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EFFECT OF DIFFERENT DENTURE BASE MATERIAL ON THE SUPPORTING STRUCTURE OF PARTIALLY COVERAGE MAXILLARY IMPLANT RETAINED OVERDENTURE

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ABSTRACT

Objectives: This research was carried out to evaluate radiographically the effect of different denture base materials "poly methyl methacrylate base (PMMA) processed by conventional technique versus thermoplastic biocompatible (Polyan IC) base processed by injectable mold technique on the prei-implant bone height changes of partially palatal coverage mucosal-implant retained maxillary overdenture.

Materials and Methods: Totally, fourteen completely edentulous participants were equally assigned into two groups (G1 and G2). Each group has received four implants (3mm diameter and 12 mm length), two in the lateral region, and two in the first premolar region. All the participants received partial palatal coverage complete implant overdentures retained by four O-rings. G1 participants have received PMMA denture base processed by conventional method. G2 participants have received Polyan IC denture base processed by using injectable mold. In this Study, crestal bone height changes around each implant were evaluated at time of prostheses insertion, six month and one year later using CBCT.

Results: In this study, at the end of follow up period, there was statistically significant difference in the marginal bone height loss between the two groups. The least bone loss was reported around the implants in group 2. After six months, the mean difference of bone height loss were (0.65±0.14) and (0.33±0.09) while from six to twelve month, the mean difference of bone height loss were (0.37±0.11) and (0.20±0.08) in group 1 and group 2 respectively

Conclusion: Within the limitation of this study, it was concluded that Polyan IC denture base processed by using injectable mold may yield more predictable bone/implant interface and may ensure well fitted denture base compared to PMMA denture base processed by conventional method, when partially palatal coverage mucosal-implant retained maxillary overdenture were used.

KEY WORDS: Dental Implant, maxillary, overdenture, palatal coverage, and marginal bone height.

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INTRODUCTION

The complete maxillary denture wearers usually needs and desire their natural palate to be uncovered. The gaggers, patients with large maxillary tori or bony exostoses, singers and actors require the partial coverage of the palate due to voice changes caused by any change in the prosthesis volume. Also, the new denture wearers are unfamiliar with the palatal aspect of the maxillary denture. [1]

Omission of palatal aspect of the maxillary denture adversely affects its retention, so implants were installed to maintain retention, support, and stability. [2, 3] Several studies have recommended a minimum of four implants to be installed in maxilla while removing partially the palatal coverage. [4-6] Combined mucosa-implant supported overdenture retained by two to four implants positioned in the anterior region of the jaw with resilient attachment is indicated in cases of retention problem due to severely resorbed ridge[7,8].This type of overdenture when opposed by a resorbed jaw provides greater stability than fixed detachable prosthesis. [9, 10]

A successful denture should have dimensional stability to enhance chewing efficiency, increase patients comfort, and prevent injury to the oral tissue [11]. During processing, dimensional changes of the denture base are affected by the type of material used and other factors like polymerization shrinkage or stresses generated by cooling of flask [12]. Although acrylic resin is the most commonly used material in fabrication of denture base, it is dimensionally changed and distorted during acrylic processing and throughout clinical use. These dimensional changes lead to inappropriate adaptation of the denture base to the oral tissue, reduced denture stability, and changes of the positions of the artificial teeth [13].

In addition to factors related to physical properties, processing procedures of denture base material, physiological and the anatomical conditions of patient's oral tissue also could affect the dimensional stability of denture base [14]. Therefore, many researches aimed to compare dimensional stability of new denture base materials and processing techniques [15, 16].

Thermoplastic resins are completely polymerized or prepolymerized resins which are processed using only thermal energy processing without any chemical reactions [17] they are very comfortable for the patient. They are characterized by high dimensional stability, fatigue and wear resistance.[18] Thermoplastic resins are processed using injection molding technique[19].In injection molding technique, the polymerization shrinkage is compensated by continuously injecting resin at certain pressure through a carefully controlled procedure.[20]

Hence, this study was conducted to evaluate which type of these denture base materials causes less bone height changes of partially palatal coverage mucosal-implant retained maxillary overdenture.

MATERIALS AND METHODS

This study had been done in the Removable Prosthodontic Department Faculty of Dentistry, Ain shams University. Fourteen patients were selected to share in this study, this patient were selected to be between the ages of 45-65. Inclusive criteria were: U-shaped alveolar arches, Angle class I ridge relationship, adequate inter arch space .Exclusion criteria were: V-shaped edentulous ridge, insufficient bone volume in the pre-maxillary region of the maxilla with a minimum length of 14 mm and 5mm width, class II and III ridge relationship, patients suffering from neuromuscular disorders and temporomandibular joint disorders. Un-controlled diabetes, smokers and administrative that would seriously affect the surgical procedure were also excluded.

All patients participating in this study were rehabilitated by implant supported maxillary over denture by installing four implants (two in the lateral region, and two in the first premolar region) and mandibular complete denture.

The patients were divided into two equal group: G I: patients received partially palatal coverage maxillary implant retained overdenture of "poly methyl methacrylate (PMMA) (Vertex regular, Zeist, Netherlands) base processed by conventional method using compression mold technique. G II: patients received partially palatal coverage maxillary implant retained overdenture of thermoplastic biocompatible "Polyan IC" (Polyan IC, Modified methacrylate, Bredent, Germany) base processed by injectable mold technique

Maxillary and Mandibular complete dentures were constructed to all the patients following the same basic principles. Centric occlusion was developed at centric relation. Modified cusped acrylic teeth were used and balanced on semi-adjustable articulator for centric and eccentric positions following the lingualized concept of occlusion. Finally, seven maxillary dentures were processed by conventional compressible mold for G1 while seven maxillary dentures were processed by injectable mold. (Thermopress 400 version 2.4/2.56, Bredent, Germany) **(fig1)**

Modification of the palate was done by measuring first the distance between the fovea palatine and midpoint of the incisive papilla, and then measuring the distance from the contact point between second premolar and first molar (a and b) to the median palatine raphe of the arch (c) bilaterally (a-c and b-c). A mark was done at one third of this distance on both sides of the arch (d and e) and one third the distance from fovea palatine and incisive papilla (f). The line joining the 3 marks till the posterior border represents the palatal extension (d-f-e).

Cone beam computerized tomography (CBCT) was made for all the participants to determine the approximate bone width and height at the proposed implant site. The radiographic diagnostic stent was modified to act as surgical stent; channels were drilled in the position of the proposed implant. The patients received four small diameter implants (one piece 3 mm diameter, 12 mm length). The implants used in the study were one-piece (ball type) implants (INNO SLA implants system. Co., Korea). The

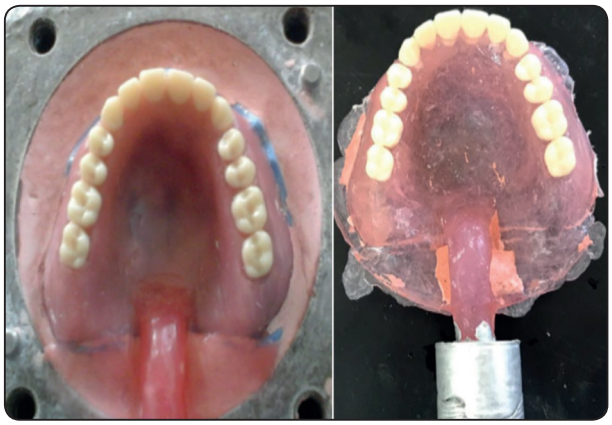

Fig. (1) Spruing of waxing up and processed thermoplastic denture.

Fig. (2) Complete denture modification into partial palatal coverage in group1and 2 respectively

modified surgical stent was seated in the patient's mouth to mark the site of the implant and the area of incision. After that, the stent was removed. The implant surgical procedures were performed under local anesthesia.

Implant loading was done seven days after surgery. Areas in the maxillary denture opposing to the inserted implants were marked and relieved on the fitting surfaces of the denture. The denture was placed in the patient's mouth to check and ensure complete seating and proper intercuspal relation. Hard acrylic pickup material was added to the relieved areas and the denture was reseated inside the patient's mouth. Excess acrylic resin was removed. Recall appointments were scheduled for patients for evaluation of the prosthesis and to perform any needed adjustments. **(Fig 3)**

Follow up visits were scheduled, 0, 6 and 12 months after loading for making radiographic records evaluate the implant marginal bone height changes.

Radiographic evaluation

Marginal bone height change around the implants was evaluated using the linear measurement system supplied by the cone beam computed tomography. Marginal bone height changes around each implant were monitored. A ruler in the software was used to measure the bone height from the apex of the implant to crestal bone in contact with the implant.

Fig. (3): Fitting surface of picked up denture

The measurements were carried out at the end of each follow up appointment (at insertion, 6, and 12 months post insertion). The marginal bone loss at different intervals was obtained by calculating the difference in bone height at that interval from the base line measurement. (**fig4)**

RESULTS

Data management and analysis were performed using Statistical Analysis Systems. SPSS software (version 13.1: SPSS Inc). Probability values ≤0.05 to indicate significant relationships between variables. Shapiro-Wilk tests was used to assess data normality and showed normal distribution. Data were summarized using means and standard deviations. Independent t-test was used to compare between the two groups. Paired t-test was also used to study the changes by time in each group.

As confirmed in table 1 throughout the whole follow up period there was statistically significant difference between the two groups with the least mean difference within group 2.

In this study, statistical analysis revealed that the bone height changes by time within each group were statistically significant from time of loading to six month and from six months to one year with least mean difference bone height loss from six to one year.

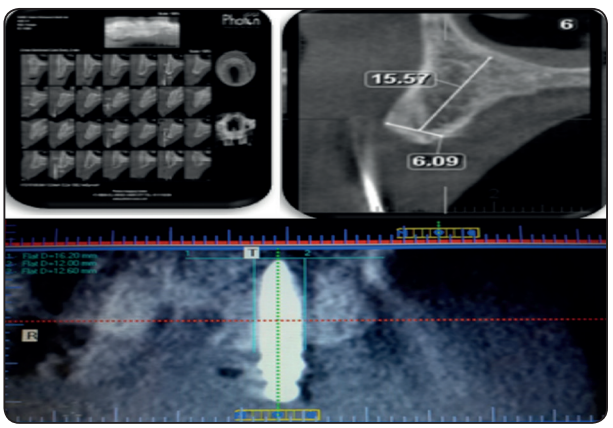

Fig. (4): Radiographic diagnosis and follow up measurement

TABLE (1) The mean differences, standard deviation (SD) values and comparison between amounts of bone loss around the two groups at different intervals.

Intervals	Group 1		Group 2		P value
	Mean	SD	Mean	SD	
Time of loading –six months	0.65	0.14	0.33	0.09	0.00*
six months-one year	0.37	0.11	0.20	0.08	0.01*
Time of loading -one year	1.02	0.16	0.53	0.12	<0.001*

TABLE (2): The mean differences, standard deviation (SD) values and results of paired t-test for the changes by time in mean bone height within each group

	Mean difference Time of loading –six months		**Mean difference** six months-one year		P value
	Mean	SD	Mean	SD	
Group 1	0.65	0.14	0.37	0.11	0.02
Group 2	0.33	0.09	0.20	0.08	0.05

DISCUSSION

Partially coverage the palatal part of the dentures were declared by many investigations to be lighter, more comfortable, provide better tongue recognition, taste and temperature perception, as well as more effective phonation, and mastication.[12-13-21-22] Partially palatal coverage implant overdentures were approached to compensate for limited physical means of retention caused by lack of maximum palatal coverage.[23] For overdenture design with partial palatal coverage, a minimum of four implants is a must so stresses over each implant would be clinically acceptable[24]

All patients have been totally edentulous for at least 6 months before placement of the implants in the maxillary arch to avoid the effect of alveolar bone remodeling that follows tooth extraction. [25]

In this study, the Polyan IC was selected to use as a material for fabrication of denture bases processed by injection molding technique. It is a thermoplastic resin biocompatible, colour stable and residual monomer content < 1% so no mucosal irritation Moreover, this thermoplastic can be relined and repaired easily.[26]

Decreasing the palatal coverage was done under a standardized method for all the patients to overcome the effect of different palatal coverage in patient than other which affects the result of the study.

The removal of the part of the palate in done after processing of the denture as the sprue reservoir must attached to the thickest area of denture base to allow continuous injection of the resin at a certain pressure which compensated for polymerization shrinkage. [20]

Results of this study have shown that the mean difference in bone height changes from time of loading to six months is greater than from six to one year during the follow up period. The increased bone reduction during the first six months could be attributed to increased mechanical stresses that may cause fatigue microdamage and bone resorption. Likewise, immediate loading of small implants diameter during the healing period could lead to greater bone overload, which may exceed physiologic threshold since the implants have less mechanical anchorage. [27]

At the end of the follow-up period, a statistically significance decrease in peri-implant bone height for the two groups was detected. A total change of

1.02 ± 0.16 mm and 0.53 ± *0.12* mm was detected for group I (patients received partially palatal coverage maxillary implant retained overdenture of "poly methyl methacrylate (PMMA) base processed by conventional method) and group II (patients received partially palatal coverage maxillary implant retained overdenture of thermoplastic biocompatible "Polyan IC" base processed by injectable mold technique. This amount of bone reduction is within the permissible range to occur within the first year of implant placement. [28]

In this study, the group 2 showed the least crestal bone loss throughout the study period compared to the group1. This could be due to that the injection molding technique produces a more dimensionally stable denture compared to dentures fabricated using compression molding technique[4].It was stated that injection molding technique improves the physical properties of dentures and dimensional stability compared to compression molding technique. Moreover, it decreases polymerization shrinkage.[29]

Gharechahi et al. studied the dimensional changes of acrylic resin denture bases processed using conventional molding technique to those fabricated using injection molding technique. They assumed that, injection molding technique procedure exhibited higher dimensional accuracy compared to conventional molding technique, leading to higher denture base adaptation.[30]

It was claimed that the combination of polymerization shrinkage and distortion of denture bases due to thermal stresses which occur in compression molding technique affects the adaptation accuracy of denture base to the underlying tissues creating a microgap. Injection molding technique is an alternative technique which may overcome these problems and increase denture base adaptation.[31,32]

Also the results of this study agree with a study reported that the denture base affect the load applied to implant and act as important factor for implant survival rate. Close adaptation of the denture base reduces the movement of the denture and allow the forces distribution over the implants and supporting structure in turn decrease the stress concentration around the implants. [33-35]

CONCLUSION:

Within the limitation of this study ,it was concluded that Polyan IC denture base processed by using injectable mold may yield more predictable bone/implant interface and may ensure well fitted denture base compared to PMMA denture base processed by conventional method, When partially palatal coverage mucosal-implant retained maxillary overdenture were used.

REFERENCE

1. Närhi TO, Hevinga M, Voorsmit RA, Kalk W. Maxillary overdentures retained by splinted and unsplinted implants: A retrospective study. Int J Oral Maxillofac Implants 2001; 16:259-66.
2. Ochiai KT, Williams BH, Hojo S, Nishimura R, Caputo AA. Photoelastic analysis of the effect of palatal support on various implant-supported overdenture designs. J Prosthet Dent 2004; 91:421-7.
3. El-Amier NM, Elsaih EA, El-Motaiam HA, Al-Shahat MA. Effect of implant location on palateless complete overdenture retention: Preliminary study. J Dent Impll 2015 ; 5 :6-10it
4. Vogel RC. Implant overdentures: A new standard of care for edentulous patients current concepts and techniques. Compend Contin Educ Dent 2008;29:270-6.
5. Kiener P, Oetterli M, Mericske E, Mericske-Stern R. Effectiveness of maxillary overdentures supported by implants: Maintenance and prosthetic complications. Int J Prosthodont 2001; 14:133-40.
6. Blockin M. S., Kent J. N. and Finger I. M. Use of the integral implant for overdenture stabilization. Int J Oral and Maxillofacial implant 1990 5; 140-147.
7. Cranine A. N., Klien M. and Simsomn. A. Atlas of oral 7. Implantology. New York; Theme Medical Publishers inc.; 199342-43
8. Meijer H. J., Stamans F. J. and Steen W. H. Location implants in the inter-foriminal region of the mandible and theconsequences for the design of the superstructure. J Oral Rehabil 1994, 21; 47-56

9. Widbom C, Söderfeldt B, Kronström M. A retrospective evaluation of treatments with implant-supported maxillary overdentures. Clin Implant Dent Relat Res 2005;7: 166-72.
10. Williams BH, Ochiai KT, Hojo S, Nishimura R, Caputo AA. Retention of maxillary implant overdenture bars of different designs. J Prosthet Dent 2001;86 :603-7.
11. Lerner H. Minimal invasive implantology with small diameter implants. Implant Pract 2009;2:30-5.
12. Furuya-Yoshinaka M, Yoshinaka M, Isogai F, Maeda Y. Influence of an experimental palatal plate on thermal perception. J Prosthodont Res 2009;53:193-6.
13. Engelen L, Prinz JF, Bosman F.The influence of density and material on oral perception of ball size with and without palatal coverage. Arch Oral Biol 2002;47:197-201.
14. Kumamoto Y, Kaiba Y, Imamura S, Minakuchi S. Influence of palatal coverage on oral function – Oral stereognostic ability and masticatory efficiency. J Prosthodont Res 2010;54:92-6.
15. Zhang H, Sone M, Yamamoto H, Ohmori K, Yaka T, Ohkawa S. Influence of experimental palatal plate on mandibular position during continuous phonation of [n]. J Prosthodont Res 2009; 53:38-40.
16. Albuquerque Júnior RF, Lund JP, Tang L, Larivée J, de Grandmont P, Gauthier G. Within-subject comparison of maxillary long-bar implant-retained prostheses with and without palatal coverage: patient-based outcomes. Clin Oral Implants Res 2000;11:555-65.
17. Negrutiu M, Sinescu C, Romanu M, Pop D, Lakatos S. Thermoplastic resins for flexible framework removable partial dentures. Timisoara Med J 2005;55:295–9
18. Nandal S, Ghalaut P, Shekhawat H, Singh M. New era in denture base resins: a review. Dent J Adv Stud 2013; 1:136–43.
19. John J, Gangadhar SA, Shah I. Flexural strength of heat-polymerized polymethyl methacrylate denture resin reinforced with glass, aramid, or nylon fibers. J Prosthet Dent 2001;86:424–7.
20. Ramadan A, Moussa A, Yehia D, Zaki I, Samir H, Gabry E. Comparative adaptation accuracy of heat cured and injection molded resin denture. J Appl Sci Res 2012;8:4691–6.
21. Kaiba Y, Hirano S, Hayakawa I. Palatal coverage disturbance in masticatory function. J Med Dent Sci 2006; 53:1-6.
22. Zhang H, Sone M, Yamamoto H, Ohmori K, Yaka T, Ohkawa S. Influence of experimental palatal plate on mandibular position during continuous phonation of [n]. J Prosthodont Res 2009; 53:38-40.
23. Engelman M. Clinical Decision Making and Treatment Planning in Osseo-Integration. Chicago: Quintessence Publishing (IL); 1996. p. 187-92.
24. Cavallaro JS Jr, Tarnow DP. Unsplinted implants retaining maxillary overdentures with partial palatal coverage: Report of 5 consecutive cases. Int J Oral Maxillofac Implants 2007;22:808-14.
25. Olson JW, Shernoff AF, Tarlow JL, Colwell JA, Scheetz JP, BinghamSF. Dental endosseous implant assessment in a type 2 diabetic population: a prospective study. Int J Oral Maxillofac Implants 2000; 15:811-8.
26. Senden KG, Shade W. Latest press release. Bredent Gr 2013;49:22–4.
27. Jivraj, S., W. Chee, et al. "Treatment planning of the edentulous maxilla." Br Dent J 2006; 201(5): 261-279.
28. Hansson, S. A.: Conical implant abutment interface at the level of the marginal bone improves the distribution of stresses in the supporting bone. An axi-symmetric finite element analysis. Clin Oral Impl Res 2003 ,14: 286.
29. Ucar Y, Akova T, Aysan I. Mechanical Properties of Polyamide Versus Different PMMA Denture Base Materials. J Prosthodont 2012;21:173–6.
30. Gharechahi J, Asadzadeh N, Shahabian F, Gharechahi M. Dimensional changes of acrylic resin denture bases: conventional versus injection-molding technique. J Dent (Tehran) 2014;11:398–405
31. Lee C, Bok S, Bae J. Comparative adaptation accuracy of acrylic denture bases evaluated by two different methods. Dent Mater J 2010;29:411
32. Shawky Y, Youssef H. Adaptation accuracy and retention of injection - and compression - molded maxillary complete denture: in - vitro and in - vivo study. Egypt Dent J 2014; 1011–7.
33. Palmqvist S, Sondell K, Swartz B. Implant supported maxillary overdentures outcome in planned and emergency cases.Int J Oral Maxillofac Implant 1994:9;184-190
34. Shamnur SN, Jagadeesh KN, Kalavathi SD, Kashinath KR. Flexible dentures- An alternate for rigid dentures? J Dent Sci Res. 2005; 1:74–9
35. IchikawaT, Horiuchi M, Wigianto R, Matsumoto N, in vitro study of mandibular implant retained overdentures the influence of stud attachment on load transfer to the implant and soft tissue. Int J Prosthodontic 1996,9,(4)394-399