/ hold button.

FIG. (1a) The Locator implant attachment system was used in this study.

FIG. (1b) The Magnet implant attachment system was used in this study.

Retention measurement procedure: The relative geometric center of the lower denture was recognized first. A wrought wire, 1 mm in diameter was bent at its center and adjusted to run 2 cm above the occlusal plane from one retro-molar pad groove of one side to that of the other side. A second wrought wire, 1 mm in diameter was adjusted to extend from the groove at the lingual flange upwards to be 2 cm above the occlusal plane and the other end was shaped to form a c-shaped loop around the first wire. The lower denture was then inserted inside the patient's mouth to check tongue freedom, loop position and denture stability, the wired-lower denture was inserted into the patient's mouth. The patients were seated in upright position so that the floor of the mouth parallel to the floor and his head is well supported. The wire hook at the lower denture detached was hanged to the force-meter appliance through a bar and engaged to the rigid loop; the displacing force was applied till elevation of denture. The procedure was repeated five times. The highest and lowest readings were excluded and the mean of the other three readings was analyzed. The retentive force was measured for the initial separation of the overdenture. The lower denture was then removed from the patient. The wires were removed. The grooves were re-filled with self-cured acrylic resin. These areas were then refinished and re-polished. Previous steps were repeated at time of insertion, after three and six months after implant loading.

Radiographic evaluation: Each case was evaluated radiographically at the time of denture insertion, six months, 12 months and 18 months later. Radiographic evaluation included assessment of bone height around the implants. Direct digital radiography computerized system, the XCP per-apical film holder and individually constructed radiographic acrylic templates were used for taking standardized reproducible serial digital images for the implants by applying paralleling technique. The template was designed to receive the XCP periapical film holder in a position just lingual to the areas of interest.

Digital image analysis: Changes in marginal bone height the linear measurement system supplied by the special software was used to assess bone height at three main locations bilaterally: Mesial and distal to the implant. A line was drawn from the shoulder of the implant abutment to the highest level of the alveolar crest at both mesial and distal aspects of each implant.

Statistical analysis:

Statistical analysis was performed with SPSS 20®15, Graph Pad Prism®16 and Microsoft Excel 2016. All data were presented as means and standard deviation (SD) values. Comparison was performed using independent t test between two group, while One Way Repeated ANOVA was performed to compare between different follow up periods followed by Tukey`s Post Hok test for multiple comparisons. The results of this study were represented by tables. The significant level was set at $P \leq 0.05$.

RESULTS

TABLE (1) Retention of group I in different follow up periods:

	Min	Max	M	SD	P value
At time of insertion	7.00	8.00	7.45 a	0.42	0.691
After 3 months	7.30	8.40	7.65 a	0.51	
After 6 months	7.12	7.90	7.68 a	0.38	

Min; minimum Max; maximum M; mean SD; standard deviation P; Probability level (0.05)
Retention of locator attachment increases by time.

TABLE (2): Retention of group II in different follow up periods:

	Min.	Max.	M	SD	P value
At time of insertion	4.12	5.31	4.66 a	0.59	0.771
After 3 months	4.21	4.80	4.55 a	0.26	
After 6 months	4.00	5.10	4.45 a	0.46	

Min; minimum Max; maximum M; mean SD; standard deviation P; Probability level (0.05)
Retention of magnet attachment decreases by time.

TABLE (3): Comparison between group I & II regarding retention:

	Group I		Group II		P value
	M	SD	M	SD	
At time of insertion	7.45	0.42	4.66	0.59	0.001*
After 3 months	7.65	0.51	4.55	0.26	0.001*
After 6 months	7.68	0.38	4.45	0.46	0.001*

M; mean SD; standard deviation P; Probability level (0.05)

Retention of group I was higher than group II. Comparison was performed between both groups & revealed significant difference between them at each follow up period as p value < 0.05 as presented in table

TABLE (4): Comparison between group I & II of right side regarding bone resorption:

Right side		Group I		Group II		P value
		M	SD	M	SD	
Mesial	After 6 months	0.05	0.029	0.037	0.025	0.336
	After 12 months	0.16	0.041	0.135	0.08	0.521
	After 18 months	0.04	0.029	0.017	0.009	0.091
Distal	After 6 months	0.06	0.091	0.051	0.021	0.831
	After 12 months	0.21	0.089	0.150	0.075	0.332
	After 18 months	0.04	0.026	0.022	0.009	0.111

M; mean SD; standard deviation P; Probability level (0.05)

Comparison between group I & II was performed by Independent T-test which revealed that amount of bone resorption was higher in group I with insignificant difference (P>0.05) regarding mesial & distal surface at each follow up as presented in table.

TABLE (5): Comparison between group I & II of left side regarding bone resorption:

Left side		Group I		Group II		P value
		M	SD	M	SD	
Mesial	After 6 months	0.04	0.02	0.032	0.01	0.41
	After 12 months	0.15	0.03	0.137	0.05	0.51
	After 18 months	0.09	0.04	0.067	0.02	0.22
Distal	After 6 months	0.04	0.02	0.021	0.01	0.12
	After 12 months	0.15	0.05	0.081	0.04	0.07
	After 18 months	0.06	0.02	0.041	0.01	0.12

M; mean SD; standard deviation P; Probability level (0.05)

Comparison between group I & II was performed by Independent T-test which revealed that amount of bone resorption was higher in group I with insignificant difference (P>0.05) regarding mesial & distal surface at each follow up as presented in table.

DISCUSSION

In the present study, magnetic attachments permit the minimum bending moment transmission to the implant and to the bone/implant interface during overdenture dislodgement, which might be in part explained by the denture forward shift caused by load application in the chewing area. After comparing magnetic attachments with bar attachments, it was shown that bar attachments induce a major axial load and bending moment on implant with consequent reduced movement of the overdenture. Ball attachments have been reported to possess the minimum axial force and bending moment to the implant and less movement of the overdenture. For this reason, different studies have analyzed the resonance frequencies of magnetic retained implant overdentures, to assess the implant stability quotient (ISQ).

Some authors in preliminary studies conducted on magnetic attachments supporting implant overdentures, found a decrease in implant stability after 6 months [13]. On the contrary, it was found that magnetic attachments showed higher implant stability than locator attachments after 1 year. This may be attributed to the increased vertical bone loss with locators compared to magnets [14]. Another study was done to compare the retention of locator, ball and magnet attachment in mandibular implant retained overdenture. The locator attachment recorded the highest value followed by the ball and socket then the magnet attachment [15]. The magnet attachment showed the least retentive characteristics which may be due to its flat and simple geometrical configuration. So, the desire to use magnetic retention is related to the simplicity of the clinical and laboratory procedures. Furthermore, patients found it easy to place the prosthesis in the mouth and locate the magnets to the implants especially for those whose dexterity eyesight is poor [16]. The present study was found to be in accordance with an in vitro study that was done to compare between four different types of attachments (Ball, Locator, O-ring, magnet attachments).

Comparison among different attachments showed that ball attachment produces the highest level of retention and stability followed by locator, O-ring, and magnet attachment [17]. Magnet attachment group showed significant decrease in their retention values throughout the follow up period. Some studies have found that the wear of components of magnet attachment due to Wear and corrosion are the main limits that affect long-term durability of magnetic attachments. Corrosion, such

as tarnish and pitting, occurs by breakdown of the coating and diffusion of ions through the seal. Magnets, due to their microstructure composition are highly susceptible to corrosion in oral environments containing chloride. Was responsible for a decrease in the initial retentive force of magnet attachments [18]. The magnets are usually encapsulated by a corrosion-resistant tight sealer because corrosion of the magnet leads to loss of its attractive force. These relatively new magnetic attachment systems provide more stability and greater attractive forces than those produced by the old magnetic system.

While in case of locator attachment group provides dual retention internal retention and external retention. This may be explaining the reduction in retention values in magnet attachment rather than locator attachment by time [19]. The authors explained that the resiliency of the locator attachment dissipates torque on the abutment when horizontal, lateral and vertical forces are applied. Movement of the resilient attachment is allowed under functional loading thus, torque force on the abutment implant is reduced. It has been reported that the design of the locator attachment allows it to move in both the vertical plane and the hinge axis. Through this mechanism the locator can favorably distribute the forces along the long axis of the implant, Attributed the greater load transmitted to the denture bearing area to the 0.2mm vertical gap (space) inherent in the locator attachment design, and that is created when the black processing patrix is replaced by the definitive nylon patrix. Under functional loading, this vertical gap delays the axial contact between female and male implant parts, while the residual ridge is being loaded. Hence, the implant bears the smaller magnitude of the contact force while the residual ridge (denture bearing area) bears the greater magnitude of force due to its higher involvement and wider contact area [20] It seemed necessary to discuss some general observations. First observation is that the average annual bone loss recorded in this study around the implants ranged from 0.21mm to 1.25mm collectively. This could be considered an acceptable result.

Based on the dental literature, one of the implant success criteria is an average annual bone loss of 1.2mm as reported by or an annual bone loss less than 1.5mm as reported and there is no significance in bone loss between locator attachment and magnet during the follow up period. Such finding supports that the two treatment options provided in the current study could be considered clinically acceptable and successful [21] The second observation was that the bone loss recorded around the implants was generally higher distally than mesially in both groups. Similar findings were reported by other investigators. This could be attributed to the fact that the implants were mainly placed anteriorly. Hence, implants provided positive support anteriorly only. The lack of positive "posterior" support allowed the potential movement of the distal extension bases under function. Because of the well-known differences between tissue support and implant support, the moving bases may have torqued the implants distally [22]. The main conclusion that could be drawn here is that peri-implant bone loss is a multi-factorial phenomenon that depends on many factors; patient-related, prosthesis–related, implant-related as well as factors related to surgical procedures. Attachments type are the only one of these factors [23]

CONCLUSION

Within the limitations of this study, the following conclusions could be drawn: The use of locator and magnet attachments with two implant supported mandibular overdentures leads the same amount of bone resorption around the implants. At the beginning the two attachment have the same retention quality by time magnet attachment loss some of its retention rather than locator attachment due to poor corrosive resistance of magnets within oral fluid requires encapsulation within a new hybrid material.

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