



Radiographic evaluation of marginal bone loss of two implant-retained Bar mandibular overdenture utilizing two different impression materials (Vinyl Polyether Silicone versus additional silicone)

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Abstract

Background: Splinted implants with bar is superior for force distribution and decreasing the load on the anterior edentulous ridge area. There is a controversy which impression material and technique will enhance the passive fitness of the bar- abutments connection and its effect on the marginal bone level . **Objective:** The aim of this study was to evaluate marginal bone loss of two implant-retained Bar mandibular overdenture utilizing two different impression materials (Vinyl Polyether Silicone versus additional silicone) with two impression techniques (splinting and non-splinting). **Materials and Methods:** Twenty completely edentulous patients were restored with implant retained Bar overdentures. They were divided into 2 main groups and two subgroups: **Group (I):** Divided into two subgroups **Group (IA):** 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by Vinyl Polyether Silioxaine (VPES) with splinting technique. **Group (IB):** 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by polyvinyl silicone with splinting technique. **Group (II):** Divided into two subgroups **Group (II.A):** 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by Vinyl Polyether Silioxaine (VPES) without splinting . **Group (II.B):** 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by polyvinyl silicone without splinting . **Follow up:** Bone loss evaluation around the 2 implants was done using measurements on digital periapical radiograph with long cone paralleling technique for one year (at loading, 3, 6 ,9, 12 months). **Results:** After mean percentage change calculation, independent t-test was performed to Determine the significance between both groups which concluded that there was significant difference between all groups as (P-value < 0.05). **Conclusion:** The marginal bone loss in the group of Vinyl Polyether Silioxaine (VPES) with splinting was the least compared to the other three groups (Vinyl Polyether Silioxaine (VPES) without splinting, polyvinyl silioxane with splinting Group) while the marginal bone loss in the group of polyvinyl silioxane without splinting was the greatest.

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INTRODUCTION

Complete loss of teeth or edentulism has a very detrimental effect on individuals. It has been observed to result in functional, psychological, and social limitations and affects the quality of life and general health. (1) .

Edentulism is still a challenging problem for healthcare providers all over the world. Dental caries and periodontal diseases are the main responsible factors for teeth loss (2) .

Teeth loss have a negative impact on esthetics and functional activity, this can be managed by prosthetic rehabilitation, either traditionally using

complete dentures or by implant supported fixed or removable prostheses (3) .

The use of implant-overdenture has improved many functions as retention, support, stability and chewing ability. two implant overdentures have been agreed to be the basic standard restorative solution for the edentulous mandible overcoming the problems associated with conventional dentures (4) .

The number of implants and placement sites depend on many factors, including anatomical condition and the economic status of patients. Implant overdentures can be divided according to

the type of retaining system to bar or solitary attachments (5)

From the biomechanical point of view, overdenture prosthesis is considered the optimal restorative solution as they allow for a more uniform physiological force distribution and gentle to moderate impact on the mucosa and alveolar ridge . (6)

functional loads on implants, leads to bone resorption. This may result from biomechanical adaptation of bone to stress. However, implant overloading, may results in implant failure (7) .

The impression is a crucial part of the process of constructing a well-fitting prosthesis; it is imperative that it copies the exact topography of the recorded site and translates it accurately to its cast. To achieve this, the impression material must be both accurate and stable(8,9)

Accuracy of impression plays an essential role in prosthesis-implant fit. (9) Although there are many studies comparing different impression materials and techniques, but there is still no consensus-10) .(14)

Materials and methods

Twenty completely edentulous patients were selected from the outpatient clinic of the Prosthodontic department, Faculty of dentistry, Minia University according to the following **inclusion criteria**:

- 1 .Highly motivated completely edentulous patient with aged range from 50 to 60 years old.
- 2 .According to American Society of Anesthesiologists (ASA) Classifications which illustrate the types of patients free from any systemic diseases that will hinder or affect the survival rate of the implant. or affect implant surgery: patients Selected were (ASA.type.1) and (ASA.type.2) ,
- 3 .Well-developed ridge with adequate amount of keratinized mucosa.
- 4 .patients with adequate inter arch space.
- 5 .patients with normal facial symmetry and normal muscle tone .
- 6 .Angle's Class I skeletal relationship

The following patients were excluded from the study:

- 1.severely atrophied ridges

2 .Young aged patients

3 .(ASA.type. 3)& (ASA.type. 4) having a systematic disease that may affect the survival rate of the implant.

4 .Angle's Class II and III skeletal relationship

5 .Irradiated patient or patient undergoing chemotherapy

6 .D1&D4 bone densities

Upper and lower Complete dentures were constructed for all patients, the lower denture was duplicated, radiographic markers inserted into canine region to be used as a radiographic stent and later as a surgical stent.

Each patient received two mandibular root form implants with standardized diameter of 3.5 mm. and 13mm length, placed at the canine region. then they were divided randomly into two main groups(I&II) and two subgroups(A&B):

Group (I): Divided into two subgroups Group (I.A): 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by Vinyl Polyether Silioxaine (VPES) with splinting technique.

Group (I.B): 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by polyvinyl silicone with splinting technique.

Group (II): Divided into two subgroups Group (II.A): 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by Vinyl Polyether Silioxaine (VPES) without splinting .

Group (II.B): 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression technique made by polyvinyl silicone without splinting .

After the period of Osseointegration the implants were uncovered using tissue punch, multi-unit abutments were screwed (fig 1), Then covered by its healing caps. all patients were recalled after ten days for primary impression which poured to obtain a study model upon which a customized tray was made for open tray impression techniques.



Figure (1): Multi unit Abutments screwed to the two implants

For group (I.A) five patient receive The final impression of implants retained mandibular overdenture by Vinyl Polyether Siloxane (VPES) without splinting of transfer copings , impression transfers attached , then

Vinyl Polyether Siloxaine (VPES) prepared and injected around transfres and loaded into the tray , after complete setting , transfer copings unscrewed and impression removed then analogues attached (Fig 2).



Figure (2): Nonsplinted Vinyl Polyether Siloxaine (VPES) impression

For group (I.B) : impression transfers attached , tray checked , then elastic power chin attached between transfer copings to act as a scaffold for flowable composite jig , then polyvinyl siloxane impression materials prepared and injected around the transfers

and loaded into the tray , after complete setting , transfer copings were unscrewed and impression was removed then implant analogues were attached and screwed .(Fig 3)



Figure (3): Splinted polyvinyl silioxane impression

For group (II.A) 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression

technique made by Vinyl Polyether Silioxaine (VPES) without splinting (Fig 4)

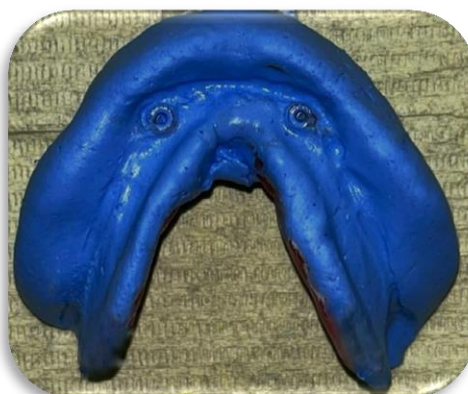


Figure (4): Non Splinted Vinyl Polyether Silioxaine impression

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For Group (II.B) 5 patient receive two implants with bar retained mandibular overdenture opposing maxillary complete denture with final impression

technique made by polyvinyl silicone without splinting (Fig 5).



Figure (5): Non Splinted polyvinyl silicone impression

Two castable plastic abutments were then attached to the analogues then cut and Adjusted on the articulator resembling the normal future height of the Bar owing to the inter-arch space. Then Cast scanned and the bar was designed with dimensions (4 mm height , 2.5 mm width) with two distal cantilevers 3mm and 1 mm space underneath the

bar to facilitate oral hygiene. screw access channels were designed onto the plastic castable abutments to be flushed on one level parallel to the occlusal plane (Fig 6) .the virtually designed bar file was sent to the 5 axis milling machine. This bar design was initially milled into a plastic burn-out resin bar for passivity checking and future casting.

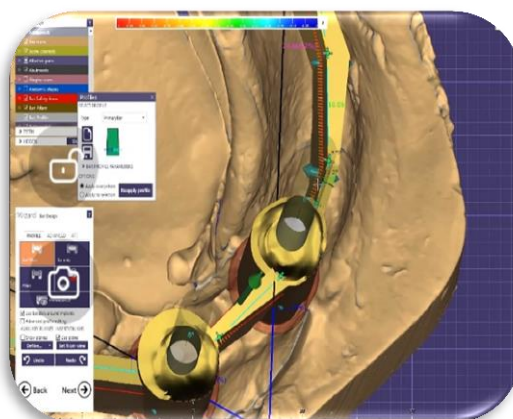


Figure (6): Bar designed with two distal cantilevers 3mm and 1 mm space underneath the bar to and design screw access channel

Then Resin bar checked intraoral for passivity, then this resin bar pattern was invested and Cast with

Co-Cr alloy, then reattached to the multiunit abutments for final seating. (Fig 7)



Figure (7): metal bar tried intra-orally for passivity.

After checking bar passivity the Metal bar rescan again and starting of making the retaining

framework design closely adapted into the metal bar for future milling in BIOHPP material (Fig 8)

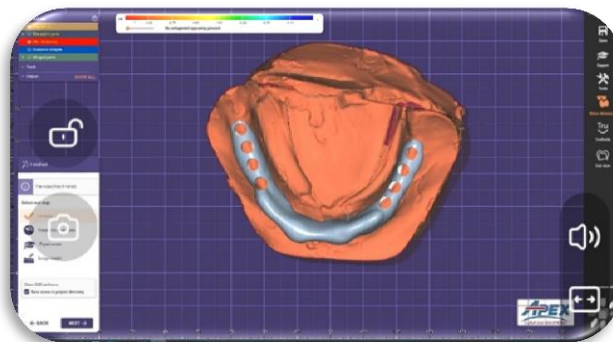


Figure 8: Designing of bar housing after scanning of metal bar

Then housing milled and tried intra-orally over the metallic bar for checking its seating and retention (Fig 8)



Figure 8: Bar Housing tried in patient mouth

The follow up started, using a film holder and long cone paralleling technique (Fig 9) sequential digital x-rays were taken at loading, 3, 6, 9 and 12months. The digital images were analyzed to evaluate the level of marginal bone height mesial and distal to the implant. To obtain an actual measurement the option calibration was used. The screen length of the implant was measured and calibrated to the actual length of the implant. The contact between the implant platform and the abutment base was selected as reference point.

-Bone height was measured as a distance between the reference point and the highest point of bone crest in contact with the implant.

Measurements of marginal bone loss were divided into four intervals (1st interval 0-3 months, 2nd interval 0-6, 3rd interval 0-9 &4th interval 0-12).

Marginal bone loss at 1st interval was measured by subtracting the bone height after one month from bone height at loading time.

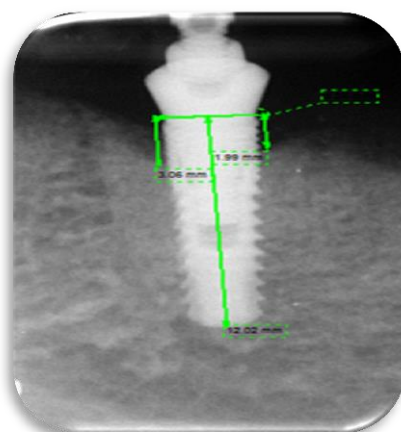


Figure (9): Periapical radiograph showing the bone height measurements

RESULTS

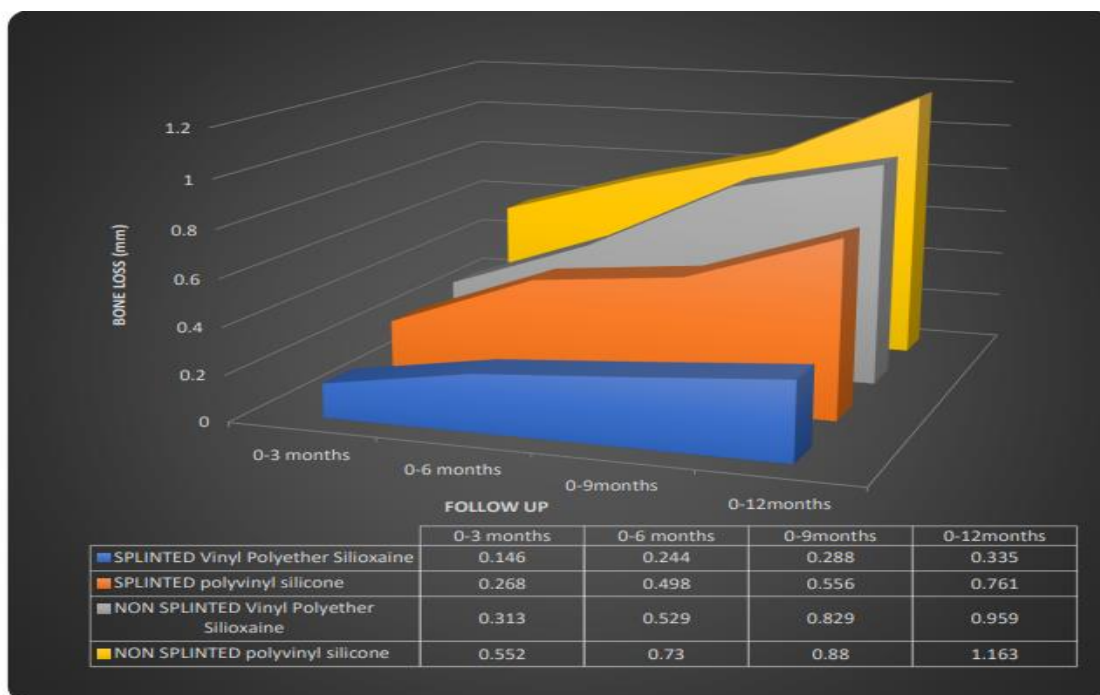
Data were presented as means and standard deviation (SD) values. One Way-ANOVA was used to study the bone loss after different follow up intervals, different splinting techniques and the effect of different impression materials used within each group. Tukey’s post-hoc test was used for pair-wise comparison between the means when ANOVA test was significant. Statistical analysis was performed with IBM® SPSS® (SPSS Inc., IBM Corporation, NY, USA) Statistics Version 23 for Windows .

The success rate of the placed implants during the follow up was 100% (i.e. No implant was lost or showed signs of failure). The two bone height readings recorded for each implant (Mesial and distal aspects) were pooled for further statistical analysis as the statistical analysis for all the implants in all groups showed no significant difference . the readings were pooled for further statistical analysis. The mean bone loss values recorded for different study groups are shown in (Table 1).

Table (1): Mean and SD and results of comparison of bone loss (mm) for the different treatment options in the current study:

Variables		Follow UP intervals					P-value
<i>Splinting</i>	<i>Material</i>	<i>Baseline</i>	<i>0-3 months</i>	<i>0-6 months</i>	<i>0-9months</i>	<i>0-12months</i>	
SPLINTED	Vinyl Polyether Silioxane	0 ± 0 ^{Aa}	0.146 ± 0.05 ^{Ba}	0.244 ± 0.07 ^{Ca}	0.288 ± 0.07 ^{Da}	0.335 ± 0.06 ^{Ea}	< 0.001*
	polyvinyl silicone	0 ± 0 ^{Aa}	0.268 ± 0.12 ^{Bb}	0.498 ± 0.19 ^{Cb}	0.55 ± 0.12 ^{Db}	0.761 ± 0.193 ^{Eb}	< 0.001*
NON SPLINTED	Vinyl Polyether Silioxane	0 ± 0 ^{Aa}	0.313 ± 0.16 ^{Bc}	0.53 ± 0.18 ^{Cc}	0.829 ± 0.1 ^{Dc}	0.959 ± 0.32 ^{Ec}	< 0.001*
	polyvinyl silicone	0 ± 0 ^{Aa}	0.55 ± 0.128 ^{Bd}	0.73 ± 0.16 ^{Cd}	0.88 ± 0.14 ^{Dd}	1.16 ± 0.17 ^{Ed}	< 0.001*
P-value			< 0.001*	< 0.001*	< 0.001*	< 0.001*	

Where *: significant at P<0.05; P>0.05(non-significant), P<0.05(significant), and P<0.01 (highly significant). and the letters denotes Tukey HSD all-pairwise comparisons test report where means that are not sharing similar letter are significantly different. capital letters denotated comparison between different follow up intervals while small letters denotated comparison between different treatment options for the same follow interval.



Graph 1. Mean values of bone loss (mm) for the different treatment options in the current study

DISCUSSION

The original implant position must be reproduced in an accurate working cast by means of an impression technique which differ from splinting and non-splinting techniques This plays an essential role in the prosthesis implant adaptation consequent of crestal bone loss (9,10). Several authors have reported that addition silicones are very accurate impression materials and should be used for implant-level impressions.(10,11)

In addition, condensation silicone had been described as the worst material for implant transfer impressions and may be considered contraindicated.(12)

The objective of this study was to compare two different impression materials (Vinyl Polyether Silicone and additional silicone) by splinting and non-splinting grouping on amount of marginal bone loss of two implant-retained Bar mandibular overdenture.

Polyvinyl siloxane produced accurate casts in this study in less chair time , as a dimensionally stable material , characterized by its rigidity for proper splinting of transfer copings without micro movement, in agreement with other studies .(13)

One of the drawbacks when the impression copings are rigidly splinted with autopolymerizing acrylic resin and making impression with additional silicone they seem to be susceptible to shrinkage lead to difficulty in determining the passive fit. However, if polymerization shrinkage occurs, it will be noticeable and the resin should be sectioned and joined again with small amounts of acrylic resin, all of that's process surely affect passive fit of jeg than affect passive fit of prosthesis and affect amount of bone loss if prosthesis non passive.(12)

CONCLUSION

The marginal bone loss in the group of Vinyl Polyether Silioxaine (VPES) with splinting was the least compared to the other three groups (Vinyl Polyether Silioxaine (VPES) without splinting, polyvinyl silioxane with splinting Group) while the marginal bone loss in the group of polyvinyl silioxane without splinting was the greatest.

REFERENCES

1. Rajaraman, Vaishnav & Ariga, Padma & Dhanraj, M. & Jain, Ashish. Effect of edentulism on general health and quality of life. *Drug Invention Today* (2018). 10. 549-553.

2. Al-Rafee MA. The epidemiology of edentulism and the associated factors: A literature Review. *J Family Med Prim Care.* (2020); 9:1841-1843.

3. Gupta, A., Felton, D.A., Jemt, T. and Koka, S. Rehabilitation of Edentulism and Mortality: A Systematic Review. *J of Prosth* (2019), 28: 526-535.

4. Alqutaibi AY ,Esposito M , Algabri R , et al .single vs two implant retained overdentures for edentulous mandible : a systemic review . *Eur j Oral implantology* (2017) :10 :243-261.

5. Cicciù, M.; Tallarico, M. Dental implant materials: Current state and future perspectives. *Materials* (2021), 14, 371.

6. Sadowsky, S.J. Occlusal overload with dental implants: A review. *Int. J. Implant. Dent.* (2019), 5, 29–34.

7. Kitamura E, Stegaroiu R, Nomura S, et al. Biomechanical aspects of marginal bone resorption around osseointegrated implants: Considerations based on a three-dimensional finite element analysis. *Clin Oral Implants Res.* 2004;15:401–412.

8. Vigolo P, Majzoub Z, Cordioli G. Evaluation of the accuracy of three techniques used for multiple implant abutment impressions. *J Prosthet Dent.* 2003;89: 186–192.

9. Kotsiomiti E, Tziialla A and Hatjivasiliou K , Accuracy and stability of impression materials subjected to chemical disinfection - a literature review. *Journal of Oral Rehabilitation* .2008- 35: 291-299.

10. Filho HG, Mazaro JV, Vedovatto E, et al. Accuracy of impression techniques for implants. Part 2: Comparison of splinting techniques. *J Prosthodont.* 2009;18: 172–176 .

11. Lee H, So JS, Hochstedler JL, et al. The accuracy of implant impressions: A systematic review. *J Prosthet Dent.* 2008; 100:285–291.

12. Assuncao WG, Filho HG, Zaniquelli O. Evaluation of transfer impressions for osseointegrated implants at various angulations. *Implant Dent.* 2004;13:358–366 .

13. Vigolo P, Fonzi F, Majzoub Z, et al. An evaluation of impression techniques for multiple internal connection implant prostheses. *J Prosthet Dent.* 2004;92:470– 476.

14. Wee AG. Comparison of impression materials for direct multi-implant impressions. *J Prosthet Dent.* 2000;83: 323–331.