



Effect of Two Retention Modalities on Single Midline Implant Supporting Mandibular Overdenture

Ahmed Shaaban^{1*}, Ahmed Ibrahim Mahrous², Sara Maher Shaaban³, Mohamed Denewar⁴

¹Department of Prosthodontics, Faculty of Dentistry, Future University, New Cairo, Egypt; ²Department of Prosthodontics, Vision Medical College, Jeddah, KSA; ³Department of Prosthodontics, Faculty of Dentistry, Badr University, Cairo, Egypt; ⁴Department of Prosthodontics, Faculty of Dentistry, Delta University for Science and Technology, Mansoura, Egypt

Abstract

AIM: The purpose of this research was to examine the effect of locator attachment versus retention silicone lining material on the supporting structure and retention of a single midline implant supporting mandibular overdenture.

METHODS: Sixteen patients with completely edentulous mandibles were selected for this study and divided into two groups. In all patients, a single implant was placed at midline area after cone-beam radiography was performed. Group I was retained with locator attachment, while Group II was retained with silicone material. Follow-up was carried out at denture insertion, 6 months and 12 months following insertion. Peri-implant bone loss as well as posterior bone loss was evaluated using cone-beam computerized tomography and retention was evaluated using force meter device and wire hook attaches to the prosthesis.

RESULTS: There was a statistically significant difference in peri-implant bone loss between the two groups at the 2nd follow-up period and at the end of the study period ($p \leq 0.05$). There was no statistically significant difference in posterior bone loss between the two studied groups ($p \leq 0.05$) and regarding retention that there was no statistically significant difference between the two groups along the follow-up periods.

CONCLUSION: From the results obtained from this study, it could be concluded that locator attachment showed lower peri-implant bone loss than retention silicone liner in the overall follow-up period with a statistically significant difference. This was attributed to the decrease in the effect of the resiliency of retention silicone liner over time and the more permanent effect of locator attachment.

Edited by: Aleksandar Iliev
Citation: Shaaban A, Mahrous AI, Shaaban SM, Denewar M. Effect of Two Retention Modalities on Single Midline Implant Supporting Mandibular Overdenture. Open Access Maced J Med Sci. 2023 Jan 04; 11(D):15-19. <https://doi.org/10.3889/oamjms.2023.10608>
Keywords: Single implant; Overdenture; Attachments
***Correspondence:** Dr. Ahmed Shaaban, Associate Professor of Prosthodontics, Faculty of Dentistry, Future University, New Cairo, Egypt.
E-mail: ahmed.abdelwahed@fue.edu.eg
Received: 04-Jul-2022
Revised: 01-Nov-2022
Accepted: 14-Dec-2022
Copyright: © 2023 Ahmed Shaaban, Ahmed Ibrahim Mahrous, Sara Maher Shaaban, Mohamed Denewar
Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
Open Access: This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Introduction

Edentulism affects oral and general health, as well as quality of life [1]. Rehabilitation using a complete denture for those with alveolar bone loss frequently leads in denture pain, retention and stability issues, and diminished mastication effectiveness. Implant-retained overdentures are commonly utilized for the rehabilitation of edentulous jaws due to their ability to promote prosthesis retention, improve chewing function, and minimize alveolar bone resorption by controlling neuromuscular adaption [2], [3].

Evaluating at least two implant-retained mandibular overdentures, with conventional complete dentures will certainly improve function and chances of success [4], [5]. However, the York consensus statement says that patients should have at least two implants to support mandibular overdentures [6]. The stability, retention, and masticatory effectiveness of an overdenture supported by two implants positioned in the interforaminal region (canine region) have been significantly increased [7], it is difficult to obtain complete parallelism between bilateral implants and excessive

cost, and the effect of the different angulations of the two implants on the retention of the overdenture may be considered as a shortcoming of the bilateral implant overdenture [8]. For elderly individuals, a single midline implant put in the sympheseal region may be a more affordable therapeutic option than total dentures, as it can solve the problem of high cost and, achieve the same retentive properties, high durability, and success rate [9], [10]. The maintenance costs play a significant role in choosing the best form of implant attachment.

There have been reports of successful outcomes with locator and ball attachments.

Since the ball attachment is an elastic retainer that permits a little amount of overdenture rotation and transfers the load to the nearby bone tissue, it is frequently used in single implants.

However, this attachment type's applicability is constrained by its high maintenance costs [11], [12] [13]. Retention silicone is a silicone liner with very high tensile strength (available in three friction strengths hard, medium, and soft), which is perfectly suited to ensure a stable position of the denture. This material combines the cushioning effect of the soft denture liner

with the retentive force of the female portion of the attachment [14].

Materials and Methods

For this investigation, 16 totally edentulous individuals were chosen, they were clinically free from any systemic diseases with suitable inter arch distance and normal ridge relationship and form. The residual ridge had adequate bone width of not <6 mm in the anterior region of the mandible and sufficient length of not <17 mm.

Pre-operative cone-beam computed tomography (CT) with the patient wearing a radiographic stent with a gutta-percha size of 80 was fitted in the midline. The gutta-percha was used as a reference point when a cone-beam CT scan was performed. Bone width and height were estimated using a cone-beam CT scan at the proposed implant site.

The patients were prepared for surgery. A crestal incision was made that extended 10 mm mesial to and distal to the midline. A full-thickness mucoperiosteal flap was, then, created.

A point drill of 2 mm diameter was held in a vertical direction and moved up and down during drilling, and a pilot drill with diameter 3.25 mm was then used to widen the osteotomy. The final drill of diameter 3.75 mm was, then, used to shape the osteotomy according to the selected implant diameter and length. Appropriate irrigation was performed, and the implant was positioned in the mandibular symphysis and oriented perpendicular to the occlusal plane. The implant used had a diameter of 4.00 mm and a length of 13 mm.

A cover screw was placed over the implant fixture and screwing was performed until complete sealing was achieved. The mucoperiosteal flap was then repositioned and sutured with interrupted black silk 000 sutures. Ten days later, the sutures were removed, the dentures were relieved, and relining was performed in relation to the implant site using a tissue conditioning material. After complete healing, the tissue conditioner was removed, a rubber base impression was made under biting force for the lower denture, and relining was performed using heat-cured acrylic resin.

The patients were recalled 4 months after surgery. The implant was palpated and exposed using a sterile punch. The cover screw was placed over the implant fixture and screwing was done until complete sealing. The mucoperiosteal flap was, then, repositioned and sutured by interrupted sutures using black silk 000. Ten days later, sutures were removed, dentures were relieved, and relining

was performed in relation to implant site using tissue conditioning material. After complete healing, tissue conditioner was removed and rubber base impression was made under biting force for the lower denture, relining was done using heat-cured acrylic resin.



Figure 1: Denture fitting surface with metal housing

The patients were recalled 4 months after surgery. The implant was palpated and exposed using a sterile punch. The cover screw was unthreaded with a finger using an unscrew instrument.

Two groups of patients were randomly allocated. Group I received a single midline implant-supported overdenture and was retained by locator attachment, whereas Group II received a single midline implant-supported overdenture and was retained by retention silicone 400 g (Figures 1 and 2).



Figure 2: Fitting surface of denture after setting of retention silicone

For retention measurements, the geometric center of the lower denture was relatively identified, and a rigid wire was used to make a retentive hook within the geometric center to be attached to the force meter to begin the evaluation and measurement of retention. A wire with a hook was attached to the denture base using self-curing acrylic resin to permit the (force meter) to apply a vertical displacement force on the denture.

Follow-up visits were scheduled at the time of denture insertion, 6 and 12 months after overdenture insertion for inspection of the prosthesis and collection of the data radiographic evaluation (Figure 3).

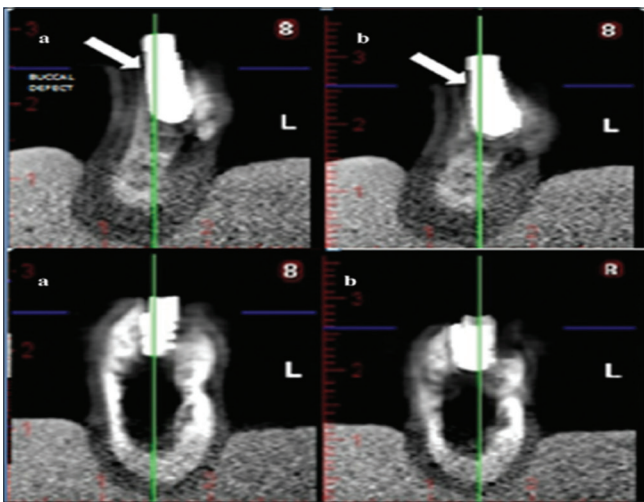


Figure 3: Cone-beam computed tomography for midline implant

Results

Patients were satisfied with their prosthesis. Clinically, neither palpation nor percussion induced discomfort, and no exudates were identified related to the implants. The effect of time on peri-implant bone loss and retention in the two analyzed groups was investigated each 6 months from the time of implant placement. Tables 1, 2 and 3 compared the two groups (group I locator, group II retention Sil).

Discussion

Patients were selected free from any systemic diseases to avoid any disease that may affect healing, complicate the surgical procedures, or prevent successful osseointegration [15]. Patients with sufficient buccolingual width of the edentulous ridge were selected to ensure that at least 2 mm of bone remained around the implant to preserve bone nutrition and vitality [16].

Table 1: Locator group showed lower mean values of peri-implant bone loss in the 2nd follow-up period than retention silicone group. The difference was statistically significant

Time	Group I (locator)		Group II (retention silicone)		p value
	Mean	Standard deviation	Mean	Standard deviation	
0–6 months	0.51	0.06	0.46	0.08	0.139
6–12 months	0.36	0.05	0.54	0.038	0.001*
0–12 months	0.88	0.06	0.98	0.098	0.05*

*statistically significant differences.

Due to decreased functional demands and the understanding that implant/patient life expectancy is limited, single implant-supported overdentures may be acceptable for the treatment of edentulism in old patients [9]. The midline of the mandibular arch was chosen for the placement of a single implant since it is a favorable host zone for an implantation in terms of bone quantity and quality [17].

Table 2: There was no statistically significant difference in posterior bone loss between the two groups in the different follow-up periods with $p \leq 0.05$

Time	Group I (locator)		Group II (retention silicone)		p value
	Mean	Standard deviation	Mean	Standard deviation	
0–6 months	0.73	0.12	0.74	0.07	0.78
6–12 months	0.47	0.06	0.41	0.09	0.205
0–12 months	1.19	0.14	1.13	0.08	0.388

Retention silicone is a silicone matrix with a very high tensile strength, which is perfectly suited to ensure the resilient position of the denture. It is available in three friction strengths: - hard, medium, and soft (600, 400, and 200 g, respectively) [14].

Radiographic interpretation is a standard method used to evaluate the rate of bone change with height. For the evaluation of implant success, radiographic examinations were performed as in follow-up clinical trials, which were designed for the evaluation of oral implant success [18]. The pre-operative cone-beam CT was performed for each patient in the study, because the bone dimension and vital structure appear in the cone beam with accurate dimensions [19].

Table 3: Comparison between the two groups showed no statistically significant difference between mean retention values at 0–6 months and after 6–12 months and at the whole follow-up period in the two groups

Time	Group I (locator)		Group II (retention silicone)		p value
	Mean	Standard deviation	Mean	Standard deviation	
0–6 months	334.4	24.7	287.4	22.9	0.0576*
6–12 months	313.6	17.8	267.3	10.8	0.0592*
0–12 months	302.7	11.5	353.9	10.2	0.189

*statistically significant differences.

Increased retention force, support, and stability given by attachments within the implant fixture decrease the frequency of alveolar ridge resorption and optimize prosthetic clinical outcomes; there are several studies that support this perspective.

Single implant-retained overdentures did not differ from those retained by two implants in terms of patient overall comfort and satisfaction, but had the advantage of lower cost and shorter treatment duration [20]. At denture insertion and till 6-month follow-up, Group I (locator) showed higher statistically significant values of peri-implant bone (1st follow-up period) than that revealed in Group II (Retention Silicone), and that was due to the highly noticeable resiliency and cushioning effect of retention silicone which worked on distribution of stresses evenly on the ridge. Conversely, in the 2nd follow, retention silicone showed a statistically significant higher value of peri-implant bone loss than the locator, which was attributed to the reduced efficiency of retention silicone, which should be periodically applied.

Both groups revealed a significant decrease in the amount of peri-implant bone as well as in the posterior molar area distal to the implant during the overall follow-up period. According to Cochran [21], the first 6 months after surgery are the most

important for peri-implant bone remodeling after implant placement.

There was a significant difference in the values of retention during first and second follow-up periods as the first group using locator showed more retention values with significant difference than the second group with retention silicone and in the last follow-up period the retention values decreased for the two groups and that may be due to wear in the housing material of the locator attachment and degradation of the silicone material in the fitting surface.

Conclusion

From the present study, it was concluded that:

1. An implant-retained mandibular overdenture supported by a single implant is a treatment protocol that greatly streamlines the surgical and laboratory process for elderly patients.
2. Retention silicone is a good silicone liner that combines the cushioning effect of a soft liner with the high retentive qualities of the implant overdenture; however, periodic maintenance is required; otherwise, the resiliency of the material is lost.
3. Locator attachment can give good results when used with single midline implant overdentures, they showed lower peri-implant bone loss than retention silicone.

References

1. Bakke M, Holm B, Gottfredsen K. Masticatory function and patient satisfaction with implant-supported mandibular overdentures: A prospective 5-year study. *Int J Prosthodont.* 2009;15(6):575-81. PMID:12475165
2. Heckmann SM, Heussinger S, Linke JJ, Graef F, Proschel P. Improvement and long-term stability of neuromuscular adaptation in implant-supported overdentures. *Clin Oral Implants Res.* 2015;20(11):1200-5. <https://doi.org/10.1111/j.1600-0501.2009.01722.x> PMID:19832766
3. Ueda T, Kremer U, Katsoulis J, Mericske-Stern R. Long-term results of mandibular implants supporting an overdenture: Implant survival, failures, and crestal bone level changes. *Int J Oral Maxillofac Implants.* 2017;26(2):365-72. PMID:21483890
4. Donatsky O. Osseointegrated dental implants with ball attachments supporting overdentures in patients with mandibular alveolar ridge atrophy. *Int J Oral Maxillofac Implants.* 1993;8(2):162-6. PMID:8359871
5. Gottfredsen K, Holm B. Implant-supported mandibular overdentures retained with ball or bar attachments: A randomized prospective five-year study. *Int J Prosthodont.* 2010;13(2):125-30. PMID:11203620
6. Thomason JM, Feine J, Exley C, Moynihan P, Müller F, Naert I, *et al.* Mandibular two implant supported overdentures as the first choice standard of care for edentulous patients--the York Consensus Statement. *Br Dent J.* 2017;207(4):185-6. <https://doi.org/10.1038/sj.bdj.2009.728> PMID:19696851
7. Sadowsky SJ. Mandibular implant-retained overdentures: A literature review. *J Prosthet Dent.* 2011;86(5):468-73. <https://doi.org/10.1067/mpr.2001.119921> PMID:11725274
8. Gulizio MP, Agar JR, Kelly JR, Taylor TD. Effect of implant angulation upon retention of overdenture attachments. *J Prosthodont.* 2015;14(1):3-11. <https://doi.org/10.1111/j.1532-849X.2005.00005.x> PMID:15733129
9. Cordioli G, Majzoub Z, Castagna S. Mandibular overdentures anchored to single implants: A five-year prospective study. *J Prosthet Dent.* 1997;78(2):159-65. [https://doi.org/10.1016/s0022-3913\(97\)70120-3](https://doi.org/10.1016/s0022-3913(97)70120-3) PMID:9260133
10. Krennmair G, Ulm C. The symphyseal single-tooth implant for anchorage of a mandibular complete denture in geriatric patients: A clinical report. *Int J Oral Maxillofac Implants.* 2016;16(1):98-104. PMID:11280368
11. Schneider GB, Synan WJ. Use of a single implant to retain a mandibular complete overdenture on the compromised atrophic alveolar ridge: A case report. *Spec Care Dentist.* 2018;31(4):138-43. <https://doi.org/10.1111/j.1754-4505.2011.00196.x> PMID:21729123
12. Alsabeeha NH, Payne AG, De Silva RK, Thomson WM. Mandibular single-implant overdentures: Preliminary results of a randomised-control trial on early loading with different implant diameters and attachment systems. *Clin Oral Implants Res.* 2016;22(3):330-7. <https://doi.org/10.1111/j.1600-0501.2010.02004.x> PMID:20868456
13. Cehreli MC, Karasoy D, Kokat AM, Akca K, Eckert SE. Systematic review of prosthetic maintenance requirements for implant supported overdentures. *Int J Oral Maxillofac Implants.* 2019;25(1):163-80. PMID:20209199
14. Preoteasa E, Meleşcanu-Imre MA, Preoteasa CT, Marin M, Lerner H. Aspects of oral morphology as decision factors in mini-implant supported overdenture. *Rom J Morphol Embryol.* 2010;51(2):309-14.
15. Burns DR. Mandibular implant overdenture treatment: Consensus and controversy. *J Prosthodont.* 2017;9(1):37-46. <https://doi.org/10.1111/j.1532-849x.2000.00037.x> PMID:11074027
16. Speikerman H, Donath K, Hassely T, Jovanic S, Richter J. *Atlas of Dental Medicine.* New York, USA: Theme Medical Publishers. Inc.; 1995.
17. Chee W, Jivraj S. Treatment planning of the edentulous mandible. *Br Dent J.* 2016;201(6):337-47. <https://doi.org/10.1038/sj.bdj.4814041> PMID:16990883
18. Gharechahi J, Rostamkhamni F, Saboori A. Effect of clasp design on stress distribution pattern of distal extension abutment: A finite element method analysis. *J Mash Dent Sch.*

- 2010;34:65.
19. Chan HL, Misch K, Wang HL. Dental imaging in implant treatment planning. *Implant Dent.* 2018;19(4):288-98. <https://doi.org/10.1097/ID.0b013e3181e59ebd>
PMid:20683285
20. Walton JN, Glick N, Macentee MI. A randomized clinical trial comparing patient satisfaction and prosthetic outcomes with mandibular overdentures retained by one or two implants. *Int J Prosthodont.* 2014;22(4):331-9.
PMid:19639067
21. Cochran DL, Nummikoski V, Schoolfield JD, Jones AA, Oates TW. A prospective multicenter 5-year radiographic evaluation of crestal bone levels over time in 596 dental implants placed in 192 patients. *J Periodontol.* 2018;80(5):725-33. <https://doi.org/10.1902/jop.2009.080401>
PMid:19405825