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EFFECT OF DIFFERENT PROCESSING TECHNIQUES OF DENTURE BASES ON THE SUPPORTING STRUCTURES OF MAXILLARY IMPLANT RETAINED OVERDENTURES

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ABSTRACT

Objectives: This study was conducted to evaluate the effect of two different processing techniques of denture bases on bone height changes in implant retained maxillary overdenture.

Materials and methods: Fourteen completely edentulous patients were recruited to participate in this study. Inclusion criteria: These patients had adequate bone in the maxillary arch to receive four hybrid implants, exhibited angle class I ridge relationship and adequate inter-occlusal space. Exclusion criteria were: V shaped edentulous ridges, patients with neuromuscular diseases and temporomandibular joint disorders, diabetic and smoking patients. Patients were randomly divided into two groups. Group I: Seven patients received a maxillary implant retained overdenture fabricated from (PMMA) base processed by the compression mold technique. Group II: Seven patients received maxillary implant retained overdenture fabricated from thermoplastic biocompatible base processed by the injectable mold technique. All patients received conventional mandibular complete dentures. Bone height around dental implants was measured after insertion, 6 months, and 12 months post-insertion.

Results In this study, bone height changes around dental implants for group I and group II at the first follow up period were 0.56 mm and 0.49 mm respectively, however, at the 2nd follow up period (6-12 months), they were 0.41mm and 0.34 mm consequently. There were no statistically significant differences between the studied groups regarding the average bone loss around the dental implants as as shown by independent t-test.

Conclusion Injection and compression molded processing techniques have similar effects on bone height changes in maxillary implant-retained overdentures.

KEY WORDS: Processing, denture base, maxillary implant overdentures.

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INTRODUCTION

Edentulous patients commonly experience problems with their complete dentures. The enhanced comfort of patients wearing an implant supported overdenture versus a conventional denture is striking, especially for those suffering from insufficient stability and retention of the prosthesis. [1]

Maxillary overdentures are an alternative line of treatment offering limited retention and comfort when compared with implant-supported fixed prosthesis. In some cases, maxillary implant overdentures are more appropriate as they restore normal facial contours, and cover the prosthesis-tissue junction in patients with a wide smile and a high smile line. Moreover, they can help manage adverse ridge relationships or discrepancies and may allow adjustment of palatal contours for phonation. [2,3]

It was recommended to place a minimum of four implants with a wide antero-posterior distribution for optimum support in the maxilla. More implants should be considered when associated risk factors are present. Both splinted and solitary anchorage systems are advocated. [4]

Most patients prefer palateless implant overdenture designs as they optimize oral sensation and comfort. [5,6] However, they are more susceptible to deformation and fracture than dentures with complete palatal coverage and they are at a higher risk for implant loss and prosthetic complications. [7-10]

Polymethylmethacrylate (PMMA) resin is the most popular material used for fabrication of denture bases. Acrylic resin is hard enough to evenly distribute the loads to the underlying tissues, and can be coloured and characterized to suit most patients' aesthetic demands. However, it is subjected to undesirable dimensional changes during processing that may lead to inadequate adaptation of the denture bases to the oral tissues, reduced denture stability, and may alter the positions of the artificial teeth. [11-13]

Thermoplastic resins were introduced as prepacked PMMA capsules as an alternative for conventional denture base materials. The technology is based on plasticizing the material by thermal processing in the absence of any chemical reaction. The possibility of injecting the plasticized resin into a mold has created a new perspective to removable prosthodontics technology. Improved dimensional stability, control of polymerization shrinkage, and reduced vertical dimension of occlusion changes, have been reported with injection-processed denture bases when compared with those fabricated with the conventional compression molding technique. [12,14]

Hence, this study was conducted to evaluate the effect of two different processing techniques of denture bases on the bone height changes in implant retained maxillary overdentures.

MATERIALS AND METHODS

Fourteen completely edentulous patients were selected from the Removable Prosthodontics Department, Faculty of Dentistry, Ain Shams University to participate in this study. Inclusion criteria: These patients had adequate bone in the maxillary arch to receive four hybrid implants, exhibited angle class I ridge relationship and adequate inter-occlusal space. Exclusion criteria were: V shaped edentulous ridges, patients with neuromuscular diseases and temporomandibular joint disorders, diabetic and smoking patients.

All the patients that participated in this study were rehabilitated by maxillary implant retained overdenture on four implants (two in the lateral region, and two in the first premolar region) and mandibular complete denture.

The patients were randomly divided into two groups: Group I: patients received a maxillary

implant retained overdenture fabricated from "poly methyl methacrylate" (PMMA) (Vertex regular, Zeist, Netherlands) base processed by the compression mold technique. Group II: patients received maxillary implant retained overdenture fabricated from thermoplastic biocompatible "Polyan IC" (Polyan IC, Modified methacrylate, Bredent, Germany) base processed by the injectable mold technique.

Upper and lower complete dentures were constructed following the basic principles. Centric occlusion was developed to coincide with centric relation. Centric and eccentric records were made and transferred to a semi-adjustable articulator. The teeth were set following the lingualized concept of occlusion.

At processing, seven maxillary dentures were processed by the conventional compressible mold technique (Group I) while seven maxillary dentures were processed by the injectable mold technique. (Thermopress 400 version 2.4/2.56, Bredent, Germany) (Group II) (Fig.1)

Four hybrid implants were surgically installed in the maxilla, two in the lateral region and two in the first premolar region for all patients. The radiographic diagnostic stent was modified to act as a surgical stent. Holes were made in the position of the proposed implants to guide their insertion. The patients received four one piece ball implants of 3 mm diameter and 12 mm length (INNO SLA implants system. Co., Korea).The surgical procedures were performed under local anesthesia.

The overdenture was picked up seven days after the surgery. Undercuts around the implant heads were carefully blocked out. The rubber O-rings and metallic housings were placed on the implants. Areas opposing the housings were marked on fitting surface of the denture. Adequate amount of resin was removed at the marked areas, until a clearance space of about 1-2 mm was provided.

Self-cured acrylic resin was mixed and applied in the dough stage to the relieved areas of the fitting surface. The denture was reseated in the patient's mouth and he was instructed to close in centric occlusion. Excess material was trimmed using a finishing stone. Recall appointments were scheduled for the patients to evaluate the prosthesis and to perform any needed adjustments. (Fig. 2)

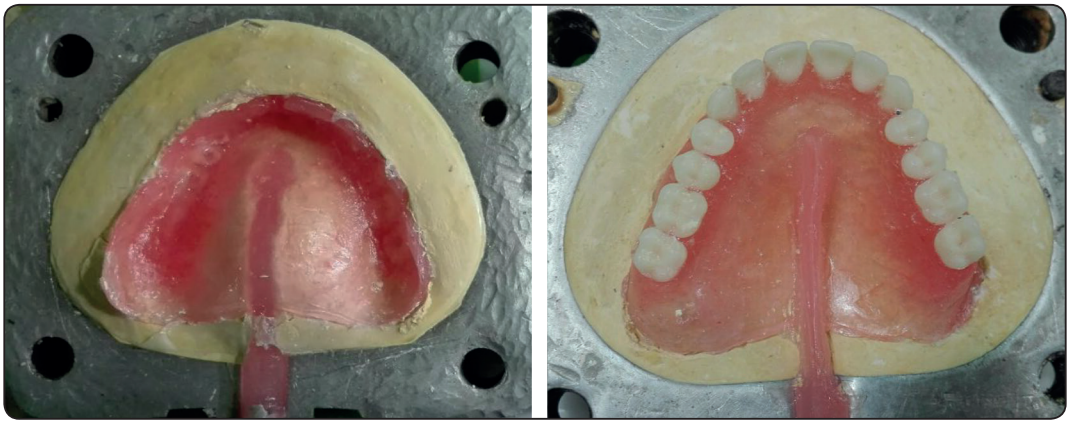

Fig. (1): Spruing of waxed up and processed thermoplastic denture.

Fig. (2): Metallic housings were placed on the implants then picked up in the denture.

Radiographic evaluation:

Bone height was assessed using the liner measurement system supplied with the cone beam CT. Bone height was measured from the apex of each implant to the crestal bone using a ruler in the software. The marginal bone loss at different intervals was obtained by calculating the difference in bone height at that interval from the baseline measurement. The measurements were carried out at the end of each follow-up appointment (at insertion, 6, and 12 months post insertion).

RESULTS:

Collected data were tested for normality by checking the data distribution, calculating the mean and median values, evaluating histograms and normality curves and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data were presented by mean and standard deviation (SD). Independent t-test was used for comparison between the groups. Paired t-test was used for comparison between the follow-up periods. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

As shown in table (1), bone height changes in both groups I and II at the first follow up period were higher than that at the 2nd follow up period. Although greater crestal bone height changes were observed in group I (compression molded) during the first and second follow-up periods, however paired t test showed no statistical difference between the studied groups.

TABLE (1): Mean and std. deviation of crestal bone height changes for group I and group II at different follow up periods and p value for paired t test.

	0-6 months		6-12 months		P value
	Mean	Std. Deviation	Mean	Std. deviation	
Group I	.56	.12	.41	.08	0.089
Group II	.49	.09	.34	.07	0.471

TABLE (2): Mean and std. deviation of crestal bone height changes for group I and group II and p value for Independent t test.

	Group I		Group II		P value
	Mean	Std. Deviation	Mean	Std. deviation	
0-6 month	.56	.12	.49	.09	0.2406
6-12 months	.41	.08	.34	.07	0.107
0-12 months	.96	0.11	0.83	0.21	0.173

Independent t test showed no statistical difference between group I and group II at all follow up periods (0-6, 6-12, 0-12 months) as shown in table (2).

DISCUSSION

A Maxillary implant overdenture is a stabilized removable prosthesis used for rehabilitation of the edentulous maxilla that provides increased patient satisfaction and improved oral health. It should be designed to be maintainable, retrievable, repairable or replaceable. [4]

The dimensional accuracy and stability of the denture bases during processing and function are important for obtaining closely fitting denture bases to the underlying soft tissues. Consequently, denture retention is improved, a correctly functioning denture is attained, health of the oral tissues is maintained and, the comfort and satisfaction of the patient are ensured. [11,15,16]

Compression molded PMMA (poly methyl methacrylate acrylic) resin denture bases undergo unavoidable dimensional changes during processing, mainly, thermal shrinkage and polymerization shrinkage. Furthermore, they expand when they are stored in an aqueous environment and contract upon dehydration. [11,12,17]

Unlike conventional acrylics, thermoplastic resins have several advantages which include long-term performance, stability, resistance to wear and deformation, resistance to solvents and, absence or low quantity of the residual monomer. Moreover, they have reduced porosity, thus prevent the development of microorganisms and maintain size and color over time. They also possess a high degree of flexibility and resistance, through the addition of elastomers for increased elasticity or reinforcement with fiberglass [14,18].

The advantages of using the injection-molding system are attributed to the fact that the resin is delivered in a cartridge, which excludes mixing errors with long-term shape and stability. It also reduces contraction, and provides mechanical resistance to ageing. [12] The high-pressure injection is maintained during the curing cycle and as polymerization proceeds and shrinkage occurs, an additional fresh non-polymerized material is supplied from a reservoir through the sprue, which compensates for the polymerization shrinkage. [14,19-21]

Crestal bone loss is one of the important factors that affect the long term prognosis of implant supported restorations. [22] It has been documented that following implant surgery, remodeling occurs which is characterized by a reduction in bone, both horizontally and vertically. [23] The accepted criteria for implant success include bone loss of 1-1.5 mm during the first year after loading and less than 0.2mm annually thereafter. [24,25]This coincides with the results of this study where bone height changes at the first follow up period (0-6 months) were

higher than that at the 2nd follow up period in both groups A and B. Moreover, immediate loading of small diameter implants could lead to greater bone overload during the healing period, which may exceed the physiologic threshold of bone. [26]

Several studies reported that close adaptation of the denture base to the underlying tissues reduces the movement of the denture and allows the distribution of the forces over the implants and supporting structures. [7,27,28] This coincides with the results of this study where greater crestal bone height changes were observed in group I (compression molded) during the first and second follow-up periods, however the difference between the two groups was statistically insignificant.

CONCLUSION

Within the limitations of this study, it was concluded injection and compression molded processing techniques have similar effects on bone height changes in maxillary implant-retained overdentures.

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