



Comparison of the retention force in Symphyseal and Parasymphyseal Single Implant Versus Two Implants in Complete Mandibular Overdentures

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KEYWORDS

*Dental implants, Retention,
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Single-implant overdentures*

ABSTRACT

Purpose: This clinical study aimed to compare between single implant (symphyseal and parasymphyseal) versus two implants in complete mandibular overdentures by measuring retention force. **Patients and methods:** Fifteen completely edentulous patients were selected for this study. The patients were divided randomly into three equal groups (five patients in each group) according to implant position and number. Group I: One median implant to retain mandibular complete overdenture. Group II: One parasymphyseal implant to retain mandibular complete overdenture. Group III: Two implants in the intraforaminal distance to retain mandibular complete overdenture. Three months later the lower denture was converted into mandibular overdenture by picking up the metal house into the denture. Retention force was measured for the conventional complete denture after one month of denture insertion (Recorded as Base line) and measured for implant retained overdenture at time of insertion, after three and six months after over denture insertion by digital force meter. **Results:** There was a significant difference between the three groups with a higher retention of group (C) than groups (A) and (B), and non-significant difference between, group (A) and group (B). In all test groups, there was increased retention during the follow-up period, with a statistically significant difference from (Baseline) recording. **Conclusion:** The utilization of a single implant positioned (median or parasymphyseal) may offer an efficient treatment option to retain mandibular overdentures in edentulous patients. This approach becomes particularly valuable when limitations restrict the use of multiple implants.

INTRODUCTION

Due to the increase in populace lifespan, the need for dental treatment for edentulous individuals has become bigger. Removable dentures whatever complete or partial, are used for the replacement of missing natural teeth. They restore the appearance, enhance mastication, and the ability to talk clearly. However, this treatment has several drawbacks specially that of the lower complete denture such as resorption of the alveolar ridge and atrophy of the denture supporting areas leading to ill-fitting denture, lack of stability, and impaired masticatory efficiency.⁽¹⁾

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Treatment of edentulous patients with mandibular implant-supported overdentures can provide an effective treatment as an alternative to vestibuloplasty, ridge augmentation or implant supported fixed full prostheses, to provide a predictable and successful outcome that overcomes the functional deficiencies that are associated with conventional dentures.⁽²⁾

Sufficient evidence is available to support the suggestion that a two-implant supported mandibular overdenture should be suggested to edentulous patients as a first choice of treatment.⁽³⁾ Although the success of this treatment modality is remarkable but beyond the purchasing power of many edentulous individuals and the low economic status of developing countries represents the major obstacle. Hence, the introduction of single-implant concept to stabilize the lower denture was developed as an acceptable alternative to two implant supported mandibular overdenture besides surgical advantages; shortened surgical time, reduced associated morbidity and postsurgical maintenance especially for those patients having higher risks for surgical intervention or impaired health conditions, such as geriatric patients. Additionally, high implant survival rates and significant patient satisfaction improvements have already been reported for Single-implant mandibular overdentures (SIMO)^(4,5)

A finite element study was carried out by Jingyin Liu et al.⁽⁶⁾ on the implant number required to retain mandibular implant-retained overdenture, found that single implants were able to bear and dissipate the load to the bone well.⁽⁶⁾

Using a single implant placed in the midline symphyseal region to retain the mandibular complete overdenture has been suggested with an excellent success rate according to the success criteria of Albrektsson.⁽⁷⁾ And Patients have also elaborated significant enhancement of chewing ability and an overall improvement in oral health related quality of life. However, the susceptibility of

the overdentures to fractures in the midline regions above the supporting implant is still a common obstacle.⁽⁸⁾ The parasymphyseal area has been suggested for implant insertion for single implant-retained mandibular complete overdenture due to anatomical limitation on the symphyseal area or no sufficient bone width was detected.⁽⁹⁾

Evaluation of retention can easily assess efficiency and performance of prosthesis. Retention of mandibular denture can be achieved perfectly by implant retained attachment in the anterior region of the mandible. Better retention improves biting force, chewing efficiency and increased speed of controlled mandibular movement.⁽¹⁰⁾

This clinical study was conducted to compare between symphyseal and parasymphyseal single implant versus two implants in complete mandibular overdentures regarding the retention force.

MATERIALS AND METHODS

A: Patient selection:

Fifteen completely edentulous patients were selected for this study from the clinic of removable prosthodontics at Al Azhar University's Faculty of Dental Medicine. Medical history and laboratory examinations confirmed that all patients were free of systemic disease. Patients with habits potentially detrimental to bone health (e.g., bruxism, clenching), medications affecting bone quality, or inadequate mandibular bone for implant placement were excluded. Informed written consent was obtained from each patient. CBCT scans were performed on all patients to assess bone quality and quantity and rule out pathologies affecting implant suitability.

B: Complete denture construction:

Each participant in the study received upper and lower conventional, heat-cured acrylic resin dentures, fabricated according to usual protocols.



C: Surgical phase:

The enrolled patients were categorized according to the number and location of implants used for mandibular complete overdenture retention into three distinct groups: **Group I:** Received a single, median implant for mandibular complete overdenture retention. **Group II:** Received a single, parasymphiseal implant for mandibular complete overdenture retention. **Group III:** Received two bilaterally placed implants in the canine regions, for mandibular complete overdenture retention.

Preoperative: Patients received oral amoxicillin (1g) twice daily for 24 hours before surgery, continued for one week postoperatively, to prevent infection. Non-steroidal anti-inflammatory drugs (50 mg ketoprofen twice daily for 3 days) were administered for pain management. Patients used 0.12% chlorhexidine mouthwash 24 hours preoperatively to reduce infection risk. **intraoperative:** Surgical site was disinfected with 10% povidone-iodine. Bilateral mental nerve block, lingual infiltration, and ring block anesthesia were performed using 2% mepivacaine hydrochloride with 1:100,000 epinephrine. A mucoperiosteal flap was reflected, exposing the anterior mandibular alveolar ridge for implant placement. Drilling sequence (pilot, intermediate, final) was followed. A 10 mm x 3.5 mm Neobiotech implant (Korea) was inserted and secured. The incision was closed with interrupted 3/0 silk sutures. **Postoperative:** Oral and written postoperative instructions were provided. Denture wear was restricted for 2 weeks, followed by adjustments at implant sites for proper fit.

D: Prosthetic phase:

Following a three-month healing period, the second stage surgical procedure was performed. The ball attachment was secured to the implant using a hand torque controller at 30 Ncm. Subsequently, the flap margins were repositioned and sutured. Autopolymerized acrylic resin was employed for both the attachment installation and pick-up technique.

Upon completion, the fabricated implant-supported mandibular overdenture was inserted in the patient's mouth, and retention and occlusion were evaluated. Final adjustments were implemented as necessary. Patients received detailed instructions regarding the care and use of their existing maxillary complete denture and the newly placed implant-supported mandibular prosthesis for a subsequent three-month period.

E: Evaluation of overdenture retention

Retention force was measured for the conventional complete denture after one month of denture insertion (Recorded as Base line) and measured for implant retained overdenture at time of insertion, after three and six months after overdenture insertion by digital force meter.^(11, 12)

Retention of complete mandibular overdentures was measured by digital force meter, which is capable of applying a vertical dislodging force on the mandibular denture and evaluate its retention in Newton, Fig. 1.

Two wrought wires (1 mm in diameter) were used. The first one bent at its center and adjusted to run 2 cm above the occlusal plane from one retro-molar pad of one side to that of the other side and attached to the denture base with self-curing acrylic resin. The second wrought wire was adjusted to extend from the lingual flange opposite to the midline and attached to the denture base with self-curing acrylic resin, 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 at the geometrical center of the polished lingual surface to make retentive hook within the geometric center⁽¹¹⁾, Fig. 1.

The lower denture with the attached wrought wires was then inserted inside the patient's mouth and positioned correctly on the tissues and patient was asked to rest his tongue passively in the floor of the mouth with its tip adjacent to the anterior denture teeth, then the tongue freedom, loop position and

denture stability were checked. The patient asked to sit on the dental chair in an upright position with the head resting firmly on the head rest and the occlusal plane parallel to the floor.

The hook attachment was placed on the shaft of the force meter device and engaged the center of the rigid loop, the displacing force (A vertical upward force) was applied till the elevation of the denture. This force was measured in Newton and was recorded as the denture's retention. The procedure was repeated five times.

The lower denture was then removed from the patient's mouth, then the wires and self-curing acrylic resin were removed then these areas were then refinished and repolished.

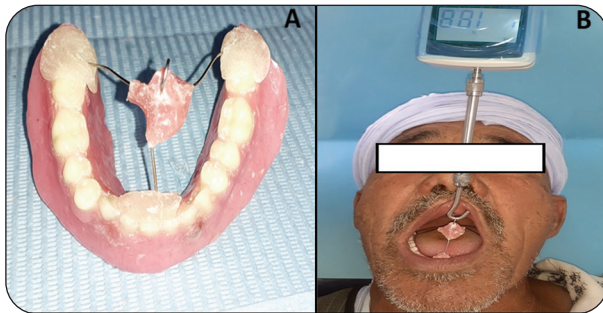


Fig. (1) **A.** Attached two wrought wires to the lower denture, **B.** Retention Testing Using Digital force meter.

RESULTS

In all overdenture follow up periods, the difference between groups was statistically significant as proved by the One-way ANOVA test ($p=0.000<0.05$). Pair-wise Tukey's post-hoc test showed a significant higher retention of group (C) than groups (A) and (B), and non-significant ($p>0.05$) difference between, group (A) and group (B).

In all test groups, the difference between follow up periods statistically significant as proved by the One-Way Repeated ANOVA test ($p=0.000<0.05$). Pair-wise Tukey's post-hoc test showed a significant higher retention in (At time of insertion) follow up than in (After-3-months) and (After-6-months) follow-ups, and non-significant ($p>0.05$) difference between, (After-3-months) and (After-6-months) follow-ups. There was increased retention during the follow-up period, with a statistically significant difference from (Baseline) recording ($P < 0.05$).

The statistical analysis of the amount of retention for test groups, showing mean values, standard deviation, the relation between different times of follow-up, and relation between test groups are summarized in tables (1, 2) and graphically drawn in figure (2) for the effect of time on the retention in each group and in figure (3) for effect of different treatment modalities on the retention.

Table (1) Comparison of retention results (mean \pm SD) between different follow up periods for each group.

Time interval	group (I)	group (II)	group (III)	P value
Baseline	2.19 \pm 0.60	1.40 \pm 0.24	1.67 \pm 0.53	0.069
At time of insertion	8.58 ^B \pm 0.73	8.80 ^B \pm 0.55	18.69 ^A \pm 0.36	0.000*
After (3) months	7.97 ^B \pm 0.88	8.56 ^B \pm 0.30	17.95 ^A \pm 0.69	0.000*
After (6) months	6.85 ^B \pm 0.54	7.59 ^B \pm 0.53	17.42 ^A \pm 0.65	0.000*

Means with different letters in the same row indicate statistically significance difference ($p<0.05$).

*; significant ($p<0.05$) ns; non-significant ($p>0.05$)



Table (2) Retention results (mean \pm SD) between test the effect of time on retention groups at different follow up periods and intervals.

Test group	Baseline	At time of insertion	After (3) months	After (6) months	P value
Group (A)	2.19 ^C \pm 0.60	8.58 ^A \pm 0.73	7.97 ^A \pm 0.88	6.85 ^B \pm 0.54	0.000*
Group (B)	1.40 ^C \pm 0.24	8.80 ^A \pm 0.55	8.56 ^A \pm 0.30	7.59 ^B \pm 0.53	0.000*
Group (C)	1.67 ^C \pm 0.53	18.69 ^A \pm 0.36	17.95 ^A \pm 0.69	17.42 ^B \pm 0.65	0.000*

Means with different letters in the same row indicate statistically significance difference ($p < 0.05$).
*; significant ($p < 0.05$) ns; non-significant ($p > 0.05$)

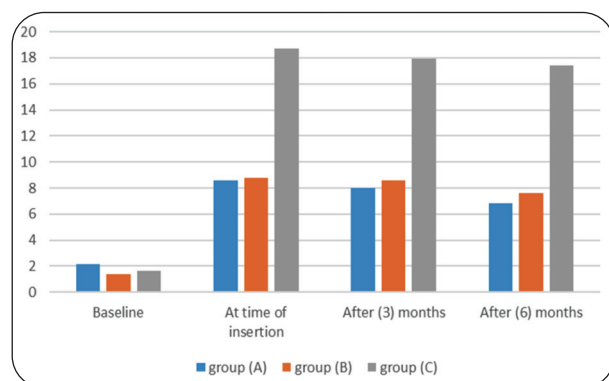


Fig. (2) Histogram of retention comparing test groups at different follow up periods.

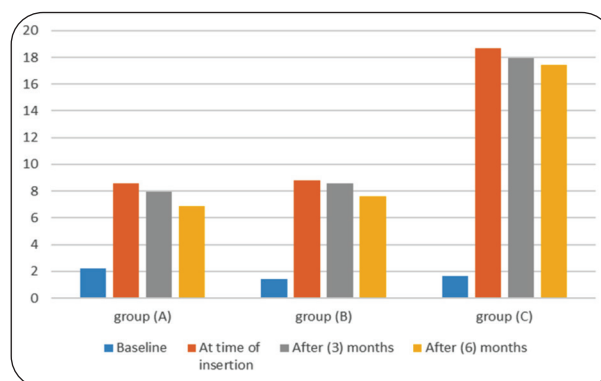


Fig. (3) Histogram of retention comparing different follow up periods for each test group.

DISCUSSION

Edentulism is a common problem in individuals aged 50 years and above, the estimated prevalence worldwide is over 10%.⁽¹³⁾ A two-implant retained mandibular overdenture must be recommended to edentulous individuals as a first treatment choice, according to much research, due to its better retention, stability, and providing greater satisfaction than the conventional complete denture.⁽¹⁴⁾ SIMO concept gives another choice for elderly populations to reduce the time and cost of treatment, especially those with low economic status in developing countries.¹¹⁻¹⁴⁾ The parasymphiseal area has been suggested for implant insertion for single implant-retained mandibular complete overdenture due to anatomical limitation on the symphyseal area or no sufficient bone width was detected and the potential risk factors for mandibular arch fracture, especially in older patients.⁽¹⁵⁾

CBCT was used preoperatively to provide a three-dimensional image of the bone. This image provided adequate information about the location, width, volume, and degree of mineralization of the bone.⁽¹⁶⁾ Ball and socket attachments were chosen for this study because they are one of the most resilient attachments available. They are also relatively simple to apply, low-cost, and easy to handle. In addition, ball and socket attachments allow for multidirectional movements of the prosthesis, which can help to decrease the load on the abutments and reduce the torque action on the abutments (acting as shock absorber).⁽¹⁶⁾

All treatments modalities greatly improved the retention of lower dentures with no statistical difference between groups at baseline. However, the results of the present study demonstrated clear superiority of two implant retained mandibular

overdenture - group (C) - mean retention value at three, six- and 12-months follow-up periods than single implant retained mandibular overdenture groups (A), (B). Group (C) showed statistically significantly higher mean retention value than Groups (A), (B) at all follow-up periods. These findings were in agreement with the results of previous studies.⁽¹⁷⁾

This can be explained by the stability and retention of implant retained overdenture is greatly impacted by implant number and position as the increased number of implants will increase retention and stability of implant supported overdenture.⁽¹⁸⁾ On the other hand, it has been recognized that for many patients the importance of fewer implants as a price saving strategy features a merit. In some cases, however, the use of two-implants is suggested to provide greater overdenture stability and retention⁽¹⁹⁾.

In the current study, all groups demonstrated a reduction in retention over time. These results coincided with the results of other previous study⁽¹¹⁾ which study the impact of single implant versus two-implant mandibular retained overdentures on retention and success rate in totally edentulous patients and mention that, the mandibular overdenture retention had greater values at time of insertion, and decreased gradually in the following three, six and 12 months.

These findings can be explained by the ball attachments tend to wear over time of clinical use and thus, lose retention. Wear occurs primarily during insertion and removal of overdentures, function, and parafunctional activities or may be related to deformation that occurs through prosthesis removal and insertion according to Alsabeeha et al.⁽²⁰⁾

CONCLUSIONS

While acknowledging the limitations of this study, including the sample size and study duration, the findings suggest that oral rehabilitation using a

single implant supported mandibular overdenture (median or parasymphiseal placement) may represent a viable treatment option for edentulous mandibles. From retention view, this modality gains more importance in cases where there is any limitation that restricts the use of more implants.

Conflict of Interest

There was no conflict of interest.

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مقارنة قوة الاستبقاء في الغرسات المفردة الارتفاقية والنظرية مقابل غرستين في أطقم الأسنان السفلية الكاملة

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الملخص :

الهدف: تهدف هذه الدراسة السريرية إلى المقارنة بين الغرسة المفردة (الارتفاقية والنظرية) مقابل غرستين في أطقم الأسنان السفلية الكاملة عن طريق قياس قوة الاحتفاظ.

المواد والإساليب: تم اختيار خمسة عشر مريضاً عديم الأسنان تماماً لهذه الدراسة. تم تقسيم المرضى عشوائياً إلى ثلاث مجموعات متساوية (خمسة مرضى في كل مجموعة) وفقاً لموضع وعدد الزرعات. المجموعة الأولى: زرعة متوسطة واحدة للاحتفاظ بالطقم الزائد الكامل للفك السفلي. المجموعة الثانية: زرعة نظيرة سفلية واحدة للاحتفاظ بالطقم الزائد الكامل للفك السفلي. المجموعة الثالثة: زرعتان في المسافة داخل الحفرة للاحتفاظ بالطقم الزائد الكامل للفك السفلي. وبعد ثلاثة أشهر، تم تحويل طقم الأسنان السفلي إلى طقم أسنان سفلي سفلي زائد عن طريق رفع البيت المعدني إلى طقم الأسنان. تم قياس قوة الاستبقاء للأسنان الكاملة التقليدية بعد شهر واحد من إدخال طقم الأسنان (تم تسجيله كخط أساسي) وتم قياسها للزرعة الزائدة المحتجزة في وقت الإدخال. بعد ثلاثة وستة أشهر بعد إدخال طقم الأسنان الزائد بواسطة مقياس القوة الرقمي.

النتائج: كان هناك فرق كبير بين المجموعات الثلاث مع احتفاظ أعلى بالمجموعة (ج) من المجموعتين (أ) و (ب). وفرق غير كبير بين المجموعة (أ) والمجموعة (ب). في جميع مجموعات الاختبار، كان هناك زيادة في الاحتفاظ خلال فترة المتابعة، مع وجود فرق ذو دلالة إحصائية عن التسجيل (خط الأساس).

الخلاصة: إن استخدام زرعة واحدة موضوعة (متوسطة أو شبه سفلية) قد توفر خيار علاج فعال للاحتفاظ بأطقم الفك السفلي لدى المرضى عديمي الأسنان. يصبح هذا النهج ذا قيمة خاصة عندما تقيد القيود استخدام الغرسات المتعددة.

الكلمات المفتاحية: زراعة الأسنان، والاحتفاظ بها، وأطقم الفك السفلي، والأطقم الارتفاقية، والأطقم المجاورة للعضلات ذات الزرعات المفردة