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DIRECT PICK-UP VERSUS INDIRECT PICK-UP TECHNIQUE FOR 4- IMPLANTS RETAINED SINGLE MAXILLARY OVERDENTURES WITH BAR ATTACHMENT: CLINICAL EVALUATION

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ABSTRACT

Purpose of Statement: This study was conducted to assess the retention and soft tissue condition (gingival index, pocket depth (sound)) of retained implants in the maxilla using bar attachments that were placed using different pick-up techniques (direct and indirect techniques) were manufactured.

materials and methods: Twenty patients with edentulous upper arches were divided into two groups according to their treatment modalities. The first group used the direct pick-up technique to place four implants in the canine and molar areas, and the second group used the indirect pick-up technique to place four implants in the canine and molar areas. Dental implants were assessed for retention using (force meter analysis) and pre-implant conditions (probing depth and gingival index) were assessed using silliness and low index. These assessments were established at loading, 1 month, 3 months, and 6 months later. Data were collected and the values of changes between each successive time were tabulated.

Results: There is no statistically significant difference between the two groups observed throughout the study period for changes in retention values between the two groups after a one-month overdenture insertion. The probing depth showed no significant increase with time. though there was a statistically significant increase in probing depth in **Group A** (use of bar attachments with direct pick-up technique) than in **Group B** (use of bar attachments with indirect pick-up technique during prosthesis processing) after 1 month.

Conclusion: Overall, bar-retained maxillary implants were associated with a high retention score and satisfactory peri-implant condition.

KEYWORDS: Maxillary overdenture, bar attachment, retention, pocket depth evaluation.

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INTRODUCTION

Rehabilitation of the edentulous jaw with a dental implant is a predictable and successful treatment modality [1]. Perhaps for edentulous maxillary bone, less favorable success rates have been reported because of bone quality and quantity. [2] The distribution of implants and their number for rehabilitation are factors that influence loading conditions and may be associated with maxillary implant success and implant prosthodontic treatment outcome [3].

Treatment success with an implant is based on the stability of the bone surrounding the implant [4], a major change can take place in peri-implant bone level between implant placement and prosthetic loading, this bone remodeling occurs to re-establish the biological width, especially at sites with thin, soft tissues [5] And this remodeling depends on multiple factors: type of implant used, surgery, and prosthetic aspects. In long term, bone loss is most often a consequence of peri-implant diseases inducing pocket formation and suppuration, all these depend also on several factors including the accumulation of bacteria of the micro-gap at the interface between the fixture and abutment, and technical issues such as loose screws, mobile components, and fractured material [6-7]

Multiple options exist for the selection of the appropriate attachment system for maxillary implant overdenture (MaxIODs), based on implant number and distribution, and whether the MaxIOD is being designed to be completely implant-supported, or mucosa-and-implant supported[8-9] By contrast, six factors have been cited in determining the choice of the full arch fixed implant bridges: (1) presence or absence of composite bone defect, (2) possible visibility of the residual ridge in both the relaxed lip and smiling states, (3) the need or not for a labial flange, (4) inter-arch space whether adequate or not, (5) amount of available bone in the lateral and anterior segments of the maxilla, and (6) number and position of implants [10].

The implant-supported treatment modality might be in the form of splinted implants (e.g., bar-retained overdentures), or non-splinted implants (as in the case of the ball, locator, or magnetic attachments). Owing to the smaller space requirements, ease of cleaning, more economical achievement, and lower technique sensitivity [11-12]

The most common reason for needing to replace an overdenture is that the retentive element needs to be renewed or reactivated. Attachment systems wear over time, which can lead to a decrease in retention and even loss of function.[13]

MATERIALS AND METHODS

Twenty patients were selected from the outpatient prosthodontic department clinic of the Faculty of Oral and Dental Medicine, Cairo University. All Patients were selected for the current study according to the following inclusion criteria:

Inclusion criteria

1. Age ranged from 45-60 years.
2. Patients with completely edentulous maxillary arch opposing with fully dentated mandibular arch (maxillary single denture)
3. All patients did diagnostic preoperative cone beam computerized tomography (CBCT) to evaluate the residual alveolar bone height and width anterior to the maxillary sinus of the maxilla.
4. Patients exhibited sufficient inter-arch space at least 15 mm from the mucosa covering the crest of the maxillary residual ridge to the planned occlusal plane to allow construction of bar attachments that was determined by Tentative jaw relation by using a simple hinge articulator.
5. Patients showed maxillo-mandibular relationship Skeletal Angle's class I with normal occlusion and with good oral hygiene.

6. Patients were also selected systematically free from any diseases that affect bone healing around the implants (e.g., uncontrolled diabetics or osteoporosis), and also free from harmful habits such as smoking, clenching and bruxism finally the cooperative participants were recommended in this current study.

All patients were knowledgeable about the treatment plan and asked for approval on it with written consent forms according to the ethical principles stated in Helsinki Declaration (https:// www. wma.net) was signed by the patient himself.

Construction of the complete maxillary denture before surgery in a conventional manner, Upper and lower primary impressions were made utilizing alginate impression material (Cavex Holland B.V., P.O Box 852-2006 RW Harlem, Holland) then, the secondary impression was made on the fabricated acrylic resin special tray (Peka tray Acrostone . England)) using rubber base impression material (Gollene Speedex Dental Vertrieb G murrbtt Konster. Germany), boxed and poured in dental stone. Occlusion blocks were constructed on the master cast. Maxillary face bow record (Gnatus face bow Brazil) was made to mount the upper cast on a semi-adjustable articulator (Whip Mix # 8500; Louisville, KY.U.S.A), and the mandibular cast was mounted according to a centric relation record obtained from the patient using check bite technique, and finally, a protrusive record was essential to adjust the horizontal condylar guidance of the articulator. Setting-up of teeth was followed by (Vertex quint teeth vertex. dental, Netherland) was followed by try -in and the maxillary single denture was Processed using heat-cured acrylic resin. The denture was finished and polished then inserted and checked intraorally for extension, stability, retention, vertical dimension centric relation, and esthetics, any necessary occlusal adjustment was performed to achieve harmonious occlusion was completed, and a regular recall appointment to assess the retention and stability and refine any occlusal discrepancies. (**Figure 1-A)**

Regarding the mandibular arch, the clear acrylic template was fabricated over a modified cast with pressure indicating paste according to the **Bruce technique** to adjust and modify the occlusal plane of the opposing arch in single denture cases.

The radiographic template was constructed with a clear acrylic duplicate of the existing maxillary denture, utilizing metal radio-opaque markers at anticipated implant sites then, then metal tubes at proposed implant sites were inserted to convert the radiographic template to a surgical template. **(Figure 1-B)**

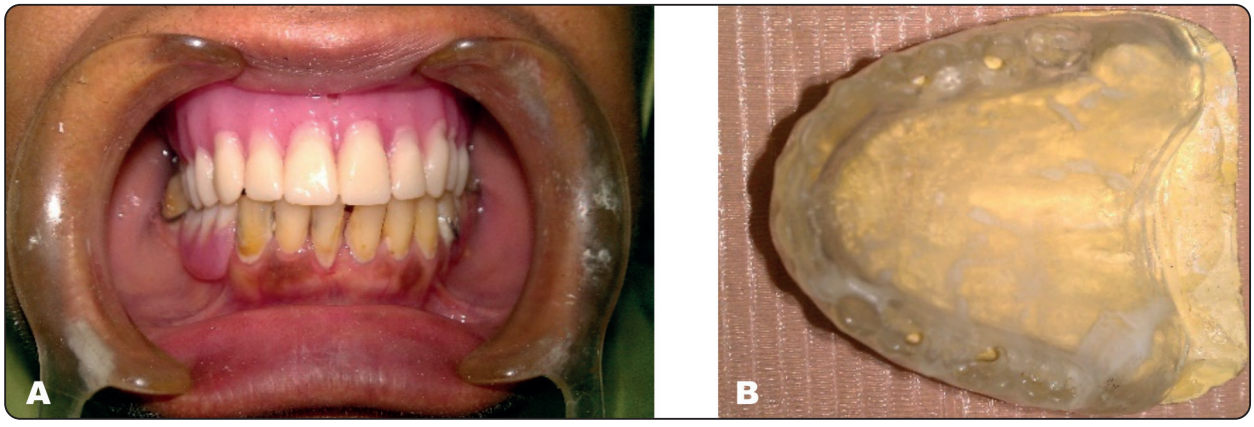

Fig. (1): (A)finished and polished maxillary single denture, (B) Acrylic Resin upper surgical template

The patient was instructed to care about oral hygiene measures and take a prophylactic antibiotic preoperatively to control the infection. Amoxicillin-clavulanate 625 mg was taken 24 hours before the surgery as one tablet every 8 hours, and patients were asked to continue the antibiotic for one week after surgery to guard against any possible infection. Also, an anti-inflammatory and an analgesic drug were given.

Surgical installment of dental implants

The surgical stent was chemically sterilized and stored in 0.2% chlorhexidine solution and used during surgery. The surgical template was introduced into the patient's mouth, seated over the maxillary arch, and checked for accuracy & stability in place. field block anesthesia was applied to minimize the bleeding as much as possible at the surgical site, a Mid-crestal incision was made and a full-thickness mucoperiosteal flap was raised. Each participant received 4 implants (Tiologic® Implants, Dentaurum, Ispringen, Germany) in the maxillary arch (at canine and 2nd premolar areas), Osteotomy sites for the 4 implants were performed using a pilot drill of 2.3mm diameter & a final drill of 2.8mm diameter. For each drill, a specially designed "drill guide" was used.

The flap was closed with interrupted sutures. Three weeks postoperatively, the patient's existing maxillary dentures were relieved over implant sites and refitted to the mucosa using a tissue conditioner. The sutures were removed on the seventh day after the operation.

Second stage surgery:

Four months following surgical implant installation, patients were checked to maintain the measures of oral hygiene and start the prosthetic phase of treatment.

A post-operative panoramic radiograph was done for the installed implants. The implants were relocated using the surgical template, and the implant cover screws were exposed by short crestal incisions under local anesthesia guided by the surgical stent. The cover screws were loosened using the hex driver followed by an abutment connection. And healing abutments were installed for two weeks. (**Figure 2-A)**

The denture was relieved over them and relined with tissue conditioning material. Two weeks later the healing abutments were replaced with the appropriate extension abutments.

Patients grouping

The patients were randomly divided (blind randomization) into two equal groups (ten patients/each), **Group A** received their maxillary overdenture retained with bar attachment fabricated with a Direct (chair-side) pick-up technique, while

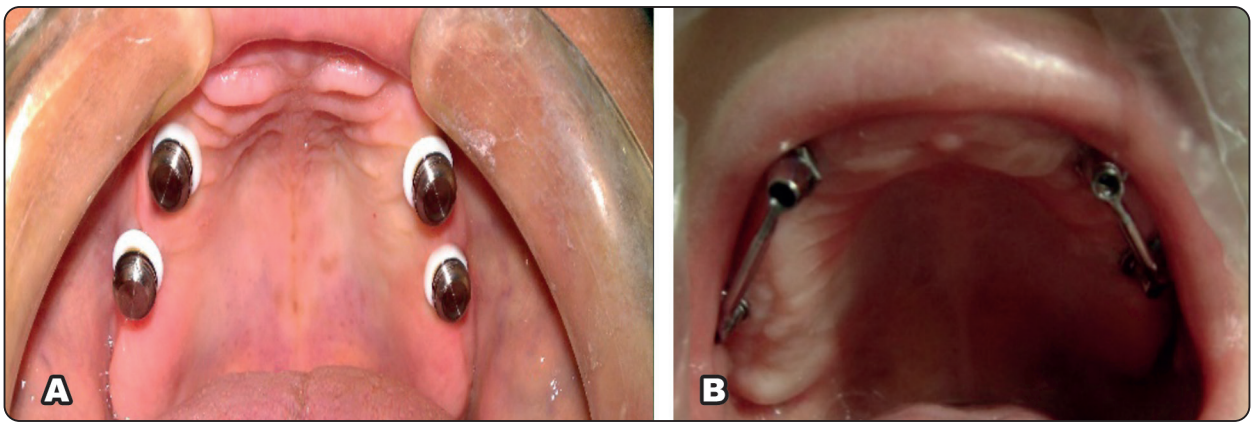

Fig. 2: (A) healing abutments, (B)Bar assembly inside the patient mouth

Group B received their overdenture retained with bar attachment fabricated with indirect (laboratory) pick-up technique.

The bar assembly consisted of a round bar (Tiologic® Implants, Dentaurum, Ispringen, Germany), 2 hollow bar joints, and 2 fixation screws. The bar was shortened to the correct length and then the trimmed end was smoothened to ensure that the bar move freely into the joint. All abutments were 3mm collar height. They have been screwed on the implants and tightened by a 30n torque wrench**,** providing about 2 mm space between the undersurface of the bar and the mucosa to facilitate oral hygiene procedures

The bar was inserted into the joints, and the joints were fastened to the abutments by the fixation screws at 10 Ncm. **(Figure 2 B)**

The direct technique consists of attaching the clip to the denture base as a clinical procedure. While in the indirect technique, the clip was attached during laboratory processing.

For Group A using bar attachments with a direct pick-up technique:

The fitting surface of the maxillary denture opposite to bar attachment was marked by an indelible pencil, the area was relived, and two small holes were made using acrylic metal bur in the palatal surface of the denture for easy escapement of excess acrylic resin material during the pick-up procedure.

The Hader nylon clip was attached directly to the corresponding bar attachment. The denture was checked to make sure it was fully seated in the corresponding dental housing before completing the pick-up procedures. The denture is then dried, and the loose areas are lightly coated with acrylic monomer. Enough chemically cured acrylic resin is then mixed and inserted into the loose areas of the denture mating surface and the denture is positioned exactly while the patient occluding in a centric position (i.e., closed mouth).

After setting the acrylic resin, the denture was carefully removed from the patient's mouth and checked that all metal housings were picked up into the fitting surface. The dentures are then trimmed and polished.

For Group B using bar attachments with an indirect pick-up technique during denture processing:

The waxed-up trial denture was flasked while the bars were seated on the cast. **(Figure 3)**

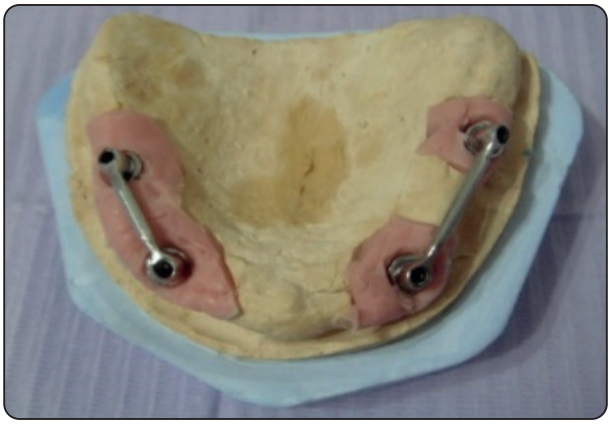

Fig. (3): Bar assembly over the cast

The spaces below the bars and approximal spaces around the abutments were filled and closed thoroughly before polymerization. Wax elimination laboratory step was done, then packing of heat-cured acrylic resin was done after placing the clips (processing clips) including clip housing (metal) on the bar as a place holder. After processing, the metal housing with the yellow clips was picked-up to the fitting surface of the denture. The denture was finished and polished then inserted and checked for extensions, retention, and stability.

Both groups of patients received instructions on how to insert and remove their dentures, as well as instructions on oral hygiene. Patients were then asked to follow up 1 month, 3 months, and 6 months after the training.

The retention of the implant-supported overdenture was measured using a Digital Force meter with the help of a Retention-Aided Measuring Device. To ensure accurate and reproducible measurements of the dislodging forces, every patient was instructed to sit in the dental chair so that the occlusal plane of the maxillary teeth was parallel to the floor. Patients were asked to fix their heads during the examination stages. The maximum Vertical Displacement force in Newtons (N) was calculated; each measurement was repeated three times, and the mean of those measurements was used to represent the recorded retention value. The plaque index is an evaluation tool that is used to measure the level of dental plaque in a person's mouth. Evaluation of plaque index and probing depth in millimeters according to the modified silness and loe index used (0 to 3). Pocket (probing) depth was defined as the mean of measurements at 4 sites (mesial, distal, lingual, and buccal) made using a calibrated periodontal probe(Hu-Friedy, Chicago, IL). The presence (score 1) or absence (score 0) of the calculus was noted.

Statistical test

Data were presented as mean, standard deviations and mean percentage changes. For parametric data, a repeated measures of ANOVA test was used to compare two groups and determine changes over time within each group. Bonferroni's post-hoc test was performed for pair-wise comparisons when the ANOVA test is significant.

RESULTS

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 24 for Windows.

Retention (Force- meter) measurements, Regarding the changes by the time it was shown a significant difference in retention values occurred between the two groups after one month of overdenture insertion but there was a statistically non-significant difference in retention values between the two groups observed for the whole study period.

Comparison between the two groups revealed that **(Group A)** showed a statistically significantly higher mean retention value than **(Group B)** after one month while there was no statistically significant difference between the two groups at the time of overdenture insertion,3 months, and after 6 months. **(Figure 4), Table (I)**

Table (I): The mean, standard deviation (SD) values, and results of repeated measures ANOVA test for comparison between retention values in the two groups as well as changes by time within each group

	Group A		*Group B*		*P-value*
	M	*SD*	*M*	*SD*	
At insertion	***71.9***	***1.9***	***69.8***	***4.9***	***0.195***
After 1 month	***67.4***	***3.8***	***62.7***	***5.7***	***0.005****
After 3 months	***65.2***	***5.9***	***59.8***	***4.9***	***0.084***
After 6 months	***54.7***	***4.9***	***57.4***	***3.9***	***0.832***

M: mean SD: standard deviation * Significant difference as P < 0.05.

Fig. 4: A chart representing mean retention values in the two groups.

Table (II): Comparison of measured clinical outcomes between groups and observation times.

		Group A		Group B		P-value
		M	SD	M	SD	
Plaque index	At insertion	55.4	1.8	54.9	3.8	0.823
	After 1 month	56.6	1.9	57.4	4.6	0.732
	After 3 months	59.3	2.0	57.8	4.9	0.912
	After 6 months	59.6	2.1	58.2	4.1	0.829
		Group I		Group II		P-value
		M	SD	M	SD	
Probing depth	At insertion	56.7	2.7	57.2	3.1	0.328
	After 1 month	57.2	2.3	56.4	3.6	0.832
	After 3 months	59.4	2.6	60.2	4.2	0.912
	After 6 months	60.3	2.8	61.4	4.1	0.879

M: mean ***SD: standard deviation*** **** Significant difference as P < 0.05.***

Regarding both the probing depth and plaque index of both groups, probing depth showed a nonsignificant increase with time. Although there was a statistically significant increase in probing depth in **Group A** (using bar attachments with a direct pick-up technique) than in **Group B** (using bar attachments with an indirect pick-up technique during denture processing) after 1 month. (**Table II**)

DISCUSSION

Before selecting the patients for this study, the biological and mechanical aspects that might affect the osseointegration of dental implants were meticulously considered. The age range of 45 to 60 years was integrated into this study to avoid any bone changes that might create instability and impair the outcomes. [14].

Uncooperative and heavy smoker's patients were excluded from this study as these factors reflected difficulties to maintain good oral hygiene throughout the study, thus increasing plaque formation and calculus deposits.

Patients should have enough inter-arch space (minimum 15 mm) to allow for the overdenture superstructure and bar attachment without compromising the normal vertical dimension of occlusion.

In addition, patients with adequate bone quality and quantity and sufficient buccolingual width at sites of implant placement were selected to ensure at least one mm thickness of bone remaining to allow for implant primary stability. [15]

Moreover, Utilizing the Retention Aided Measuring Device, consistent measurements of retention were taken while vertical dislodging forces (provided by the digital force metre) were distributed evenly across the whole overdenture surface.

The maxillary overdenture with bar attachments is supported by four osseointegrated implants as part of the management of a patient with total maxillary edentulousness. However, there is debate regarding the most effective pick-up method to apply in these conditions.. [16-18]

Regarding the retention results of this study, both groups recorded a reduction in the retention values over the whole study period, which might be attributed to the wear of the retentive Hader nylon clip that also, might attribute to the presence of saliva and constant occlusal load. But it was found that after 6 months of clinical evaluation the range of retention values of bar attachments was still within the accepted range of required retention.[19-20]

Also, the results of this study also revealed that while there was a statistically non-significant difference in retention values between the two groups throughout the entire study period, there was a significant difference in retention values between the two groups after one month of overdenture insertion. That could be explained by the muscles surrounding the overdenture physiologically adapting more quickly in Group A using bar attachments with a direct pick-up technique than in Group B using bar attachments with an indirect pick-up technique during denture processing, which might coincide with the studies that have reported that the posterior denture settling was greater in overdentures with a direct pick-up technique than in overdentures with an indirect pick-up technique attributed to the fulcrum created between the implants, which may have caused rotation of the denture around that fulcrum during the direct pick -up technique. Moreover, the compressibility of the mucosa might have allowed the denture to settle more posteriorly during the direct pick-up technique where the patients' biting forces amplified the mucosal compression. Finally, during the direct pick up the male components of the Positioner attachment were activated which may have caused the denture to settle more posterior after activation of the attachment. [21-22]

Regarding **the probing depth and plaque index** of both groups, probing depth showed a non-significant increase with time. The increased probing depths with time may be due to increased bone resorption and also, may be attributed to old-aged patients that showed reduced interest in performing adequate cleaning of the overdenture especially in the area beneath the bar and around the implants also, The reduced socio-economical level of the participants together with the reduced manual skill of the old participants may be another reason of increased plaque accumulation around the attachments through the follow-up period. (23,24)

A significant increase in probing depth in **Group A** than **Group B** after 1 month may be due to the irritation from the residual monomer in the self-cure acrylic resin during the direct pick-up technique and that correlates with the significant difference in retention values that occurred between the two groups after one month of overdenture insertion that may attribute increase wearing time of the overdenture after delivery due to the improve retention in Group A when compared with Group B and thus indirectly attribute to the plaque accumulation and gingival enlargement. (25)

Several studies also reported that the increased plaque scores with bar attachment may be related to the relieving spaces around the bar and the abutments which lead to gingival hyperplasia that may permit the rotation of overdentures around the bar without implant loading but help plaque to accumulate.(26-30)

Although implant pocket depth increased with time, this increase was not significant. Also, no significant difference in pocket depth between groups was observed. The increased pocket depth may be due to increased bone loss. However, the lack of significant difference between observation times and groups could be attributed to the gingival recession around the implants that may occur later.(31-33)

CONCLUSION

Based on the findings of this study, the following conclusions were drawn:

1- Bar attachments are highly recommended to retain maxillary overdentures, as they exhibited high retention values.

2- Treatment option for rigid splinting of four implant-retained maxillary overdentures; therefore, the decision for selecting one of the two techniques will rely on the preference of the dental clinician.

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