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Effect of Using Locator Versus O-Ring Attachments on Hybrid Implants Retaining Lower Complete Dentures

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Abstract

Objective: To evaluate the effect of using Locator versus O-ring attachments on peri-implant bone loss related to hybrid implants retaining mandibular complete dentures.

Materials and Methods: Fourteen completely edentulous male patients were randomly divided into two groups, the first group received mandibular overdenture retained with three hybrid implants (2.9 mm.- 12 mm.) as one unit with Locator attachments and the second group received mandibular overdenture retained with three of the same implant type as one unit with ball and socket attachments. Cone Beam Computed Tomography (CBCT) was used to evaluate peri-implants bone height for each patient at the time of loading, after 6 months and after 12 months of loading implants. The difference in the amount of bone loss during the follow up periods and the difference in bone loss between the two groups were measured and statistically analyzed.

Results: It was found that there is no significant difference in peri-implants bone resorption with the use of Locator attachments or with ball and socket.

Conclusion: It can be concluded that both attachments have comparable effect on peri-implants bone resorption.

Key words: overdentures, implants, narrow diameter implants, ball, Locator

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Introduction

Edentulism is a multifactorial outcome that results from various combinations of cultural and attitudinal determinants, and to treatment previously received. The state of complete edentulism represents a compromise in the masticatory system integrity accompanied by adverse functional and cosmetic sequelae. Individual perception of the edentulous state may range from little inconvenience to feelings of sever handicap[1]. Depending on the shape of the residual ridge, some conventional dentures may be unstable or inadequately retained, which will affect the patient satisfaction with the functional results of the treatment[2].

The use of entirely implant supported prosthesis result in considerable delay in the resorption process of the posterior mandibular ridge and may even contribute to increase in the amount of posterior bone height even when no posterior implants are inserted[2].

Mini implants were cleared by the FDA for long term intra-bony applications, as a result of their clinical success. Numerous surveys, testimonials, research projects and satisfied dentists agree with successful survival rate of 91% to 97%[3].

After a while some implant companies recognized the risk of fracture of mini implants in situations of minimal bone presence, and manufactured implants of smaller diameter than conventional but larger than mini implants, which were commercially known as narrow diameter implants with a diameter ≤ 3.5 mm.[4]

Narrow diameter implants are widely used now due to their many advantages which include reduced bleeding, less postoperative discomfort, shortened healing time and immediate loading protocol[5]. Sendax[6], also stated that these implants could serve as a low-cost alternative implant in edentulous ridges for definitive prosthodontic treatment.

They can be used satisfactorily in areas with compromised bone without the need for more advanced surgical procedures to reconstruct the bony ridge as it is needed in case of conventional diameter implants[7]. Hybrid versus mini-implants has the advantage of the possibility to use a decreased number of implants, for example in the mandibular prosthesis 2 hybrid implants can be used instead of 4 mini-implants[8].

Disadvantages of hybrid implants include loosening, deformation, and fracture during treatment and at removal because their diameters are small. In general most disadvantages are a result of poor planning or inexperienced practitioners[9].

Implants are considered acceptable abutments in conjunction to attachments for efficient retention of the overdentures[10]. Choosing the type of attachment depends on many factors, including available space, necessity for maintenance, spare parts availability and their ease of change, distribution of force to the supporting structures and the level of retention required[11].

The O-ring attachment system is a resilient attachment for overdentures, its dynamic movement allows one of the most resilient or mobile types of attachments because it allows motion in six different directions[12]. The O-ring system is particularly suitable for immediate loading because of its shock absorption capacity[13].

Another type of resilient stud attachment that may also be used with overdentures is the Locator system. The Locator is a relatively newer clinical alternative to the established attachments that was introduced in 2001. This attachment is self-aligning and has a characteristic feature which is the unique dual retention with combined internal and external retentive features[14, 15].

Locator attachments are available in different vertical heights from 2mm to 6mm. They are

resilient, retentive and durable. In addition, repair and replacement are easy and fast[16, 17]. The Locator attachment system has the lowest profile of all attachments allowing the clinician to use it in areas of restricted vertical space, and is versatile up to 20° of divergence between two implants[18].

Materials and Methods

Fourteen completely edentulous male patients were selected.

Patients were randomly divided into two equal groups:

Group (I): seven patients were rehabilitated with three, one piece implants retained mandibular overdentures with Locator attachments of 2.9 mm. diameter and 12 mm. length.

Group (II): seven patients were rehabilitated with three, one piece implants retained mandibular overdentures with O-ring attachments of 2.9 mm. diameter and 12 mm. length.

Pre-surgical procedures and patients preparations

Cone beam computed tomography (CBCT) was done for each patient in the presence of a radiographic stent to measure the bone length and width at the sites of a three gutta percha cones corresponding to jaw regions where it is planned for placement of the three implants.

Each patient was delivered his new denture one month before surgery. The occlusal scheme used was the medial positioned lingualized scheme of occlusion.

Surgical procedures

Flapless surgical technique was conducted for implants placement.

A punch instrument was used to remove soft tissues at the predetermined sites of implants placement, through the openings of the surgical stent.

Initial point of entry was conducted to penetrate the cortical plate of bone, with the initial drill at a speed of 1200 rpm.

A pilot drill was used to drill into the cancellous bone under slow parallel rotation with up and down movements.

A hybrid one piece implant was retrieved from the sterile package and inserted directly into the prepared osteotomy.

The ratchet was used to apply slight apical pressure and rotation by slow back and forth movements. Torque was limited to 35-40 N-cm using the torque wrench for insertion of the implant in position till only the male part of the attachment is shown above the mucosal level fig.(1).

FIG. 1. Three hybrid implants with Locator attachments

Loading protocol

Loading of the implants was performed after two weeks of the surgery.

The plastic spacer was placed on the attachment before the positioning of the metal housing on it.

Pink auto polymerized acrylic resin material was used to pick up the housings in the fitting surface of the denture. The patient was asked to close his jaws together in centric position until the acrylic material was completely set.

The plastic processing caps of Locator attachments within their metal housing were used during the pick-up procedure, then after finishing and polishing of the auto-polymerizing acrylic resin the processing caps were removed and replaced with the retentive plastic caps into the metal housing by the use of Locator core tool.

Radiographic bone assessment

A cone beam computed tomography (CBCT) was conducted for each patient on the mandible while he was wearing his denture three times, at the time of loading, after six months and after twelve months of loading. Marginal bone height change around the implants was evaluated using the machine software.

Results

I. The effect of time on the peri-implants bone heights in both groups:

The mean values of bone height at all aspects surrounding the implants decreased from each follow-up period to the next. The bony changes at the first follow up period were found statistically significantly higher than bone changes at the second follow up period.

Mean values related to group II showed that the amount of bone height decreased from each follow-up period to the next. Bone changes at the first follow up period were found statistically significantly higher than bone changes at the second follow up period.

II. Effect of different treatment modalities on the peri-implants bone height changes:

The mean value of the peri-implants bone height changes, for the two different treatment modalities (groups) during the follow-up intervals were evaluated.

Mean value of the peri-implants bone changes in the two different groups revealed that the peri-implants bone loss was slightly higher in group II, than in group I, but there was no statistically significant difference between the bone loss in the two groups table (1).

III. Effect of time on mesial and distal peri-implants bone changes of the two peripheral implants in each group:

The mean value of the amount of bone height changes mesially and distally around the two peripheral implants in each group were evaluated.

Table (1) *mean, standard deviation and P value of the peri-implants bone changes in both groups showing no significant differen*

Bone change around implants					
Time intervals	Groups	Number	Mean	Std. Deviation	P value
Base line – 6 months	Group I	7	0.5362	0.19469	0.57
	Group II	7	0.5952	0.18361	
6 – 12 months	Group I	7	0.2981	0.07164	0.938
	Group II	7	0.2948	0.08565	
Base line - 12 months	Group I	7	0.8343	0.24557	0.651
	Group II	7	0.8900	0.20164	

Paired T test

Mean value in the mesial and distal peri-implants aspects during the time interval between the follow up periods related to group I showed that the mesial bone resorption was significantly greater than the distal bone resorption on all the follow up intervals and on the whole period of the study.

Also the mesial bone resorption was significantly greater than the distal bone resorption on all the follow up intervals and on the whole period of the study in group II.

IV. Effect of different treatments on mesial and distal peri-implant bone level:

The mean value for each of the mesial and distal peri-implants bone level changes for the two different treatment modalities (groups) during the two follow-up intervals were evaluated.

The distal peri-implants bone loss was slightly higher in group II, than in group I, but there was no statistically significant difference.

The mesial peri-implants bone loss was slightly higher in group II, than in group I, but there was no statistically significant difference between them.

Discussion

Only males were included because females show high prevalence of post-menopausal osteoporosis, that may affect the metabolism of bone and osseointegration [19].

Exclusion of uncontrolled diabetic patients was conducted because patients having diabetes represent a risky condition. Hyperglycemia may affect the surgical procedure causing delayed healing, unstable ossteointegration, alterations in bone metabolism and infections[20].

As smoking was reported as a significant risk factor for failure of implant therapy, therefor smokers were excluded from this study, specially those in association with poor oral hygiene[21].

The medial positioned lingualized occlusal scheme was chosen to be applied to the patient's dentures because it allows the occlusal forces to be directed at the implant center through its long axis, thus allowing for more even stress distribution. It stabilizes the maxillary denture by directing the stresses closer to the maxillary residual ridge which is the primary stress bearing area in the maxilla[22].

In this study hybrid implants were used because they solve the problem of narrow ridge size [23].

The choice of one unit implants has an advantage of providing a gap free connection (bacteria proof), therefore has a protection function of the peri-implant soft tissue which allows the establishment of a tissue collar overlapping the bone implant interface[24].

Three hybrid implants were used rather than two conventional implants because they may decrease applied implant moments in half and bone reaction forces by two thirds[22].

An association was detected between the diameter of the implant and complications. Loss of osseointegration was associated with wider implants and thinner implants were prone to more infectious complications[21].

Flapless surgical protocol was used because it avoids all the disadvantages of the surgical procedures, more comfortable to the patients, allows shorter healing time and doesn't cause bone resorption normally following the conventional surgeries[25].

Early loading protocol was followed as it affords the patient many benefits such as shortened treatment phase, early rehabilitation, and superior esthetics. This protocol benefits from the primary stability gained during implant insertion[26].

O-ring attachment was used because it has a range of different retention strengths[22]. The corresponding cap of an O-ring incorporated into the denture base, not only reduces shock, pressure and torque but also simple and saves time[27].

Locator system is resilient, retentive, and durable, and have some built-in angulation compensation. In addition, its repair and replacement are easy and fast. Locator attachment was found more advantageous to ball system, regarding the rate of complications in clinical practice[28].

The resilient attachments were used as they are particularly suitable for immediate loading because of their shock absorption capacity[13].

CBCT is more precise than any other technique in measuring peri-implant bone level because it allows three dimensional evaluation of the mandible providing very detailed image, with high contrast and resolution without overlapping[29].

The results of this study revealed that the implants with both types of attachments O-ring and Locator fulfilled the criteria of implant success as indicated by clinical examination and the amount of bone loss measured by the CBCT software.

In this study there was a decrease in all aspects of peri-implants bone levels in both groups related to time. It may be due to surgical trauma, bone remodeling after implant placement, or they may be related to stresses acting on peri-implants bone, occlusal forces with axial and transverse components, or it may be an early manifestation of wound healing[30, 31].

Mean peri-implants bone loss in group I treated with Locator attachments through the whole year of the study was considered acceptable. This is in agreement with Misch[22] who stated that marginal bone loss around implants up to 2 mm. in the first year after placing the fixture is considered as an accepted amount. That is further supported by Bratu et al.[32] and Payne et al.[33] and many other studies[34, 35].

There was no statistically significant difference between the effect of both attachments on the peri-implant bone resorption. This could be explained by the fact that both attachments are resilient. However, the dual retention of Locator attachment may be responsible for transferring more moment loads to the implants thus bone loss was nearly equal to that occurred with ball and socket. Ma et al[36] investigation was in line with this study findings.

Both types of attachments were found clinically satisfying and acceptable as an implant retained overdenture attachment. Cakarer et al.[28] found that Locator system showed superior clinical results than the ball and the bar attachments. But Kleis et al.[17] stated that Locator system showed a higher rate of maintenance than the ball attachments. Another clinical study reported that there were no differences between ball or Locator attachment for any items of satisfaction evaluated and neither attachment had a significant patient preference[37].

Peri-implant bone resorption following insertion of implants is more accentuated in the first 6 months after surgery, then it slowly decreases until stable levels are reached after five years[38,39]. This statement is in agreement with what was resulted in this study in which the amount of peri-implant bone loss at the first 6 months was more than the amount of bone loss that occurred on the second 6 months of the study in both groups.

The results of this study revealed that there is more bone resorption mesially than distally in the peri-implants bone level on both peripheral implants. It was found that there is significant difference between mesial and distal bone resorption in both groups. Mesial peri-implant bone resorption was more than distal[40, 41] which is in line with this study. This is in agreement with

Celik and Uludag[42] who found that placement of more than 2 implants in the inter-foraminal region may create an angular relationship between the implants instead of a straight line relationship.

Conclusion

Within the limitations of this study, it could be concluded that:

Peri-implant bone resorption of hybrid implants with either Locator or ball and socket attachments had no significant difference throughout the whole study. Mesial aspect bone resorption was significantly greater than distal aspect with both types of attachments.

References

1. Zarb G. A., Bolender C. L.and Carlsson G. E. Boucher's Prosthodontic treatment for edentulous patients. 11th ed. ed: Mosby Inc.; 1997.
2. Misch C. E. Rationale for implant, Dental Implant Prosthetics.: Mosby, Inc.; 2005.
3. Christensen G. J.and Child P. L. J. The truth about small diameter implants. Dent. Today. 2010;29(5):116, 118, 120.
4. Balkin B.E., Steflik D. E.and Naval F. Mini dental implant insertion with auto advance technique for ongoing applications. J. Oral Impantol. 2001; 27:32-37.
5. Flanagan D., Ilies H., McCullough P., et al. Measurement of the fatigue life of mini dental implants: A Pilot Study. J. Oral Impl. 2008;34(1):7-11.
6. Sendax V. Mini-implants as adjuncts for transitional prostheses. Dent. Implantol. Update. 1996;7(2):12-25.
7. Bulard R. A.and Vance J. B. Multi clinic evaluation using mini dental implants for long term denture stabilization: A preliminary biometric evaluation Compend. Contin. Educ. Dent. 2005;26(12):892-897.
8. Preoteasa E., Imre M., Lerner H., et al. Emerging trends in oral health sciences and dentistry. Chapter 11, Narrow diameter and mini dental implant overdentures. 2015:241-264.
9. Esposito M., Grusovin M. G.and Coulthard P. The efficacy of various bone augmentation procedures for dental implants: A cochrane systematic review of randomized controlled clinical trials Int. J. Oral Maxillo. Imp. 2006;21(5):696-710.
10. Adell R., Lekholm U., Rockler B., et al. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int. J. Oral Surg. 1981;10(6):387-416.
11. Zitzmann N. U.and Marinello C. P. Patient satisfaction with removable implant-supported prostheses in the edentulous mandible Schweiz Monatsschr Zahnmed 2006;116(3):237-244.
12. Tokuhisa M., Matsushita Y.and Koyan K. In vitro study of a mandibular implant overdenture retained with ball, magnet, or bar attachment: comparison of load transfer and denture stability Int. J. Prosthodont. 2003;16(2):128-134.
13. Cedric H., Marion B., Emmanuel N., et al. Geriatric slim implants for complete denture wearers: clinical aspects and perspectives. Clin. Cosm. Investig. Dent. 2013;5:63-68.
14. Trakas T., Michalakis K., Kang K., et al. Attachment systems for implant retained overdentures: A literature review. Implant Dent. 2006;15(1):137-142.
15. Evtimovska E., Masri R., Driscoll C. F., et al. The change in retentive values of locator attachments and hader clips over time. J. Prosthod. 2009;18(6): 479-483.
16. Chung K. H., Chung C. Y., Cagna D. R., et al. Retention characteristics of attachment systems for implant overdentures J. Prosthodont. 2004;13(4):221-226.
17. Kleis W. K., Kammerer P. W., Hartmann S., et al. A comparison of three different attachment systems for mandibular two-implant overdentures: one-year report. Clin. Impl. Dent. Rel. Res. 2010;12(3):209-218.
18. Neerja M.and Rahul K. Overdenture locator attachments for atrophic mandible. Contemp Clin. Dent. 2013;4(4):509-511.
19. Giro G., Goncalves D., Sakakura C. E., et al. Influence of estrogen deficiency and its treatment with alendronate and estrogen on bone density around osseointegrated implants: radiographic study in female rats. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. 2008;105(2):162-167.

20. Marchand F., Raskin A., Dionnnes-Hornes A., et al. Dental implants and diabetes: Conditions for success. Diabetes Metab. 2012;38(1):14-19.

21. Rodriguez-Argueta O. F., Figueiredo R. and Valmaseda-Castellon E. Postoperative complications in smoking patients treated with implants: A retrospective study. J. Oral Maxillofac. Surg. 2011;69(8):2152-2157.

22. Misch C. E. Dental implant prosthodontics. 2nd. ed.: Mosby Inc.; 2015.

23. Adel A. A. Clinical evaluation of immediately-loaded mini implants retained overdentures: 3 years follow up. Ain Shams Dental Journal 2012;XV(3):135-145.

24. Tennenbaum H., Schaaf J. F. and Cuisinier F. J. G. Histological analysis of the Ankylos peri-implant soft tissue in a dog model. Implant. Dent. 2003;12(3):259-265.

25. Bidra A. Flapless implant surgery to overcome anatomic challenges in the anterior mandible for overdenture therapy: A clinical report. J. Prosthet. Dent. 2014;111(3):175-180.

26. Rismanchian M., Attar B. M., Razavi S. M., et al. Dental implants immediate loading versus the standard 2-staged protocol: An experimental study in dogs. . J. Oral Implantology 2012;38(1):3-10.

27. Federick D. R. and Caputo A. A. Effects of overdenture retention designs and implant orientations on load transfer characteristics. J. Prosthet. Dent. 1996;76(6):624-632.

28. Cakarer S., Can T., Yaltirik M., et al. Complications associated with the ball, bar and Locator attachments for implant-supported overdentures. Med. Oral Patol. Oral Cir. Bucal. 2011;16(7):953-959.

29. Orentlicher G. and Abboud M. Guided surgery for implant therapy. Oral Maxillofacial Surg. Clin. N. Am. 2011;23(2):239-256.

30. Oh T. J., Yoon J., Misch C. E., et al. The causes of early implant loss: Myth or science? J. Periodontol. 2002;73:322-333.

31. Brewer A. A. and Morrow R. M. Overdentures 2nd. ed: C. V. Mosby Co., St. Louis, London; 1980.

32. Bratu E. A., Tandlich M. and Shapira L. A rough surface implant neck with microthreads reduces the amount of marginal bone loss: A prospective clinical study. Clin. Oral Implants Res. 2009;20:827-833.

33. Payne A. G., Tawse-Smith A., Duncan W. D., et al. Conventional and early loading of unsplinted ITI implants supporting mandibular overdentures. Clin. Oral Implants Res. 2002;13(6):603-609.

34. Davarpanah M., Martinez H., Tecucianu J.F., et al. Small-diameter implants: indications and contraindications J. Esthet. Dent. 2000;12(4):186-194.

35. Piao C. M., Lee J. E., Koak J. Y., et al. Marginal bone loss around three different implant systems: Radiographic evaluation after 1 year. J. Oral Rehabil. 2009;36(10):748-754.

36. Ma S., Smith A. T., Thomson W. M., et al. Marginal bone loss with mandibular two-implant overdentures using different loading protocols and attachment systems: 10 year outcomes. Int. J. Prosthodont. 2010; 23:321-332.

37. Krennmair G., Seeman R., Fazekas A., et al. Patient preference and satisfaction with implant-supported mandibular overdentures retained with ball or locator attachments: A crossover clinical trial. Int. J. Oral Maxillofac. Implants. 2012;27(6):1560-1568.

38. Hänggi M. P., Hänggi D. C., Schoolfield J. D., et al. Crestal bone changes around titanium implants. Part I: A retrospective radiographic evaluation in humans comparing two non-submerged implant designs with different machined collar lengths. . J. Periodontol. 2005;76:791-802.

39. Hebatallah T. M. A. Effect of using different number and distribution of one piece medi-implant to retain mandibular overdenture on crestal bone height.: Ain Shams University; 2013.

40. Togashi A.Y., Castaman S. A., Piccolotto A.Y., et al. Marginal bone loss around Morse taper connection implants in osseointegration period. Journal of Biomedical Sciences 2016;5(3:22):1-6.

41. Ajanovic M., Hamzic A., Redzepagic S., et al. Radiographic evaluation of crestal bone loss around dental implants in maxilla and mandibule: One year prospective clinical study. Acta Stomatologica Croatica 2015;49(2):128-136.

42. Celik G. and Uludag B. Photoelastic stress analysis of various retention mechanisms on 3-implant retained mandibular overdentures. J. Prosthet. Dent. 2007;97(4):229-235.