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Dimensional accuracy of impression techniques for the endosteal implants (An in vitro study): Part I

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ABSTRACT

Aims: To detect the most accurate impression materials and technique to transfer single or multiple implants position from the master model to the stone dies by two methods of measurement. **Materials and methods:** Two master models (Cl III Kennedy with single implant Frialit–2, and Cl II free end saddle with double implants) were fabricated. Four impression techniques were used (direct, and indirect, each with one, and two steps) using condensation, addition (heavy and light consistencies) and addition (medium consistency) silicone impression materials. Five impressions were taken for each technique to produce a total number of 100 stone casts. A mechanical apparatus was carefully designed to allow constant repeatable position of stock impression tray to the master model, and to allow vertical removal of the impression tray that helps to standardize the path of removal. The measurements were performed by using digital caliber and optical micrometer microscope. **Results:** Showed that the direct (open tray) two steps technique was the accurate technique for transferring implant position to the laboratory cast. The two steps impression technique was the most accurate one than one step. There were no significant differences between single, and double implants. There was significant difference between the two methods of measurements in (Z) axis for both single and double implants case. **Conclusion:** The direct (open tray), two steps impression technique, and addition impression material is the most accurate technique. The numbers of dental implants had no significant effect on accuracy of stone cast.

Key words: Endosteal implant, Impression technique, Silicone impression material.

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INTRODUCTION

Several implant impression techniques have been advocated for transfer of implant position before construction of the prosthesis. In relation to screw–type titanium implants, impression transfer copings may be retained either within the impression as it is removed from the mouth (direct technique) or retained on the implant and later removed, and replaced in the impresssion which is called indirect technique.(1) These techniques have been investigated with varying result.(2–4) Several authors reported that the direct method is more accurate.(5–7) One study observed better fitting castings is produced by the indirect impression technique (8) where as other studies found no difference in the accuracy of master casts when either methods were used.(9, 10) Many factors are important in selecting an impression material, some of which are accuracy, dimensional stability, working time, storage time, shelf life and taste. (11, 12)

Aims of this study were to detect the most accurate impression technique, and types of impression material used to transfer single or multiple implants position from the master model to the stone dies by two methods of measurement (An in vitro study).

MATERIALS AND METHODS

Two maxillary partially edentulous models (Frascaco,Franz Scachs and Co. GMBH, Germany, Class I, and Class III Kennedy classification) were used to construct the master models. Three implants (Friatic system ,Friadent Co.,Germany) were used to be fixed to the master models: one implant fixture (15mm length and 3.8 mm diameter) was fixed to the bounded case, and two implants fixture (13mm length and 3.8mm diameter) were fixed to the free end saddle case. A computerized micro motor hand piece (Elcomed 100, microprocessor controlled, W&H, Austria) with different drilling burs was used for drilling the sockets that receive the implants fixtures.

One type impression stock tray was used for all steps to take an impression by using three types of silicone impression materials(Condensation Ormadent Major Italy, light and patty, Addition Perfexil Septodont France Medium Body and President Colten Switzerland Low Body, and Putty Type). The impression was made by using mechanical apparatus [13] that secure a consistent master model position within the impression tray, providing the desirable thickness of impression materials, identical direction of insertion and removal of the upper metal plate with the tray that contains the impression material. A certain modification was performed to this apparatus to facilitate using it in the open tray technique.

Four impression techniques were used in this study which are direct (open tray) one step [14], direct two steps, indirect (close tray) one step, and indirect two steps. For the medium body, two techniques only used (direct and indirect one step). Dental stone was used to pour each impression. Five impressions were taken with each technique for every master model of single, and multiple implants to produce hundred impressions that when poured will produce a hundred stone dies:

a. *Indirect (one step)and (two steps) techniques:* Plastic transfer caps were fited to the metal transfer coping, which were screwed to the implant fixture on the master cast with short screw No.4305 (Figure 1). Stock tray with test apparatus was used for holding a silicone rubber base impression material. Impression along with the plastic caps was removed from the master cast. The metal copings were unscrewed from the abutments and fixed with connecting screw No.4305 to laboratory analog. The assembled metal copings–analogs were then pressed into keyed position (flat surfaces) in the plastic transfer cap within the impression. The circumferential groove provides a vertical stop and will hold the coping in place while the impression was being poured (Figure 2).

In putty–wash (one–step) impression technique, both phases of the impression material were placed in the tray at the same time and the light body material was injected around the abutments, followed by immediate placement of the tray loaded with the heavy body impression material. The mixing, and setting time were controled by a timer, and the method was kept almost constant for all the trials.

The double–impression procedure (two–steps) was used in which a prelimnary impression was taken in putty like consistency material. The standard spacer (3M Dental products, USA) was placed over the master model to provide enough space for the light body material. The impression materials were allowed to set for 15 minutes from the start of mixing; the manufacturers setting time was doubled to compensate for a delayed polymerization reaction at room temperature.[15]

b. *Direct (one step)and (two steps) techniques*: A connecting screw No.1615 (long) was used to connect the transfer coping to the implant fixture (Figure 1). The stock tray was modified by creating window openings over the position of the transfer copings to continue with the openings that are prefabricated in the upper part of the test apparatus. The stock tray was loaded with silicone impression material (in one step technique) and pressed gently over the master model. The excess of the impression material bulging out through these opening was removed to clear the slot head of the connecting screw. After the impression material has been set, the connecting screw was disconnected through the openings and the disconnection should be continued until two or three clicks are heared to insure that the transfer coping was completely separated from the implant fixture.

At this step the impression would be separated from the master model gently. The transfer copings would be retained inside the impression (pick up) and separated from the implant fixture (Figure 2). Then the laboratory analogs would be screwed to the transfer copings. While they are still in their place inside the impression, careful screwing should be taken place not to over torque the screw but to prevent the rotation of the transfer copings inside the impression material.

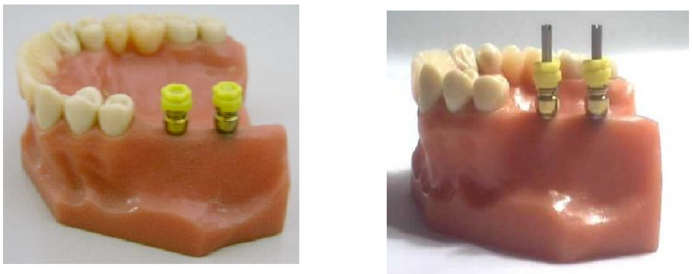

Figure (1): The plastic cap, and transfer coping fixed to the implant fixture by short (indirect), and long direct screw impression techniques.

Figure (2): The assembled metal copings–analogs fixed inside silicone impression of indirect one step technique.

Steps of direct Two step technique was followed as described previously. The impressions then were left on the bench for about 15 min. before pouring in order to get maximum precision according to manufacturers' instructions.

All impressions were poured with Silky Rock die stone. The water/powder ratio was 100gm of powder added to 23ml of distilled water. All stone dies were separated from impression after 1 hour.[15] Stone dies were based with stone using a tripod–method on a surveyor, this technique facilitated the orientation of the reference surfaces on the same plane, and aided in measurement. All stone dies were allowed 24 hours before they were tested for accuracy, in order to obtain maximum dryness, hardness and strength.[16]

Two methods for measurements were applied, one by using the digital caliber *of 0,001 mm accuracy* (using surveyor), and the second measurement was done by using the optical traveling microscope (accuracy of 0,001mm at magnification power x10) to obtain the x, y and z axes on the master model and stone dies (Figure 3). These three axes for the double implant model are represented as follows:

X (mesial): From central fossa of 6 to the midpoint at the palatal surface of the mesial transfer coping. *X* (distal): From central fossa of 7 to the midpoint at the palatal surface of mesial transfer coping. *Y* (mesial): From distal fossa of 5 to the midpoint of the mesial surface of mesial transfer coping. *Y*(distal): From distal fossa of 5 to the midpoint of the mesial surface of distal transfer coping. *Z* (mesial): From the tip of the transfer coping to the tip point of the alveolar process. *Z* (distal): From the tip of the transfer coping to the tip point of the alveolar process. Three axes of the single implant model were represented as follows: (*X*): From central fossa of 6 to the midpoint of the palatal surface of transfer coping. (*Y*): From central fossa of 6 to the midpoint of the distal surface of the transfer coping. (*Z*): From the tip of the transfer coping to the tip point of the alveolar process.

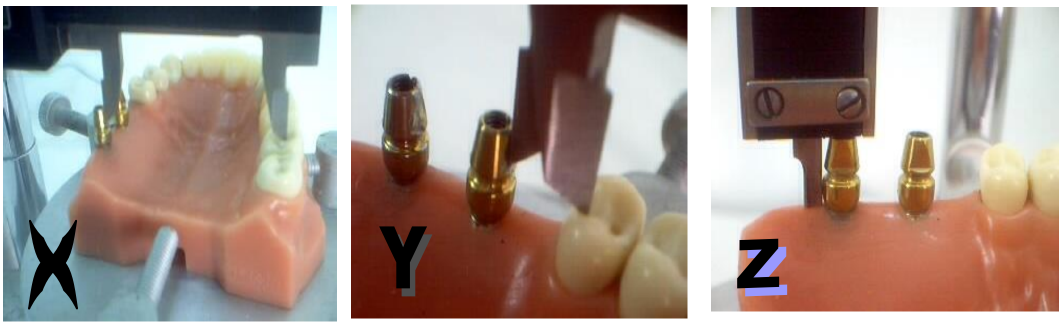

Figure (3): The distal X, Y, and Z axis measured by digital vernier

Descriptive, One sample t–test, Analysis of variance (ANOVA), and Duncan's Multiple Range Test were used in order to analyze, and assess the results.

RESULTS

One sample t–test was used to compare between the means of the three axes of the master models, and the means, and standard deviation of 100 stone dies resulted from using three brands of silicone impression material and four impression techniques, and to show if there was any signifycant difference between the levels of variable in this study; the result showed that there was highly significant difference on cast accuracy between these variables up to p≤ 0.001(Tables 1–4).

Table (1): Comparison between master model and casts produced from silicone impression materials by four impression techniques using one sample t–test (single implant, digital caliber).

Axes		**Mean ± SD mm**		
		X	**Y**	**Z**
Master Model		12.31	41.81	7.90
Materials	**Techniques**			
Condensation	**C1S**	12.44 ± 0.04	41.87 ± 0.02 **	7.98 ± 0.03 **
	C2S	12.23 ± 0.03 ***	41.83 ± 0.02	7.85 ± 0.05
	O1S	12.45 ± 0.05	41.84 ± 0.02 *	7.81 ± 0.01 ***
	O2S	12.26 ± 0.05 ***	41.81 ±0.02	7.89 ± 0.06
Medium	**MO**	12.63 ± 0.05 ***	41.79 ± 0.03	8.01 ± 0.03 ***
	MC	12.55 ± 0.04 **	41.91 ± 0.01 ***	8.70 ± 0.03 ***
Addition	**C1S**	12.40 ± 0.06	41.89 ± 0.03 **	7.98 ± 0.04 *
	C2S	12.25 ± 0.04 ***	41.83 ± 0.03	7.87 ± 0.03
	O1S	12.41 ± 0.07 *	41.83 ± 0.04	7.84 ± 0.03 *
	O2S	12.30 ± 0.04 **	41.80 ± 0.06	7.89 ± 0.03

C1S: Close tray impression technique, one step; C2S: Close tray impression technique, two steps; O1S: Open tray impression technique, one step; O2S: Open tray impression technique, two steps; MO: Medium Open; MC: Medium Closed.

*Significant difference at p ≤ 0.05, **p ≤ 0.01 and ***p ≤ 0.001.

Table (2): Comparison between master model and casts produced from silicone impression materials by four impression techniques using one sample t–test (double implant, digital caliber).

Axes		Mean ± SD mm					
		X–M	**X–D**	**Y–M**	**Y–D**	**Z–M**	**Z–D**
Master Model		8.90	18.82	45.17	46.57	7.23	7.92
Material	**Techniques**						
Condensation	**C1S**	8.92±0.01*	18.82±0.05	45.21±0.04	46.63±0.02**	7.31±0.04**	7.85± 0.07
	C2S	9.09±0.04***	18.84±0.05	45.26±0.04**	46.15±0.55	7.19±0.03*	7.89±0.03
	O1S	9.02±0.03***	18.94±0.008***	45.38±0.03***	46.71±0.02***	7.29±0.29	7.84±0.02**
	O2S	8.94±0.03*	18.84±0.12	45.16±0.01	46.56±0.07*	7.21±0.03	7.98±0.03**
Medium	**MO**	9.02±0.07***	18.91±0.16***	44.39±0.09***	45.68±0.03***	7.82±0.05***	8.28±0.02***
	MC	9.03±0.06**	18.78±0.007***	44.34±0.02***	46.62±0.03***	7.60±0.04***	8.34±0.12**
Addition	**C1S**	9.0±0.04**	18.80±0.02	45.23±0.03*	46.60±0.03*	7.28±0.03***	7.85±0.03*
	C2S	8.98±0.04**	18.81±0.03	45.22±0.02**	46.54±0.05	7.20±0.05	7.90±0.04
	O1S	9.02±0.04**	18.86±0.05	45.30±0.06**	46.68±0.04**	7.18±0.03*	7.89±0.03
	O2S	8.91±0.02	18.84±0.05	45.16±0.04	46.57±0.06	7.22±0.03	7.45±0.04

C1S: Close tray impression technique, one step; C2S: Close tray impression technique, two steps; O1S: Open tray impression technique, one step; O2S: Open tray impression technique, two steps; MO: Medium Open; MC: Medium Closed.

*Significant difference at $p \leq 0.05$, ** $p \leq 0.01$ and *** $p \leq 0.001$.

Table (3): Comparison between master model and casts produced from silicone impression materials by four impression techniques using one sample t–test (single implant, optical microscope).

Axes		Mean ± SD mm		
		X	**Y**	**Z**
Master Model		12.24	41.69	7.84
Materials	**Techniques**			
Condensation	**C1S**	12.28± 0.02*	41.52± 0.02 ***	7.75± 0.05 *
	C2S	12.26± 0.02	41.70± 0.02***	7.80± 0.05
	O1S	12.42± 0.03***	41.80± 0.11 *	7.93± 0.03 **
	O2S	12.26± 0.05	41.65±0.05***	7.79± 0.02**
Medium	**MO**	12.34± 0.03***	41.72± 0.03***	7.73± 0.01***
	MC	12.42± 0.02***	41.71± 0.02 ***	7.75± 0.03 **
Addition	**C1S**	12.30± 0.04*	41.60± 0.04 ***	7.79± 0.02 *
	C2S	12.26± 0.03	41.70± 0.08**	7.80± 0.04
	O1S	12.38± 0.03 ***	41.75± 0.04***	7.88± 0.03 *
	O2S	12.28± 0.03*	41.68± 0.03***	7.81± 0.04

C1S: Close tray impression technique, one step; C2S: Close tray impression technique, two steps; O1S: Open tray impression technique, one step; O2S: Open tray impression technique, two steps; MO: Medium Open; MC: Medium Closed.

*Significant difference at $p \leq 0.05$, **$p \leq 0.01$ and ***$p \leq 0.001$.

Table (4): Comparison between master model and casts produced from silicone impression materials by four impression techniques using one sample t–test (double implant, optical microscope)

Axes		Mean ± SD mm					
		X–M	X–D	Y–M	Y–D	Z–M	Z–D
Master Model		8.56	18.40	44.62	46.49	7.23	7.29
Materials	Techniques						
Condensation	C1S	8.49±0.01***	18.38±0.03	44.81±0.05	46.50±0.07	7.35±0.02***	7.01±0.03***
	C2S	9.60±0.04	18.40±0.05	44.61±0.03	46.45±0.03*	7.21±0.02**	7.68±0.03***
	O1S	8.56±0.01	18.51±0.11	44.68±0.02**	46.62±0.02***	7.09±0.04***	7.73±0.07**
	O2S	8.56±0.04	18.40±0.04	44.62±0.03	46.42±0.02***	7.24±0.04	7.81±0.03*
Medium	MO	8.64±0.03**	18.34±0.03*	43.89±0.02***	45.52±0.02***	7.78±0.03***	8.25±0.06***
	MC	8.65±0.05*	18.50±0.02***	43.99±0.03***	45.55±0.05***	7.86±0.04***	8.33±0.05***
Addition	C1S	8.40±0.04***	18.39±0.05	44.75±0.07*	46.42±0.06	7.30±0.05	7.95±0.07
	C2S	8.56±0.03	18.40±0.03	44.62±0.07	46.45±0.02**	7.22±0.04*	7.75±0.04**
	O1S	8.60±0.04	18.50±0.05	44.67±0.02*	46.55±0.07	7.12±0.07**	7.67±0.08**
	O2S	8.50±0.07	18.42±0.03	44.60±0.12	46.46±0.07	7.26±0.03	7.86±0.07

C1S: Close tray impression technique, one step; C2S: Close tray impression technique, two steps; O1S: Open tray impression technique, one step; O2S: Open tray impression technique, two steps; MO: Medium Open; MC: Medium Closed.
*Significant difference at $p \leq 0.05$, ** $p \leq 0.01$ and *** $p \leq 0.001$.

Analysis of variance (ANOVA) for the dimensional accuracy of stone casts resulted from using of four impression techniques showed that there were significant differences between most of the variable levels, Tables (5 and 6). Duncan's multiple range test showed that open tray two steps impression techniques were the most perfect impression techniques (Figures 4–7).

Table (5): Analysis of variance for dimensional accuracyof stone casts produced from four impression techniques measured by digital caliber.

Source of Variation	df	Sum of Square	Mean of Square	F– value	*P*– value
Techniques– mesial X (D)	3	5.425	1.808	5.048	<0.01
Techniques– distal X (D)	3	4.044	1.348	2.155	>0.05
Techniques– mesial Y (D)	3	8.925	2.975	10.028	<0.001
Techniques– distal Y (D)	3	0.804	0.268	8.883	<0.001
Techniques– mesial Z (D)	3	71.358	23.786	4.355	<0.01
Techniques– distal Z (D)	3	31.401	10.467	3.525	<0.05
Techniques– X (S)	3	10.910	3.637	8.787	<0.001
Techniques– Y (S)	3	0.157	0.052	17.556	<0.001
Techniques –Z (S)	3	112.128	37.376	5.789	<0.01

df: Degree of freedom; D: Double implants case; S: Single implant case

Table (6): Analysis of variance for dimensional accuracy of stone casts produced from four impression techniques measured by optical microscope.

Source of Variation	df	Sum of Square	Mean of Square	F– value	*P*– value
Techniques– mesial X (D)	3	3.883	1.294	5.059	<0.01
Techniques– distal X (D)	3	5.851	1.950	3.784	<0.05
Techniques– mesial Y (D)	3	5.857	1.952	8.730	<0.001
Techniques– distal Y (D)	3	0.952	0.317	4.975	<0.01
Techniques– mesial Z (D)	3	109.060	36.353	6.424	0.001
Techniques– distal Z (D)	3	40.609	13.536	5.519	<0.01
Techniques– X (S)	3	6.690	2.230	14.968	<0.001
Techniques– Y (S)	3	0.173	0.058	3.151	<0.05
Techniques– Z (S)	3	2.315	0.772	3.622	<0.05

df: Degree of freedom; D: Double implants case; S: Single implant case

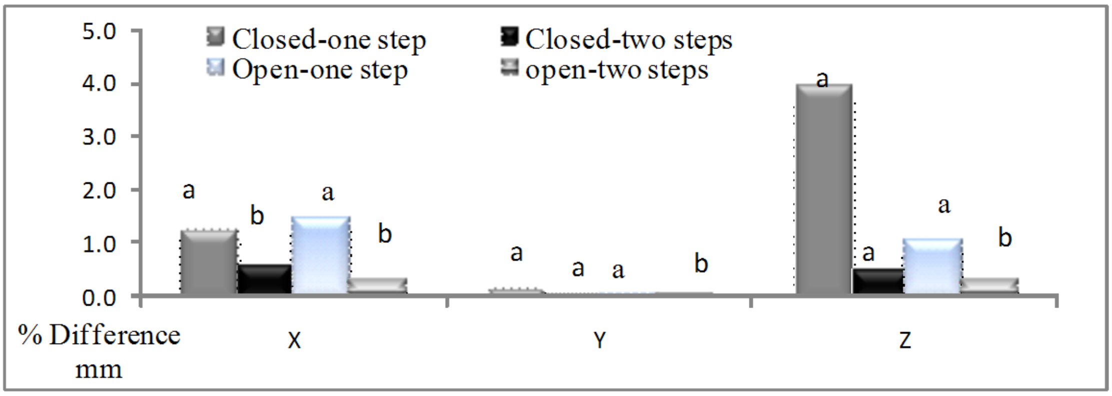

Figure (4): Mean difference of stone casts produced by four impression techniques measured by digital caliber (single implant)

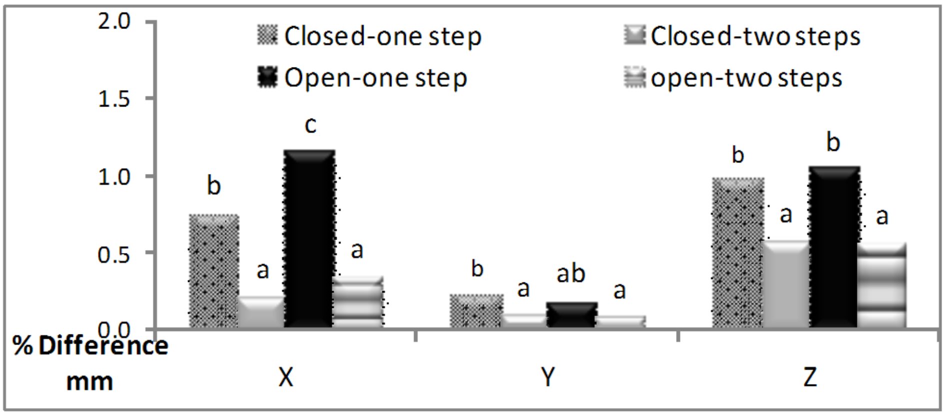

Figure (5): Mean difference of stone casts produced by four impression techniques measured by optical microscope (single implant).

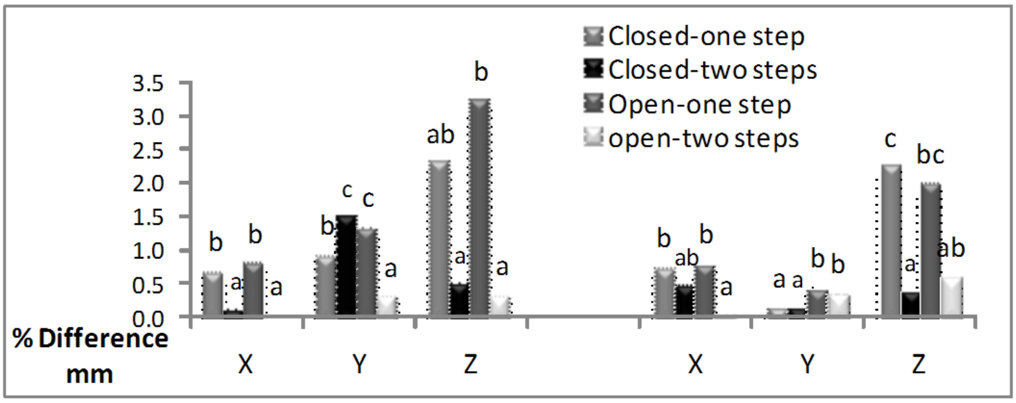

Figure (6): Mean difference of stone casts produced by four impression techniques measured by digital caliber (Double implants).

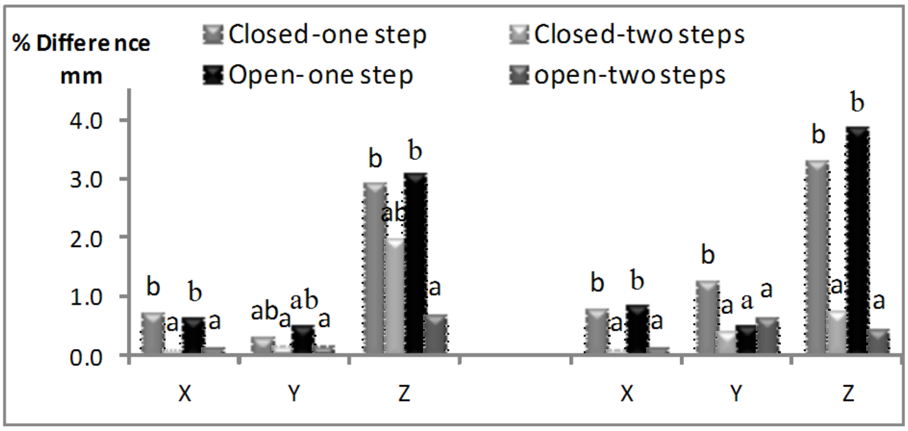

Figure (7): Mean difference of stone casts produced by four impression techniques measured by optical microscope (Double implants)

Analysis of variance for the dimensional accuracy of stone casts resulted from using of three brands of silicone impression materials showed that there was a significant difference between most of the variable levels Tables (7 and8). Duncan's multiple range test showed that the addition curing (two phase) impression materials was the best impression materials used in dental implant (Figures 8–11).

Table (7): Analysis of variance for dimensional accuracy of stone casts produced from three impression materials measured by digital caliber.

Source of Variation	df	Sum of Square	Mean of Square	F– value	*P*– value
Materials– mesial X (D)	2	20.802	10.401	443.528	<0.001
Materials– distal X (D)	2	24.704	12.352	71.558	<0.001
Materials– mesial Y D)	2	1.747	0.873	1.971	>0.05
Materials– distal Y (D)	2	0.384	0.192	4.997	<0.05
Materials– mesial Z (D)	2	288.540	144.270	199.217	<0.001
Materials– distal Z (D)	2	149.912	74.956	194.929	<0.001
Materials– X (S)	2	20.606	10.303	51.829	<0.001
Materials– Y (S)	2	0.038	0.019	3.512	<0.05
Materials– Z (S)	2	209.329	104.664	24.622	<0.001

df: Degree of freedom; D: Double implants case; S: Single implant case

Table (8): Analysis of variance for dimensional accuracy of stone casts produced from three impression materials measured by optical microscope.

Source of Variation	df	Sum of Square	Mean of Square	F– value	*P*– value
Materials– mesial X (D)	2	14.648	7.324	24.622	<0.001
Materials– distal X (D)	2	29.198	14.599	1881.014	<0.001
Materials– mesial Y (D)	2	2.730	1.365	4.783	<0.05
Materials– distal Y (D)	2	0.230	0.115	1.478	>0.05
Materials– mesial Z (D)	2	337.589	168.795	249.658	<0.001
Materials– distal Z (D)	2	115.189	57.594	70.774	<0.001
Materials– X (S)	2	2.428	1.214	5.135	0.01
Materials– Y (S)	2	0.179	0.089	5.004	<0.05
Materials– Z (S)	2	3.735	1.868	10.479	<0.001

df: Degree of freedom; D: Double implants case; S: Single implant case

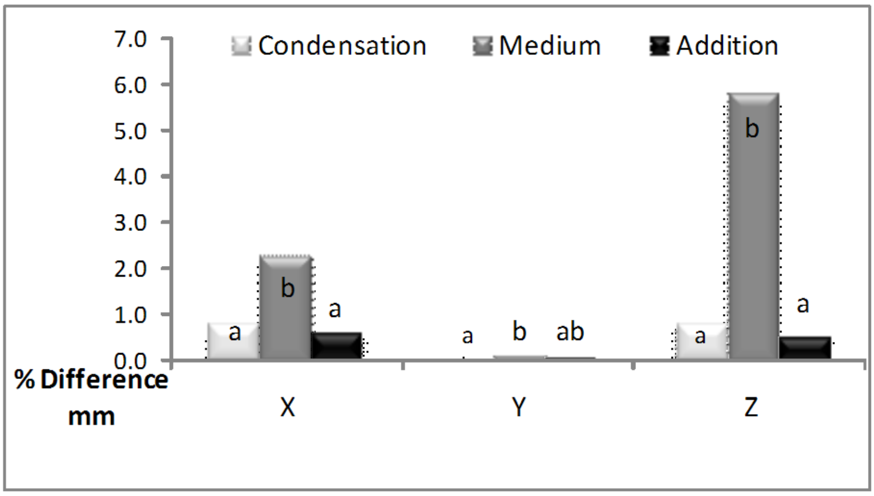

Figure (8): Mean difference of stone casts produced by three impression materials measured by digital caliber (single implant).

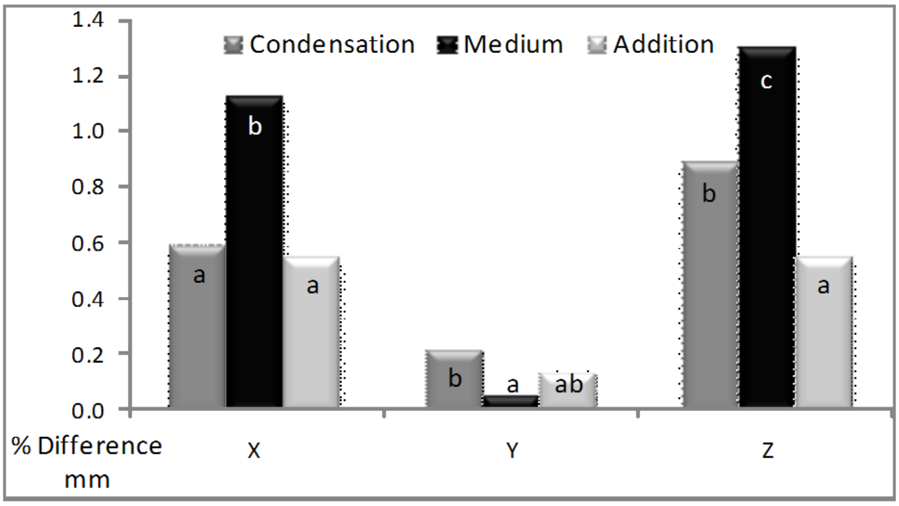

Figure (9): Mean difference of stone casts produced by three impression materials measured by optical microscope (single implant)

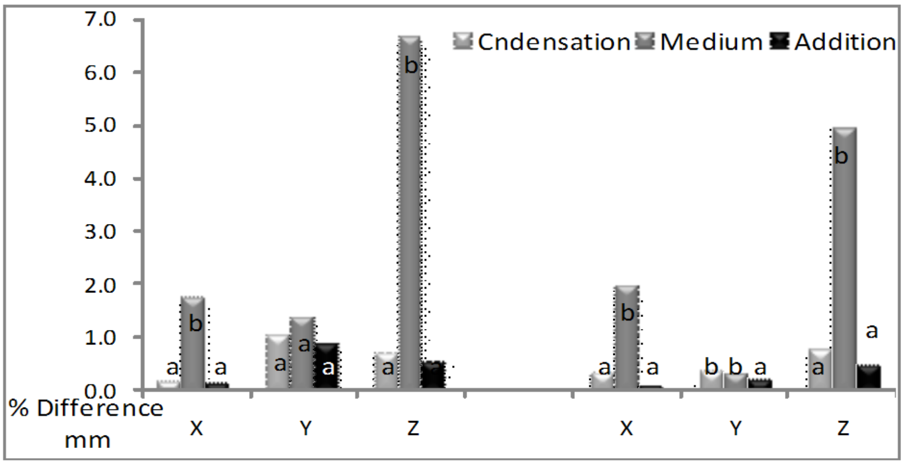

Figure (10): Mean difference of stone casts produced by three impression materials measured by digital caliber (double implants)

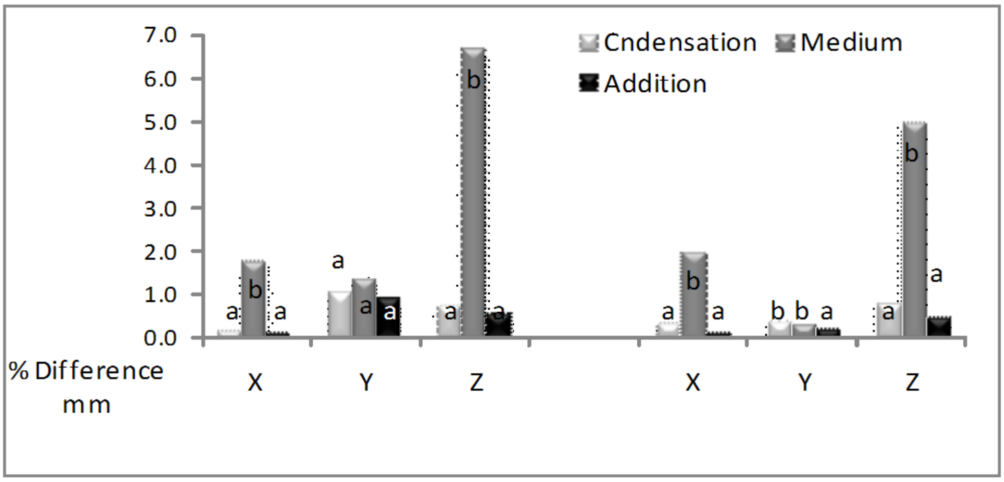

Figure (11): Mean difference of stone casts produced by three impression materials measured by optical microscope (double implants)

Paired t–test was used to compare between the accuracy of measurements obtained from digital caliber and optical microscope methods as shown in Table (9). This table showed that there was a significant difference between these two methods of measurements in (Z) axis for both single, and double implants case, where as there was no significant difference in the other axes.

DISCUSSION

Three–dimensional measurements (X, Y and Z) of stone cast produced from direct (open tray) two steps technique was the most accurate technique for transferring implant position to the laboratory cast as shown in Figure (4–7). This can be explained in that the transfer coping in this technique is still inside the impression materials during its separation from master model, and when connecting the implant analog to the implant fixture. By this way the distortion in the impression materials at the site of transfer coping was avoided, unlike the indirect (close tray) impression technique, in which the transfer coping was separated from the impression material during the separation of impression from the master model and reseated again after connecting it to the implant analog to its place inside the impression material. By this way distortion of the impression material at the site of transfer coping during removal, and reseat again cannot be avoided, and this will affect the accuracy of transferring the implant position especially in (Z) axis.

Table (9): Comparison between digital caliber and optical Microscope measurements

Descriptions		**Digital Vernier**	**Microscope**	***P*–value**
Double implant	Mesial –X	0.49 ± 0.67	0.44 ± 0.57	Not significant
	Distal –X	0.58 ± 0.82	0.53 ± 0.78	Not significant
	Mesial –Y	1.06 ± 0.68	0.74 ± 0.57	Significant
	Distal –Y	0.30 ± 0.21	0.30 ± 0.28	Not significant
	Mesial –Z	1.84 ± 2.57	2.38 ± 2.75	High significant
	Distal –Z	1.49 ± 1.85	2.31 ± 1.77	Very high significant
Single implant	X	0.68 ± 0.53	0.68 ± 0.53	Not significant
	Y	0.16 ± 0.14	0.16 ± 0.14	Not significant
	Z	1.68 ± 2.89	0.83 ± 0.50	Significant

This result is in agreement with many authors [5–7, 17, 18] and it is in disagreement with the results of Burawi *et al*.,[1] who said that the indirect impression technique was more accurate than the direct impression technique. This disagreement may be due to that of using implant system, which differs from that used in this study which exhibited difficulty in connecting the implant fixture to the transfer coping without rotation of the transfer coping in its place inside the impression material, unlike the implant system used in this study (Frialit–2) which provides this advantage.

For the one step, and two steps techniques, from the results shown in Tables (1–4), the two steps technique was the most accurate one, this result can be explained as that the putty type impression material is more stiff, and rough than the light body impression material, difference in viscosity, and flow of these materials. One step technique, a hydraulic pressure was generated while the putty impression material has set resulted in washing of the most light body impression material from the target region. Also the contraction of the putty like impression material during recovery stage would affect the accuracy of the impression.[19]

Two steps technique showed an inbuilt contraction of the impression space (due to the expansion of the putty), followed by a slow expansion (due mainly to the contraction of the wash). These results were in agreement with Ray[19] and disagreement with others [20,21] they found no difference in accuracy between one and two steps techniques. The dimensional changes of the three brands of silicone impression materials showed significant difference especially between addition curing medium body type, and the other two types (p<0.001) as found in Tables (7 and 8). Addition curing heavy, and light body impression materials produces the most accurate stone casts. This result can be explained due to its superior properties over the condensation curing silicone which produces molecule of water and ethanol per chain link, respectively, while the other materials are addition curing, so the dimensional changes and permanent deformation were improved over the condensation curing silicone.[20,22,23] While medium body addition curing silicone impression material (Perfexil) showed highly significant difference (7.57$\pm$0.22) from the other two impression materials used. This could be due to its high viscosity, since it is a mono phase impression material, and can be used with a one step impression technique only.

From the results of this study shown in Tables (5–8), there was no significant difference of the dimensional accuracy between the single and double implants cases.[24,25]

There was no significant difference in the measurements of the digital caliber and optical microscope in the two axes (X and Y) (p>0.05), while in the (Z) axis the table showed significant difference between them for both single and multiple implants case (p<0.001). This result was in agreement with many authors.[5–7, 17, 18]

CONCLUSIONS

The direct (open tray) impression technique is the most accurate for the transformation of the implant position to the laboratory cast. The two steps impression technique provides positive advantages to the cast accuracy than the one step especially with addition curing silicone impression material. The numbers of dental implants have no significant effect on the accuracy of stone cast.

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