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Research Article

A comparative study of position transferring accuracy of multi-implants by two types of Poly vinyl Siloxane and Polyether impression material

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ABSTRACT

The success of implant-supported dentures in treatment of edentulous spaces has been proved and it requires exact adaptation of the prosthesis. Designing and construction of implant-supported dentures because of its sensitivity requires enough time and exactness. Many differences regarding the accuracy of impression using different material, the impression technique, splinted and non-splinted impression coping methods, type of the attachment material and getting index has been seen in the results of the studies done. This study has compared the accuracy of transferring multi implants to cast using non-splinted open tray technique using three types of impression material, Regular and Monophase Poly Vinyl Siloxane and Poly Ether. Methods: This in vitro study has evaluated the accuracy of 45 casts of stainless steel models. In these models there are 4 parallel implants in an arch which simulates the dental arch. In this study non-splinted open tray technique with three materials Regular and Monophase Poly Vinyl Siloxane and Polyether has been used. The results were analyzed using SPSS software. One way ANOVA test has been used for comparison of the groups. Results: With comparing the amount of errors it has been shown that there is significant differences among the 3 groups (P=0.041) and showed the lowest average error in the use of Impression material is Monophase Polyvinyl Siloxane. The results of the Tukey test has also shown that between the two impression material Monophase Poly Vinyl Siloxane and Poly Ether the statistical differences has been significant(P=0.049). Conclusion: This study has shown that in direct impression technique of implants Monophase Poly Vinyl Siloxane has the most precision and accuracy.

Keywords: Implant Impression, Position Transferring, Impression Material

INTRODUCTION

One of the main objectives when making an implant supported prosthesis is fabricating a passive-fit superstructure over several implants [1]. Passive-fit of about 10 microns has been

announced acceptable by Branemark which in order to obtain it making an accurate impression is necessary and if not achieved, it will cause pressure on implants which can lead to implant failure [2,3]. The factors that directly influence on the superstructure accuracy are impression materials and impression techniques, structural and dimensional changes of stone casts, and casting process of the alloys. In most studies the selective impression materials for making impression of implants are poly ether and poly vinyl siloxane [4,5]. Wee examined the dimensional accuracy of poly sulfide, poly ether, and additional silicone. The results showed statistically significant differences that poly ether and poly vinyl siloxane is more accurate than poly sulfide. He recommended the use of poly ether and poly vinyl siloxane for direct (open-tray) technique of multi-implants impression [6]. Bambini et al. found that poly ether showed its highest position transferring accuracy when direct technique was used, but in closed-tray technique no significant differences between the accuracy of impressions made with poly ether and poly vinyl siloxane were seen [7]. In 2008 Wenz et al. studied the accuracy of multi-implants casts obtained from different impression techniques and materials and found that the dimensional changes of one-stage direct and indirect techniques with poly ether and poly vinyl siloxane did not affect the clinical fit of implants and also according to its results, the two-stage indirect technique is not suggested for impressions [8]. There are two principal techniques for transferring implant positions to the master casts: direct or open-tray impression technique and indirect or closed-tray technique [9]. In closed technique after removing the tray, the impression copings remain on the implant fixture and the clinician should put them back in the impression, but in most instances impression copings do not fit in the impression correctly, so one of the methods for increasing the impression accuracy is the splinted technique which connects the implants by using autopolymerizing acrylic resin or composite resin on the impression copings [10,11].some studies claimed that the indirect technique is more accurate than the open-tray technique [12] but the results are inconsistent [13-15]. Various researches have shown many differences in the degree of impressions accuracy when using different materials, different techniques, splinted or non-splinted impression copings, the type of splinting material and various indexing methods. The purpose of this study was to compare the accuracy of transferring multi implants positions to cast using non-splinted open tray technique with three types of impression materials, Regular and Monophase Poly Vinyl Siloxane and Poly Ether.

MATERIAL & METHODS

This in vitro study investigated the accuracy of 45 casts made of a stainless steel model made by CNC machine (Anderson Precision Machining, Iowa). 4 perpendicular holes with the dimensions of 4.2mm width and 12mm length were drilled on the periphery of an isosceles trapezoid (large edge 45mm, small edge 15mm, height 25mm) with 15mm distance between them which approximately simulated the dental arch [16]. The holes were scored from number 1 to 4. Three guiding grooves (2mm depth, 3mm width and 20mm length) parallel with the arch of implants positions were prepared on the base of model in order to assimilate the position of custom trays during impression making. One implant model (Dummy Implant,3i innovation, Barcelona, spain) with 4.1mm diameter (regular size) was placed in each hole (figure 1). Each implant was fixed rigidly in its position with Cyanoacrylate (CYACEM, Bredent Medical GmbH, KG). Direct impression copings (Open Tray Impression Coping, 3i.Implant innvovatin, Barcelona, spain) were screwed over the implants, radiography was taken to ensure the fitness of the copings. Then 2 layers of base plate wax (Modelling Wax, Dentsply, DeTrey Gmbh, Seefeld Oberbay,

Germany) with 1mm thickness were put over the copings to cover them completely except the upper platform so that the special trays could lie on this area (figure 2). An initial impression was made with putty and light body condensation silicone (Speedex silicone impression material, Coltene, Whaledent).

The implant analogues (implant analogue, 3i Implant innovation, Barcelona, Spain) were screwed to the copings and the impression was poured with die stone (Die stone type IV, Prevest, USA) and primary cast was produced. 45 special trays were made over this cast by VLC resin (Megatray, Magedenta, GmbH, Germany) in a way that the tray border was positioned inside the guiding grooves, then cured in the light cure device (Light box, Megadenta, GmbH, Germany) for completion of the polymerization according to the manufacturer's Recommendations.

After opening a 2×2mm window over the guide pins of copings, the 45 trays were perforated for appropriate retention of the impression material.The special trays were evaluated in 3 groups (N=15):

1. Non-splinted open tray technique with monophase Poly vinyl siloxane (E-lite HD+Monophase, Normal Setting, Zhermak, Italy),
2. Non-splinted open tray technique with regular body Poly vinyl siloxane (E-lite HD+Regular body, Zhermak, Italy),
3. Non-splinted open tray technique with Poly ether (Impregum, Epse Dental AG, Germany).

In each group, first the material's specific adhesive was applied to the trays 24 hours before making impressions according to manufacturer's instructions. Open-tray impression copings were connected to the implants. Periapical radiographs were made to verify complete seating. The material was mixed and placed in the tray and transferred to the suitable location on the model (figure 3). After setting the copings were unscrewed and the tray was removed. An implant analogue was attached to each coping. Type IV stone (ERNST Hinrichs; GmbH, Germany) was poured into the impression in a prefabricated mold, and allowed to set for 60 minutes. To prevent changes, the mold casts were not trimmed.

Figure 1. the base implant model

To study the abutment positions with measuring devices we need an abutment of the same shape at different angles, so 4 abutments (Standard Abutment,3i Implant innovovation, Barcelona, spain) of the same diameter (4.1mm) were selected and numbered from 1 to 4 respectively. Each abutment was screwed to the similar numbered implant analogue in a specific fixed direction. The sequence and direction of screwing for all samples remained the same.

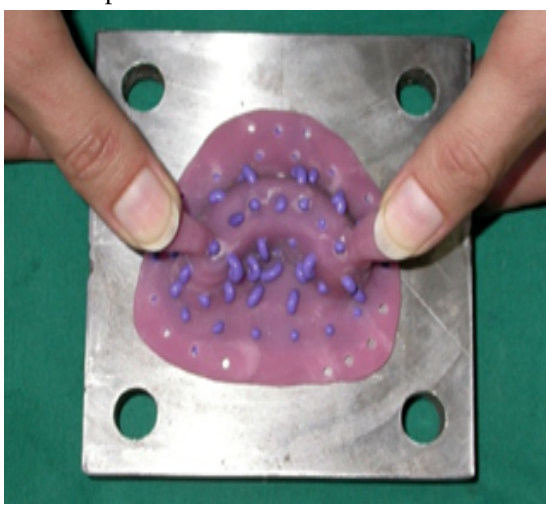

Figure 2. Poly vinyl siloxane and Poly ether impression material

The inter-abutment distance was measured by means of CMM machine (Trimek [2003], Renishaw Inc, England) in x, y and z axes. In the implant-supported prostheses, the position of the abutments cannot be measured relative to a fixed external reference.

For this reason, one of the abutments was chosen as internal reference (basic abutment) for distance measurement. After recording the coordinate of the center of each abutment relative to the standard sphere of the device, basic abutment was selected for the model and each sample separately and the distance difference of each abutment with the next one was calculated using the $\Delta R = \sqrt{(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2}$ formula. The distance difference between each two abutments compared to the original model was considered as impression and implant position transferring accuracy criteria in statistical analyses.

The results were analyzed using SPSS software (SPSS for Windows, v15.0; SPSS Inc). One way ANOVA test has been used for comparison of the group. Differences in the means were detected by using the Tukey honestly significant difference test (α=.05).

RESULTS

The results showed the lowest error mean for the monophase Poly vinyl siloxane (0.0630), Poly ether in the next rank (0.0865) and regular poly vinyl siloxane had the highest error mean (0.0909) among the impression materials. One-way ANOVA showed significant differences among the three groups in terms of impression errors (p=0.041) (table 1).

DISCUSSION

In this study a stainless steel model with 4 implants [16] was used to compare the accuracy of two types of poly vinyl siloxane and poly ether impression materials with open-tray non-splinted technique. Basically, one of the problems associated with implant supported prostheses is the errors occurred when making an impression, which is either related to the nature of the impression material or the stresses exerted to these materials. Therefore the stiffness and elasticity of the impression material affects the impression accuracy.

Natural teeth or implants apply a large amount of stress to the impression material when removing the tray from the mouth which causes irreversible changes in the material, so if the stiffness of the material increases, coping movement will be decreased in the impression and increased impression accuracy is expected. Another method is splinting the impression copings to each other; however, due to the time consuming nature of this technique in the clinic, finding a material with higher accuracy is required to meet the needs of this approach. Bambini et al. observed significant differences between the various impression techniques and materials and found that poly ether showed its highest position transferring accuracy when direct technique was used, but in closed-tray technique no significant differences was found between the accuracy of impressions made with poly ether and poly vinyl siloxane [7].

Wenz et al. also examined different impression techniques with poly ether and poly vinyl siloxane and came to the conclusion that implant position transferring accuracy was not affected by the impression technique. And so using different materials with different impression techniques may show various results [8].

In a systematic review Lee et al. stated that Although it seems that splinted open-tray technique is somewhat more accurate than other techniques, but different materials has no significant effect in increasing the impression accuracy [17].

The results of the Tukey test has also shown that the statistical differences between the Monophase Poly Vinyl Siloxane and Poly Ether impression materials was significant (P=0.049) (table 2).

Table 1. One-way analysis of variance

Impression material	**number**	**mean**	**SD**	***Min***	***Max***	***F***	***P. value***
PVS regular	15	0.0909	0.05915	0.1	0.22		
PE	15	0.0865	0.05774	0.0	0.31	3.277	0.041
PVS monophase	15	0.0630	0.04944	0.0	0.16		

Table 2. Comparative results between the impression materials.

Impression material	***Mean Diff. (I-J)***	***Std. Err.***	*****P.value***
PVS regular PE	*0.044*	*0.1172*	*0.925*
PVS regular PVS Monophase	*0.279**	*0.1172*	*0.049*
PE PVS regular	*-0.044*	*0.1172*	*0.925*
PVS regular PVS Monophase	*0.235*	*0.1172*	*0.115*
PVS Monophase PVS regular	*-0.279**	*0.1172*	*0.049*
PVS regular PE	*-0.235*	*0.1172*	*0.043*

* The mean difference is significant at .05 ** Tukey TEST

In our study it was shown that the impression accuracy of monophase and regular Poly Vinyl Siloxane and Poly ether impression materials were different. The lowest error rate was for the monophase poly vinyl siloxane, poly ether placed in the next rank, and finally regular poly vinyl siloxane had the highest error rate. Possible reasons for these results are:

1. Higher stiffness leads to lesser deviation against the forces.
2. Lower distortion and deviation in form keep the material in the higher range of elastic recovery.
3. Higher resistance against the pressures produced during making the impression, attaching the analogues and pouring the impressions will occur and therefore the material will be more accurate.

On the topic of measuring tools for the prepared samples, various methods can be used. In this study each abutment was assessed independently by measuring in x, y and z axes. The disadvantage of this method is the inability to evaluate each axis separately But since the purpose of making impressions for implant supported prostheses is the correct transfer of the implants spatial position relative to each other and to the surrounding tissues, there is no need to evaluate each axis individually because the error in the transmission of this position causing further problems results from the sum of dimensional differences of the three axes. In fact what is important in evaluating accuracy of abutment position transferring is to keep or moderate the influence of each axis.

CONCLUSION

Within the limitations of the study, the following conclusions were made:

1. Type of impression material influenced the accuracy of definitive casts.
2. Dimensional changes of the casts poured from monophase poly vinyl siloxane were negligible compared with the original model and therefore the use of this material is may be appropriate for transferring implant positions to the casts.
3. Implant position transferring accuracy for monophase poly vinyl siloxane is superior compared to the polyether.

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