

COMPARISON OF PERI-IMPLANT BONE LEVEL IN MANDIBULAR IMPLANT OVERDENTURE RETAINED BY LOCATOR ATTACHMENT WITH VARYING RETENTIVE INSERT MATERIALS: A RETROSPECTIVE STUDY

Mohamed Moustafa Said 

ABSTRACT

Aim: To compare the effect of nylon versus polyetheretherketone (PEEK) retentive insert of locator attachments on peri-implant bone loss in mandibular implant overdenture.

Materials and methods: Completely edentulous patients, with two implants locator attachment for mandibular overdenture were recalled for this study. Patients were divided into two groups: Group I: overdenture retained by locator attachment using nylon retentive male insert, and Group II: overdenture retained by locator attachment with PEEK retentive male insert. Digital periapical radiographs were conducted to capture images of dental implants using a long-cone paralleling technique. Images taken immediately (baseline) and 24 months after loading were used for this study to measure the vertical bone loss (VBL) and horizontal bone loss (HBL). It was considered statistically significant when P value was less than 0.05.

Results: Twenty-four dental implants were placed in twelve patients aged between 52 and 65 years, comprising 7 men and 5 women. There were no instances of implant loss in either group from the time of placement through prosthetic delivery up to the two-year follow-up period. Group I recorded significant lower VBL than Group II after 24 months of loading ($P < 0.05$). On the other hand, there was no significant differences in HBL between the two groups ($P > 0.05$).

Conclusion: Implant overdentures retained by PEEK insert did cause more peri-implant bone loss when compared to those retained with nylon inserts; however further studies are needed to validate these results.

KEYWORDS: Dental implants, overdenture, locator attachment

* Removable Prosthodontics Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt.,
Restorative Dentistry and Prosthodontics, College of Dentistry, American University of Iraq – Baghdad, Baghdad, Iraq

INTRODUCTION

Mandibular implant-assisted overdentures have emerged as a significant therapeutic choice for individuals with complete teeth loss. The prevailing agreement suggests the positioning of two implants in the canine area to enhance patient satisfaction and overall quality of life when compared to conventional dentures⁽¹⁾. Various attachment systems, such as ball, magnet, locator, or equator, can be utilized in implant-assisted overdentures. The selection of attachment system is influenced by multiple factors, including the available space, maintenance needs, distribution of load to the mucosa and implants, as well as the desired levels of retention and resistance⁽²⁾.

The locator attachment has a low profile design, offering dual retention, and its repair or replacement is a straightforward process. These attachments possess resilient retentive qualities, demonstrating durability and incorporating built-in angulation compensation. Typically, locators come equipped with nylon inserts for securing the denture to the implants. However, a notable drawback is the wear in the nylon insert, primarily attributed to the resilience of movement and inadequate patient training. Consequently, regular maintenance is imperative, involving the periodic replacement of the nylon insert to ensure sustained retention and enhance patient satisfaction⁽³⁾.

A recently introduced attachment type relies on mechanical retention, utilizing a polyetheretherketone (PEEK) matrix on a cylindrical matrix. This innovation holds the potential for increased wear resistance compared to traditional nylon inserts. Studies have indicated that the PEEK material could serve as a viable alternative to nylon inserts for locator attachments in implant overdentures. In a laboratory investigation, the performance of PEEK inserts was evaluated in comparison to inserts made of nylon, focusing on wear and retention loss in relation to abutment and implant angulation. Although a de-

crease in retention was noted across all attachments, PEEK inserts were superior to those fabricated from nylon after mechanical loading⁽⁴⁾. However, it is essential to conduct long-term follow-up evaluations, as there has been a notable rise in plaque accumulation associated with PEEK inserts⁽⁵⁾.

There is presently limited research available regarding the impact of various materials for retentive male inserts on peri-implant bone levels. Periapical radiographs serve as an effective tool for assessing the average marginal bone loss and are crucial for ensuring a good prognosis for dental implants. Consequently, regular follow-up radiographs are imperative for the successful maintenance of endosseous dental implants and for minimizing alterations in the surrounding bone level⁽⁶⁾. The objective of this study was to compare nylon versus PEEK retentive inserts of locator attachments on peri-implant bone levels in mandibular implant-assisted-overdentures.

MATERIALS AND METHODS

The study protocol obtained registration and approval from the Institutional Review Board of the Faculty of Dentistry, Mansoura University, under Approval No. J0108023RP. This retrospective radiographic study was conducted subsequent to a thorough examination of dental records at the Removable Prosthodontics Department, Faculty of Dentistry, Mansoura University.

Completely edentulous patients, with implant overdenture retained by locator attachments were recalled for this study (Figure 1). According to the type of retentive inserts, patients were classified into two groups: Group I: overdenture retained by locator attachment with nylon retentive male insert (n=6) (Figure 2A), and Group II: overdenture retained by locator attachment with PEEK retentive male insert (n=6) (Figure 2B). A total of 12 patients, comprising 7 men and 5 women aged between 52 and 65 years were included in this study. Individuals



Fig. (1) Intraoral view of the two canine implants with locator attachments

were not considered for inclusion in the study if they underwent radiation therapy on the head within a period of less than 12 months before the investigation, had a history of current or previous intravenous bisphosphonate treatment, engaged in a daily consumption of more than 10 cigarettes, used tobacco by chewing, exhibited signs of alcoholism, were pregnant, or expressed unwillingness to participate in follow-up radiography.

Patients were scheduled for routine assessments, including digital periapical radiographs to capture images of their dental implants. These radiographs were taken using a standardized approach employing a long-cone paralleling technique with

commercially available film holders. Images taken immediately (baseline) and 24 months after loading were used for this study to measure the outcomes.

The vertical bone level (AB line) in mm was determined by measuring the distance between the implant shoulder (implant-locator junction) (point A) and the point where the first bone makes contact with the implant (point B) (Figure 3). Meanwhile, horizontal bone level (CE line) in mm was measured perpendicularly from the implant to the bone crest (point C). Point C was the intersection point of a tangent to the bone crest [CD line] and another tangent to the crater [CB line] (Figure 3)⁽⁷⁾. Vertical bone loss (VBL) and horizontal bone loss (HBL) were calculated by subtracting AB and CE immediately after loading from AB and CE after 24 months of function. Measurements were conducted on both the mesial and distal surfaces of each dental implant.

Quantitative data were presented as mean and standard deviation (SD) after assessing normality using the Shapiro-Wilk test in SPSS (Statistical Package for the Social Sciences) software (Version 21, IBM Corp., Armonk, NY, USA). Subsequent to normality testing, independent sample t-tests were employed for data analysis, with statistical significance set at $P < 0.05$.

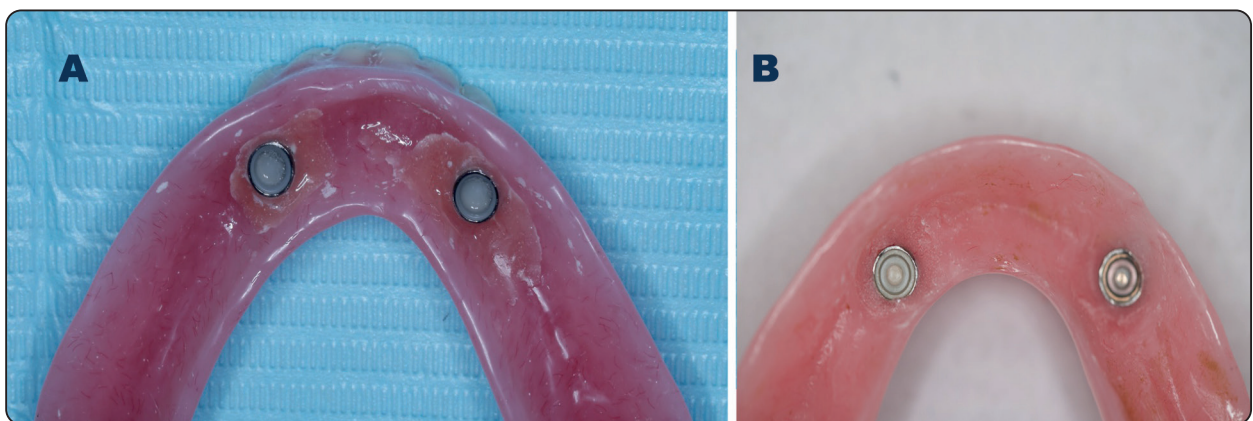


Fig. (2) Mandibular implant overdenture retained by locator attachments with nylon retentive male inserts (A) and with PEEK retentive male inserts (B)

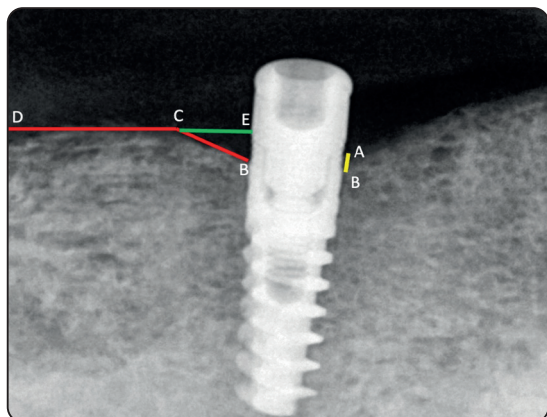


Fig. (3) Traced peri-apical radiograph.

RESULTS

In total, 12 patients, comprising 7 men and 5 women aged between 52 and 65 years, received a total of 24 dental implants. Among these patients, six received mandibular implant overdentures retained by locator attachments with nylon retentive male inserts, while the other six received mandibular implant overdentures retained by locator attachments with PEEK retentive male inserts. There were no instances of implant loss in either group from the time of implant placement through prosthetic delivery up to the two-year follow-up period.

The comparison of VBL and HBL around the implants in the two groups is summarized in Table 1. Group I exhibited significantly lower VBL than Group II after 24 months of loading ($P < 0.05$). Conversely, there were no significant differences in HBL between the two groups ($P > 0.05$).

DISCUSSION

This study observed the peri-implant bone loss in mandibular implant overdentures retained by locator attachment using periapical radiographs. Peri-apical radiographs using parallel technique offer precise measurements of peri-implant alveolar bone, eliminating distortion, limiting magnification, and providing direct rather than relative measurements⁽⁸⁾. In this study, implants demonstrated successful osseointegration at the two-year mark, achieving a 100% success rate. This rate surpassed the 97.1% rate reported by Lee et al⁽⁹⁾. The higher survival rate observed in our study could potentially be attributed to the smaller sample size and the shorter follow-up period (two years compared to five years) in our investigation.

Implant overdentures utilizing locator attachments demonstrate a remarkable success rate exceeding 94.5% and demand minimal maintenance compared to alternative solitary attachments. The locator attachment is distinguished by its low profile, dual retention mechanism, accommodation of divergence, and self-aligning capability, facilitating patients in prosthesis positioning⁽¹⁰⁾. Nonetheless, research on the retentive characteristics of overdenture attachments has indicated that attachments tend to gradually lose their retention over time. This decline has been attributed to the susceptibility of nylon caps to fatigue, wear, and loss of retention⁽¹¹⁻¹²⁾.

PEEK is a novel material in dentistry, currently undergoing extensive investigation for its potential application as a retentive cap. In this study, Group

TABLE (1) Comparison of VBL and HBL in mm between the two groups after 24 months

Outcomes	Group I (Nylon) Mean (SD)	Group II (PEEK) Mean (SD)	P-value t-test
VBL	0.85 (0.24)	1.71 (0.21)	0.0001*
HBL	0.28 (0.09)	0.36 (0.11)	0.1025

*SD, standard deviation; VBL, vertical bone loss; HBL, horizontal bone loss; *P value less than 0.05 was statistically significant*

I with nylon caps recorded significant lower VBL than Group II with PEEK caps after 2 years of loading. The elevated VBL observed in the PEEK group could possibly be linked to the higher plaque scores observed in these patients, as compared to individuals with nylon caps, as indicated by a previous study⁽⁵⁾. Because of the decreased flexibility of PEEK compared to nylon caps, PEEK demonstrated higher levels of retention⁽¹³⁻¹⁴⁾. This could potentially make the insertion and removal of the denture challenging for patients, leading them to wear the denture for extended periods, resulting in a greater accumulation of plaque compared to nylon inserts. The reduction in the overdenture flexibility might also increase the occlusal load on the implants causing overloading and VBL. Future studies are needed to examine whether VBL was due to implant overloading or because of the reduced hygiene measures and increased plaque around the implants.

On the contrary, this study found that there were no significant differences in HBL between the two groups after 2 years of loading. It is recognized that two-implant-retained overdentures consistently lead to an unfavorable distribution of occlusal load on the posterior mandibular ridge due to the potential for overdenture rotation⁽¹⁵⁾. Compression of the mucosa beneath the denture base can impede blood flow, which is crucial for delivering nutrients and removing metabolites from the bone. This disturbance in blood flow may contribute to bone resorption over time⁽¹⁶⁾. The posterior ridge resorption observed after 2 years of loading could potentially have obscured the levels of HBL.

Despite the fact that PEEK retentive material offered greater retention and enhanced patient satisfaction compared to nylon material according to previous studies^(13,17), this investigation uncovered increased peri-implant bone loss in the PEEK group after a 2-year follow-up. The small number of patients in this study limits the extent to which clinical interpretations can be drawn from

the results. Consequently, future studies with larger sample sizes and longer follow-up periods are necessary to facilitate comparison of the presented treatment modalities for implant overdentures retained by locator attachments.

CONCLUSION

Within the limitations of this study, it could be inferred that implant overdentures retained by PEEK insert caused more peri-implant bone loss when compared to those retained with nylon inserts. However, further studies are needed to validate these results.

REFERENCES

1. Thomason JM. The McGill Consensus Statement on Overdentures. Mandibular 2-implant overdentures as first choice standard of care for edentulous patients. *Eur J Prosthodont Restor Dent*. 2002 Sep;10(3):95-6.
2. Yoda N, Matsudate Y, Abue M, Hong G, Sasaki K. Effect of attachment type on load distribution to implant abutments and the residual ridge in mandibular implant-supported overdentures. *J Dent Biomech*. 2015 Mar 16;6:1758736015576009.
3. Miler AMQP, Correia ARM, Rocha JMC, Campos JCR, da Silva MHGF. Locator® attachment system for implant overdentures: a systematic review. *Stomatologija*. 2017;19(4):124-129.
4. Wichmann, N., Kern, M., Taylor, T., Wille, S., & Passia, N. (2020). Retention and wear of resin matrix attachments for implant overdentures. *Journal of the Mechanical Behavior of Biomedical Materials*, 110, 103901.
5. Elazaly, A., Hegazy, S., Salem, A., Said, M. Effect of Locator Attachments with Different Retentive Insert Materials on Peri-implant Tissue Health in Mandibular Implant Overdenture. *Egyptian Dental Journal*, 2021; 67(4): 3595-3601.
6. Pan YH, Lin HK, Lin JC, Hsu YS, Wu YF, Salamanca E, Chang WJ. Evaluation of the Peri-Implant Bone Level around Platform-Switched Dental Implants: A Retrospective 3-Year Radiographic Study. *Int J Environ Res Public Health*. 2019 Jul 18;16(14):2570.
7. Elsyad, M.A. & Shoukouki, A.H. (2010) Resilient liner

- vs. Clip attachment effect on peri-implant tissues of bar-implant-retained mandibular over- denture: a 1-year clinical and radiographical study. *Clinical Oral Implants Research* 21: 473– 480.
8. Elsyad MA, Alokda MM, Gebreel AA, Hammouda NI, Habib AA. Effect of two designs of implant-supported overdentures on peri-implant and posterior mandibular bone resorptions: a 5-year prospective radiographic study. *Clin Oral Implants Res.* 2017 Oct;28(10):e184-e192.
 9. Lee, J.Y.; Park, H.J.; Kim, J.E.; Choi, Y.G.; Kim, Y.S.; Huh, J.B.; Shin, S.W. A 5-year retrospective clinical study of the Dentium implants. *J. Adv. Prosthodontics* 2011, 3, 229-235.
 10. Schneider AL, Kurtzman GM. Restoration of divergent free-standing implants in the maxilla. *J Oral Implantol.* 2002;28(3):113-6.
 11. Schneider AL, Kurtzman GM. Restoration of divergent free-standing implants in the maxilla. *J Oral Implantol.* 2002;28(3):113-6.
 12. Sharaf M., Bakry E., Abdall M. A comparison of the retentive force of ball and socket attachment versus magnet attachment in mandibular overdentures: a randomized control trial. *Journal of International Oral Health* . 2020;12(5):420–426.
 13. Sharaf MY, Eskander A, Afify MA. Novel PEEK Retentive Elements versus Conventional Retentive Elements in Mandibular Overdentures: A Randomized Controlled Trial. *Int J Dent.* 2022 Feb 28;2022:6947756.
 14. Choi JW, Yun BH, Jeong CM, Huh JB. Retentive Properties of Two Stud Attachments with Polyetherketoneketone or Nylon Insert in Mandibular Implant Overdentures. *Int J Oral Maxillofac Implants.* 2018 Sep/Oct;33(5): 1079-1088.
 15. Tymstra, N., Raghoobar, G.M., Vissink, A. & Meijer, H.J. (2011) Maxillary anterior and mandibular posterior residual ridge resorption in patients wearing a mandibular implant-retained overdenture. *Journal of Oral Rehabilitation* 38: 509–516.
 16. Ahmad, R., Chen, J., Abu-Hassan, M.I., Li, Q. & Swain, M.V. (2015) Investigation of mucosa- induced residual ridge resorption under implant-retained overdentures and complete dentures in the mandible. *International Journal of Oral and Maxillofacial Implants* 30: 657–666.
 17. Koenig A, Rotenburg L, Fuchs F, Sander S, Lethaus B, Hahnel S. Influence of aging of PEEK attachment inserts on the pull-off force of implant-retained overdentures- A laboratory study. *Clin Oral Implants Res.* 2023 Dec; 34(12):1363-1372.