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Comparison Of The Positional Accuracy In Multiple Implants By Splinting With Bd Impress And Pattern Resin In Open Tray Impression Technique – An In Vitro Study

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ABSTRACT

BACKGROUND:

Dental Prosthesis misfit in multiple implants is often encountered and can be corrected through impression techniques in producing an accurate, passively fitting prosthesis and ensuring maximum precision. Splinting multiple implants with a ridid and dimensionally stable can be a wise choice. Therefore, an in-vitro study was designed to compare the dimensional stability of Pattern resin and BD Impress as splinting material on the positional accuracy in multiple implants by open tray implant impression technique.

AIM:

The aim of the study was to evaluate and compare the positional accuracy in multiple implants by splinting with pattern resin and BD Impress.

MATERIALS AND METHODS:

An epoxy resin model was fabricated into which four implants were placed. The open tray copings

were attached and splinting was done with pattern resin in Group I (n=6) and with BD Impress in Group II (n=6). Six open tray impressions were made with vinyl polysiloxane and analogs were attached. The casts retrieved from each group were analysed for the positional accuracy using Vision Measuring Machine (VMM). The mean values of all the measurements for each group were obtained and they were statistically analysed using unpaired t test at a significance of 0.5 using SPSS 22.0 software.

RESULTS:

The mean inter implant distance between the Group I and Group II showed that there was only marginal difference(P value ≤ 0.05) with positional accuracy in both Group I and Group II thus concluding that there was no comparable difference between Group I and Group II.

CONCLUSION:

Results showed BD Impress can be used as splinting material in multiple implant prosthesis, as both pattern resin and BD Impress exhibited similar positional accuracy in impression.

Key Words : Accuracy, BD Impress, open tray impression copings, pattern resin, polyvinylsiloxane, splinting material

INTRODUCTION:

One of the important factor for long term implant success is dependent upon the accurate design of prosthesis which should have an impeccable, passive fit to the implant. This prevents mechanical and biological failures in implant treatment. The biomechanical problems like screw loosening, fatigue, fracture of implant components, peri- implantitis, bone loss and later disintegration occur due to lack of passive fit of the frame work[1].

Splinting of open tray impression copings has been suggested by many authors in order to maintain a more accurate inter implant relationship, when compared to that obtained with non-splinted copings[2]. Various materials such as pattern resin, impression plaster, silicones and bite registration polyether have been used as splinting material in several studies. Rigid splinting of impression coping with pattern resin have been advocated to achieve accurate open tray impression by various authors[3].

However, the results were not consistent, and there is limited literature available to compare the positional accuracy of multiple implants using different impression techniques as well as different splinting materials.

The aim of this study was to compare the positional accuracy of multiple implants by splinting with two different materials in open - tray impression technique.

MATERIALS AND METHODS :

STUDY DESIGN:

The study was approved by Institutional Review Board (IRB) (SVDC/IRB/2022/PG THESIS/52) and Institutional Ethics Committee (IEC) (01/SVMCH/IEC- Cert/May22). This in vitro study consisted of 12 casts obtained using open tray impression technique where impression copings were splinted with two different splinting materials. The inter-implant distance was measured by the Vision measuring machine (VMM). Data were collected and analyzed statistically.

METHODS:

A reference model was fabricated using Epoxy resin in a mandibular edentulous arch mold. Four 4 mm x 10 mm implant analogs (CSM Implant, CSM Company, Korea) were placed in the reference model as parallel as possible to each other using a Physiodispenser with Handpiece(NSK, America) and two metal rods inserted in the posterior region to act as stops for the custom tray during impression making (Figure 1). These four implant analogs in the epoxy resin model were sequentially named as A, B, C, and D from left to right. Open tray impression copings (CSM Implant, CSM Company, Korea) were attached to the implant analogs using a hex drive by applying a torque of 15 Ncm [Newton Centimeter]. The dental floss was tied connecting the four-impression copings.

For Group I, splinting was done with Pattern resin (GC PATTERN RESIN TM LS, Self Curing , Acrylic Die Material , America). Pattern Resin was mixed and adapted around on the dental floss. Further it was then sectioned using a diamond disk and sectioned pieces were reconnected with an incremental application of pattern resin. This sectioning and bonding were done to minimize polymerization shrinkage of the pattern resin (Figure 2).

For Group II, splinting was done with BD Impress [BD Impress® , Biocompatible Thermoplastic Impression Material , Germany]. BD Impress was placed in the hot water bath, manipulated as a string and adapted around on the dental floss. Further it was then sectioned using a diamond disk and sectioned pieces were reconnected with an incremental application of BD Impress (Figure 3).

A custom fabricated light cured polymerised impression tray (Poly Tray, Delta, Chennai, India) in which a window was prepared, coinciding with that of open tray impression copings was coated with vinyl polysiloxane (VPS) adhesive (3M ESPE, USA) and allowed to dry for 15 min. Light body polyvinylsiloxane impression material (Flexceed GC, Japan) was meticulously syringed around the impression copings to ensure complete coverage of the copings and simultaneously putty consistency polyvinylsiloxane impression material (Flexceed GC, Japan) was mixed and loaded onto the tray. They were seated corresponding to the metal bar insert in the posterior region over the resin model with finger pressure. The guide pins were then loosened with a hex driver and the tray was removed from the master cast, with the impression copings. The implant analogs were then connected to the hex at the bottom of the impression coping and the guide pins were tightened with the hex driver.

Six impressions were made for each groups and a total of 12 master casts were poured in Type IV dental stone (Kalrock, Kalabhai Karson Pvt. Ltd, Mumbai). All the casts were stored at the room temperature for a minimum of 24 hrs before measurements were made. All laboratory procedures were done by the primary investigator.

A single examiner, blinded to the nature of the splinting material used, examined the all definitive casts to evaluate the positional accuracy of the implant replicas using a visually controlled measuring machine(VMM, CIPET, CHENNAI). VMM was used for all measurements which is capable of measuring with an accuracy of ±5 µm. Computed Software was used for geometric transformation and data processing. Inter implant distance between the two groups were compared by measuring the positional accuracy as a parameter.

STATISTICAL ANALYSIS:

The mean values of all the measurements for each group were obtained and they were statistically analysed using unpaired t test at a significance of 0.5 using SPSS 22.0 software (Statistical Package for the Social Sciences, IBM Corp., Armonk). Unpaired t test was done between the Group I and Group II for the assessment of difference in positional accuracy in multiple implants obtained from the master cast by assessing the inter implant distance of four implants [A - B, B - C, C - D, A - C, A - D and B - D].

RESULTS:

The present study was done to compare the positional accuracy of multiple implants by splinting with two different materials in open - tray impression technique. The data was assessed for normal distribution. Continuous data was compared between the groups using unpaired t-test. Data was presented using graphs and tables. The level of significance was set at $P \leq 0.05$.

Table 1 shows the mean inter implant distance between the centroids (A, B, C, and D) between the two groups by measuring the centroids of four implants and calculating their maximum of six values from six different possible points from the centroids (A, B, C, and D). From the Table 1, we can see that the maximum difference between the groups in seen in (A – C) with the difference of 0.4 and the maximum value is seen in Group 1 with the mean value of 37.90. The inter implant between (A-B) showed no difference between the groups and the mean value of both groups are same with the value of 12.73.

The mean inter implant distance between the centroids (A to B) between the Group I and Group II shows that there was no comparable difference between the casts obtained by splinting with pattern resin (Group I) and casts obtained by splinting with BD Impress (Group II) (Table 1). The maximum difference between the groups were observed in (A to C) and this shows that the casts obtained by splinting with pattern resin (Group I) showed least positional accuracy error than the casts obtained by splinting with BD Impress (Group II).

For implant analogues A to B, C to D, and B to D, the lowest deviation was seen in Group 2 (Table 2). This shows that the mean inter implant distance between the centroids (A to B, C to D and B to D) between the Group I and Group II shows that casts obtained by splinting with BD Impress (Group II) was marginally more than the casts obtained by splinting with pattern resin (Group I).

In addition, for implant analogues B to C, A to C, and A to D, the least deviation was seen in Group 1 (Table 2). This shows that the mean inter implant distance between the centroids (B to C, A to C and A to D) between the Group I and Group II shows that casts obtained by splinting with pattern resin (Group I) was marginally more than the casts obtained by splinting with BD Impress (Group II).

Therefore, overall the highest deviation was seen for implant analogues A to C (P value ≤ 0.05) in casts obtained by splinting with BD Impress (Group II) and the lowest deviation was seen for implant analogues A to C in casts obtained by splinting with pattern resin (Group I).

The mean inter implant distance between the Group I and Group II showed that there was only marginal difference (P value ≤ 0.05) with positional accuracy in both Group I and Group II thus concluding that there was no comparable difference between the casts obtained by splinting with

pattern resin (Group I) and casts obtained by splinting with BD Impress (Group II).

DISCUSSION:

The present study was done to compare the positional accuracy of multiple implants by splinting with two different materials in open - tray impression technique. Osseointegrated dental implants have been proven successful in the treatment of edentulous patients. Mainly osseointegrated implants were used for rehabilitation of edentulous patient with the principal objective of replacing conventional complete denture with an implant supported prosthesis. In implant prosthodontics, a successful result can be achieved only when passively fitting prosthesis are fabricated. Reproducing the intraoral relationship of implants through impression procedure is the first step in achieving an accurate, passively fitting prosthesis4.

Accurate transfer of implant position from the mouth to working cast, therefore remains a valid objective of relevance for the obtainment of optimum fit between the implant and superstructure.

The preciseness of impression depends on two factors, the types of impression technique and impression materials used.

We used Vinyl polysiloxane elastomeric impression material putty and light body in our study and this is similar to the study reported by Lee et al that vinyl polysiloxane elastomeric impression material was more accurate than the PE impression material in their study[5].

Rotation of impression copings in the impression during fastening of the implant analog was one of the main drawbacks of direct impression technique. To avoid distortion of the impression coping, splinting of impression coping was advocated. The underlying principle is that if all the impression copings were joined together using a rigid material, the movement of individual copings is avoided during the impression making procedure. This is in consensus with the study reported by Kim et al that the splint technique was more accurate during the fabrication of cast than the non-splinted technique[6].

Manoharan PS et al studied about the applications of BD Impress, as a border moulding material and an interocclusal record material, which have been tested for its accuracy and compressive resistance. It was found to be extremely superior in terms of detail reproduction, dimensional accuracy [reproducible up to 25 microns] and compression resistance[7]. Considering its greater dimensional accuracy and compression resistance we used BD Impress as a splinting material in our study.

Nassar et al reported that VPS impression material showed excellent dimensional stability, more accuracy in immediate pouring of the casts[8]. In our study, the casts were measured using Vision measuring machine. This is similar to the study reported by Balamurugan T et al that Vision measuring machine can be used for measuring the positional accuracy of multiple implants[9].

The inter implant distance values have comparable values between two groups and reference model. Spector et al reported an error up to 20-410µm and Lee et al reported an error up to 14±11.3µm[10,11]. Thus, in comparison to the reference model, the difference in this study was within the similar range when compared with previous studies. There is no significant difference between test groups and reference model. Also, the group I shows nearest value to the reference model.

Assunaco et al stated that in a good impression, a discrepancy of 50µm may be found in any axis[12]. The discrepancies are not only caused by the accuracy of impression technique and materials but also

by the machining tolerance between the implant and the impression coping and abutments. Ma et al reported machining tolerance between implant components ranging from 22µm to 100µm[13]. Hariharan et al reported that splinting might rigidly hold the impression copings together[14].

Measurement made in the present study showed that pattern resin and BD Impress used as splinting material showed minimal distortion and comparable value in inter implant relationships. Although significant differences might not be present and the collective error occurring because of dimensional changes might play a role in the passive fit of the prosthesis.

The results obtained in the present study were in line with those obtained from the previous studies wherein there is no significant variation between the splinting materials used in our study, but values obtained from splinting with pattern resin test group was very close to the reference model. In this regard, pattern resin as splinting material which was made before 24 hours prior to the procedure, has been advocated as reliable impression technique for the multiple implants.

The limitations of this study was the measurement of the inter implant distances between the implant analogs in the reference model. But framework was not fabricated on the reference model which would have helped to assess the passivity and impeccable fit of the framework over the study models. Also, all impressions were not made under ideal conditions that is without the presence of soft tissues, blood and saliva, which may affect the accuracy of the impressions.

Further studies can be conducted clinically to assess the amount of discrepancies that can occur in actual clinical situation. The future direction of this study in a clinical situation would lead to use BD Impress as a splinting material for multiple implant prosthesis which would be less time consuming, cost effective, reusable material and ease of manipulation than other commercially available materials.

CONCLUSION:

Positional accuracy of implant impressions was evaluated by master casts made by open tray impression technique by splinting with pattern resin and BD Impress. It was found that both yielded casts closer to the reference model.

Both the splinting materials exhibited similar accuracy in impression, therefore BD Impress can be used as splinting material in multiple implant prosthesis, which is easy handling, economical, timesaving , less technique sensitive, rigid and readily available material instead of pattern resin splinting material, which is technique sensitive, more time consuming, cost expensive and more cumbersome.

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LEGENDS AND FIGURES:

Figure 1
Epoxy Resin model placed with two metal rods for reference

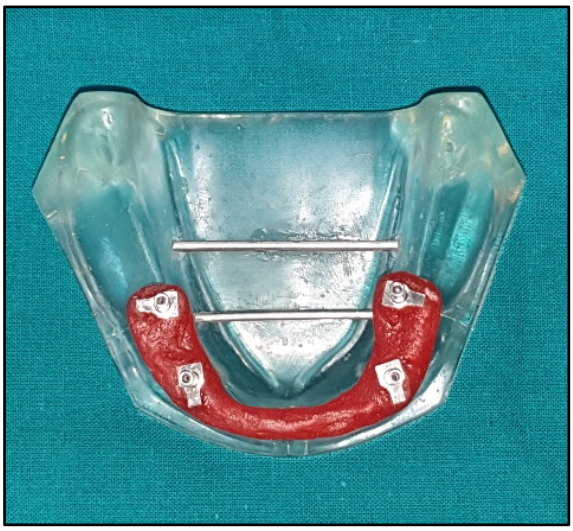

Figure 2
Reference model splinted with Pattern Resin

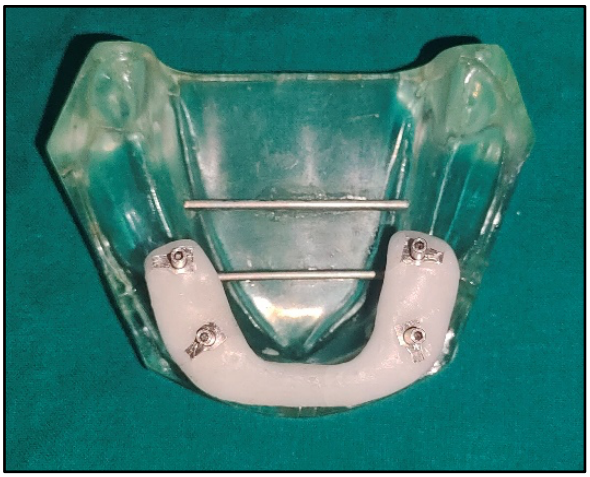

Figure 3
Reference model splinted with BD Impress material

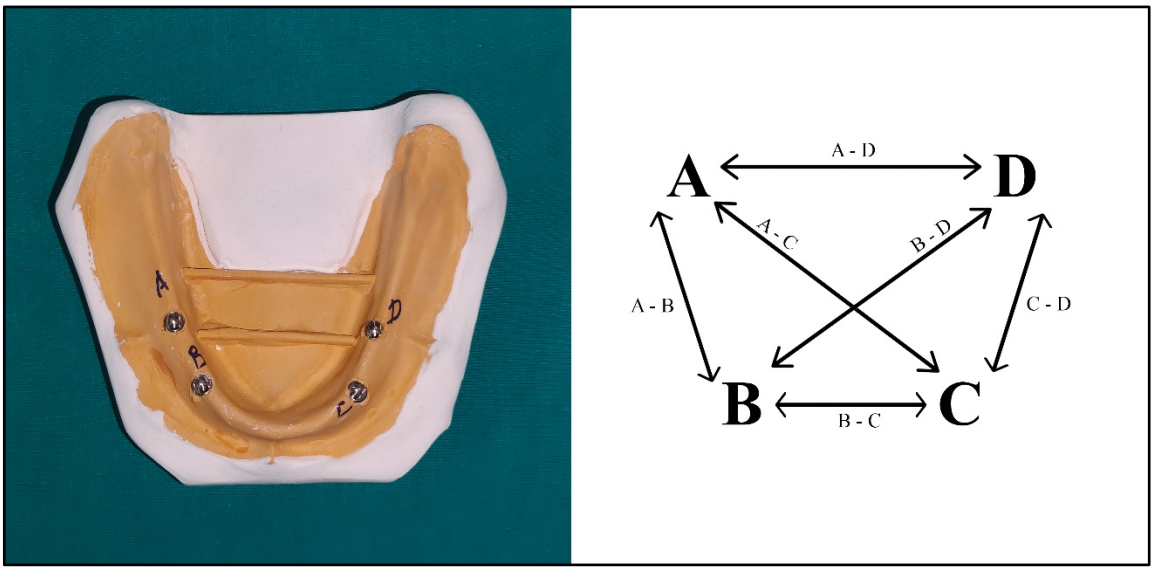

Figure 4
Master cast and Schematic Representation of the measurement of Inter implant distance

		Group 1		Group 2	
	N	Mean	SD	Mean	SD
A to B	6	12.7208	0.06	12.7223	0.09
B to C	6	30.0963	0.05	30.0502	0.09
C to D	6	11.9698	0.19	12.0628	0.12
A to C	6	37.8940	0.09	37.4950	0.08
A to D	6	39.4200	0.15	39.4900	0.11
B to D	6	35.2712	0.11	35.3642	0.06

N-number; SD-standard deviation

Table 1: Mean distance between centroids of implant analogue A and B between two groups

	A to B	**B to C**	**C to D**	**A to C**	**A to D**	**B to D**
Master Cast	12.921	30.208	12.175	37.881	39.328	35.443
Group 1	0.2002	0.1117	0.2052	-0.013	-0.092	0.1718
Group 2	0.1987	0.1578	0.1122	0.386	-0.162	0.0788

Table 2: Distance of deviation between centroids among groups and master cast