ejpmr, 2021,8(2), 338-342

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

DIMENSIONAL ACCURACY OF VARIOUS IMPRESSION MATERIALS AND TECHNIQUES OF DENTAL IMPLANT AT SECOND STAGE SURGERY- A COMPARATIVE STUDY

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Article Received on 24/11/2020 **Article Revised on 14/12/2020** **Article Accepted on 04/01/2021**

ABSTRACT

Introduction: For long term clinical success of the implant prosthesis, fabrication of precisely fitting implant-retained prostheses is of great importance. Several impression techniques using different impression materials have been suggested to ensure the passive fit of a prosthesis on osseointegrated implants. Thus, a study to compare the dimensional accuracy among different impression materials using different impression techniques was undertaken.

Material and method: A master stainless framework with 3 internal hex implants was fabricated and used to generate the samples. This assembly was duplicated in lab duplicating silicone and all the trays were fabricated on this duplicated silicone die using light cure acrylic resin. Samples were divided into 9 groups each having 5 samples. Impressions using all the techniques and materials were carried and were poured in type IV gypsum product. The master cast thus generated was then used to measure the interimplant distance using stereomicroscope and an image analyzing software, Material Plus pro. **Result:** The mean difference was found to be statistically not significant (p-value>0.05) for the material and techniques taken together. Whereas the result was statistically significant (p-value<0.05) when the materials and techniques were taken separately. **Conclusion:** Polyvinylsiloxane-polyether Hybrid impression material and Open tray Non Splinted technique gives best replication of the implant positions on the master cast and the use of this combination is encouraged whereas Polyvinylsiloxane impression material and Closed tray technique results in a large mean difference in interimplant distance and thus should be avoided as far as possible for the use of implant impressions.

KEYWORDS: POLYVINYLSILOXANE; POLYETHER, HYBRID IMPRESSION MATERIAL; CLOSE TRAY TECHNIQUE; OPEN TRAY TECHNIQUE.

INTRODUCTION

Dental implants are one of the most promising choice of treatment for restoration and rehabilitation of missing teeth. The recording of the positioning of the dental implants and subsequently transferring it to the master cast forms an important step and thus accuracy of impressions and casts is of great importance for the fabrication of precisely fitting implant-retained prostheses and consequently for the long-term clinical success of these restorations. Complications that might arise due to prosthesis misfit include screw loosening, screw fracture, and occlusal inaccuracy.[1-7] Also, marginal discrepancy occurring as a result of misfit may increase plaque accumulation and affect soft and/or hard tissues around the implant.[8-12] A successful result is believed to be fully achieved only through the fabrication of passively fitting prostheses.[13,14]

To achieve a passive fit, an accurate positioning of the implant replicas in the master cast must be assured. Several impression techniques have been suggested to achieve a master cast that will ensure the passive fit of a prosthesis on osseointegrated implants.

Not only the impression technique, but also the properties of an impression material used, including rigidity and accuracy, can influence the accuracy of the implant impression, the accuracy of the solid implant cast, and ultimately, the accuracy of the cast implant framework.

Although the efficiency of different techniques and different impression material is well documented in the literature, a study depicting the best combination of these two critical factors in implant impression is lacking. Thus, a study to compare the dimensional accuracy of

various impression materials and techniques of dental implant at second stage surgery was undertaken.

MATERIALS AND METHODS

A master metal framework of dimensions 2cm X 3cm X 3 cm made up of stainless steel with 3 internal hex implants of dimensions 3.75mm X 10 mm was fabricated and used to generate the samples (Figure 1).

Figure 1: Master metal framework with 3 implants.

A common condensation silicone putty spacer was applied over the impression copings attached to the implants. This assembly was duplicated in laboratory duplicating silicone and all the trays were fabricated on this duplicated silicone die using light cure acrylic resin.

The trays to be used for open tray techniques had their top removed for gaining access to screws of the impression copings. The splinting of the copings for the Open Splinted group was done using pattern resin (Figure 2).

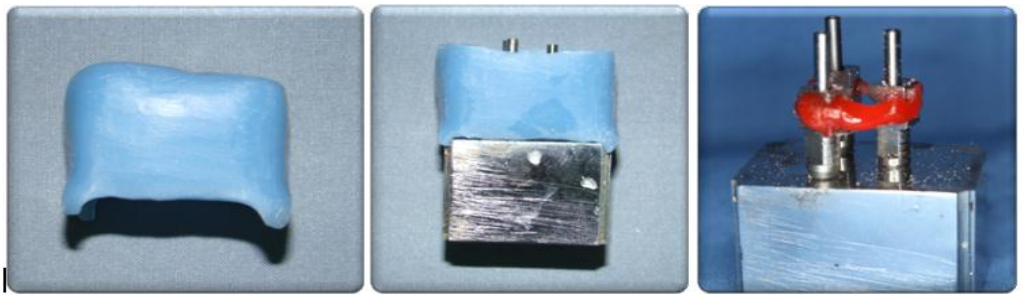

Figure 2: Tray for close and open impression and splinting of coping for open splinting impression Impressions using all the techniques and materials were carried out by a single operator and were divided into 9 groups (Table 1).

Table 1: Groupwise distribution of samples.

	Closed tray (C)	Open tray nonsplinted (ONS)	Open tray splinted (OS)
Polyvinylsiloxane (PVS)	PVS-C n=5	PVS-ONS n=5	PVS-OS n=5
Polyether (PE)	PE-C n=5	PE-ONS n=5	PE-OS n=5
Polyvinylsiloxane-polyether hybrid (Hy)	Hy-C n=5	Hy-ONS n=5	Hy-OS n=5

Impressions were then poured in type IV gypsum product after beading and boxing (Figure 3).

Figure 3: Master cast with implant analogues.

The master cast thus generated was used to measure the interimplant distance using stereomicroscope and an image analyzing software, Material Plus pro. The results generated for each sample was saved in an excel sheet.

RESULTS

The results of this study were as follows:

Table 2: Mean and Standard Deviation of mean difference of average interimplant distance using various impression materials and techniques.

Materials	Techniques	Mean	Std. Deviation
PVS	C	0.06	0.01
	ONS	0.04	0.00
	OS	0.05	0.01
PE	C	0.04	0.01
	ONS	0.03	0.01
	OS	0.02	0.01
Hy	C	0.03	0.00
	ONS	0.01	0.01
	OS	0.02	0.01

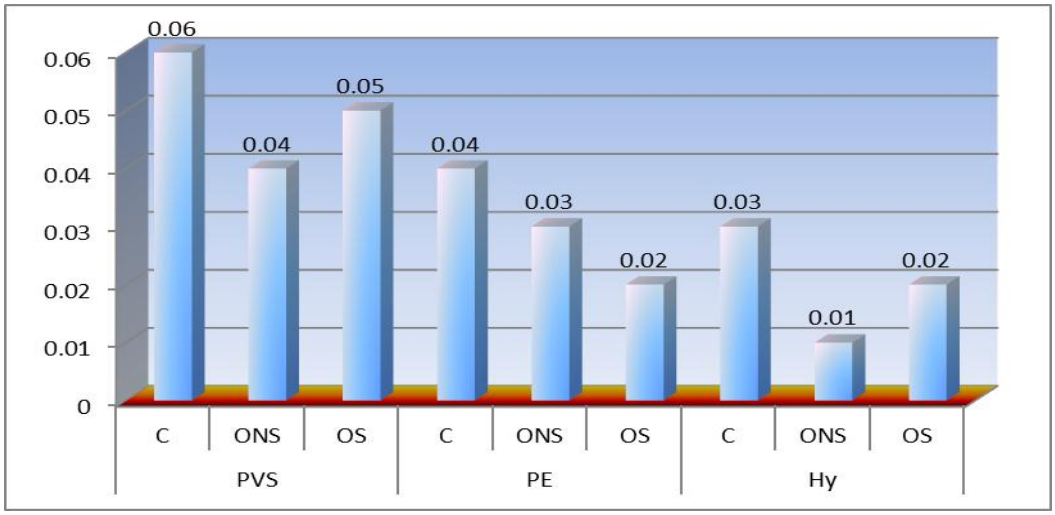

Figure 4- Mean difference of average interimplant distance using various materials and techniques.

Table 3: Test of significance of mean difference of average interimplant distance using various impression materials and techniques using Univariate Analysis of Variance.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.009(a)	8	.001	23.573	0.000
Intercept	.051	1	.051	1112.244	0.000
Materials	.006	2	.003	65.756	0.000
Techniques	.002	2	.001	24.927	0.000
Materials * techniques	.000	4	8.22E-005	1.805	**0.149**
Error	.002	36	4.56E-005		
Total	.061	45			
Corrected Total	.010	44			

a R Squared = .840 (Adjusted R Squared = .804)

Comparison of combinations of various techniques and materials

The two-way ANOVA was done for comparison of the various techniques and materials. The mean difference was found to be statistically not significant (p-value>0.05) for the material and techniques taken together. Whereas the result was statistically significant (p-value<0.05) when the materials and techniques were taken separately.

DISCUSSION

Not only the impression technique, but the impression material per se has also been a keen topic of research with respect to dimensional accuracy of implant impression. Although polyether (PE) has been suggested

as the material of choice in this regard because of its inherent rigidity and hydrophilicity, the use of more flexible Polyvinylsiloxane (PVS) is recommended in cases of deep bony undercuts. PVS has additional benefits of excellent dimensional accuracy and good flow properties. Many authors have reported that there is no statistically significant difference between the two materials. A new material has been introduced into the market claiming to be a hybrid of both PVS and PE. The hybrid material is believed to combine the best features of both PVS and PE, having high tear strength, high hydrophilicity and excellent flow. The use of PVS-PE Hybrid impression material for implant impressions is lacking in the current literature available.

In this study the difference in the Mean difference of average interimplant distance using Closed tray technique with various materials was compared using the ANOVA test. The difference was found to be *statistically significant* (p-value < 0.05). Similar results were observed with the Open tray Non Splinted and Open tray Splinted technique.

Also, the mean difference of PVS-PE Hybrid impression material was the least when compared to PVS and PE impression materials. Thus the dimensional accuracy of the Hybrid impression material was better when compared to the other two materials. Also PE gave better results than PVS irrespective of the technique used.

From the results of this study it was also observed that the closed tray technique resulted in the worst dimensional accuracy irrespective of the material used. Also for the PVS and Hy materials, Open tray Non Splinted technique gave the best results, while for PE, Open tray Splinted technique works best.

For comparing the mean difference of average interimplant distance of various techniques and materials, a 2-way ANOVA test was used. There was no statistically significant difference when the combined comparison of the materials and the techniques was done, although the combination of Hy-ONS group depicted best results followed by Hy-OS and PE-OS groups. The combination of the PVS material and the Close tray technique showed maximum difference in the interimplant distance in comparison to other groups. (Table 2 and 3)

Results similar to those of our study were reported by **Spector et al**[11] and **Heather et al**[15] when they compared the combination of various materials and techniques. They also found no statistically significant difference among different combinations of materials and techniques. In a study conducted by **Akca et al,**[16] they reported that the combination of PE and Open tray gave the maximum difference in the interimplant distance when compared to PE Open tray and PVS Open tray combinations.

CONCLUSION

Within the constraints of this study it can be considered that Polyvinylsiloxane-polyether Hybrid impression material and Open tray Non Splinted technique gives best replication of the implant positions on the master cast and thus the use of this combination is encouraged. Whereas, Polyvinylsiloxane impression material and Closed tray technique results in a large mean difference in interimplant distance and thus should be avoided as far as possible for the use of implant impressions. However, the in vivo performance of these materials and techniques warrants further investigations.

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