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EVALUATION OF THE ACCURACY OF ABUTMENT LEVEL IMPRESSION IN "ALL ON FOUR" IMPLANT CASES

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ABSTRACT

Objectives: A lack of parallelism among the implants, and that between the implants and the teeth is a common finding in clinical situations. The aim of the following study was to evaluate the accuracy of abutment level impression in "All On Four" cases.

Materials and methods: Five completely edentulous patients restored with "All On Four" distribution of implants in the lower arch were recruited in this study. Prior to restoration two impressions were made for each case. The first impression utilized a specific abutment level impression (recommended by the manufacturer) and poured into a stone cast; trans-mucosal abutments were then screwed onto the implant analogues. The second impression was in a form of a simple impression of the trans-mucosal abutments, and poured into a stone cast. This group was considered as the control group. Both casts were photographed and using the Digimizer® Software V. 4.3.1 linear measurements and surface areas were measured on the casts and compared.

Results: Using independent t-test, there was a significant difference between the linear measurements and surface areas measured on the casts produced by both impression techniques, where (P-value < 0.05).

Conclusion: In angulated implant cases (All On Four), the position of abutments on a cast produced by the abutment level impressions used showed statistically significant difference from the original abutments' position in the patients' mouth.

INTRODUCTION

In the quest of maintaining osseointegration around dental implants, researchers have concluded that a limited movement of 10 microns at the bone-implant interface is necessary; they argue that dental implants are not like natural teeth which are cushioned in their alveoli by periodontal fibers. [1]

A passively fitting prosthesis is a precondition for the maintenance of osseointegration, hence a misfit of superstructures generates initial stress and strain on implants; mechanical complications such as fracture of the prosthetic framework or veneering

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material and fracture or loosening of occlusal and/or abutment screws may be seen with functional loading.[2]

It is mandatory to understand that reproduction of the intra-oral relationship of implants through impression procedures is the first step in achieving an accurate and passive fit prosthesis. [3]

In 2008 an in vitro study done by Karl.M. et al demonstrated that a misfit of 3-5 unit prostheses, whether cement or screw-retained, may lead to strains ranging between 26 and 637.6 (micron/mm) at the level of the implant collar. They stated that "Owing to the fact that the minimum prosthesis-to-implant misfit is clinically acceptable and obscure, fastidious and accurate implant prosthodontic procedures such as accurate impression making are advised and necessary to achieve maximum fit."

In other words the precise 3-dimensional transfer of implant or abutment positions from the mouth to working casts, along with attention to obtaining "optimum" fit between the implant and the superstructure during fabrication, is our goal. [1-4]

The cause of fixed implant supported framework misfit is usually multifactorial. Distortions may occur in the x-, y-, and z-dimensions and may be introduced by one or more of the following factors: implant alignments, impression techniques and materials used, and framework design and fabrication.[3,5-9]

Furthermore, problems related to, casting, investing, alloy properties, and clinical/technical expertise should not be forgotten. [5,10-12]

As in conventional prosthesis, abutments can be transfered individually or together, with different materials and techniques: indirect or closed tray technique, direct or open tray technique and direct-splinted technique.

There may be clinical situations in which the use of the closed tray technique is indicated, such as when there is limited inter-arch space, difficult access to posterior implants and angulated implants. [13,14]

The open tray technique allows the coping to remain in the impression. This reduces the effect of implant angulations, decreases deformation of the impression material upon recovery from the mouth, and eliminates the concern for replacing the coping back into its respective space in the impression. However, there are some of disadvantages to this technique, where there are several parts that must be controlled when tightening is being performed, some rotational movement of the impression coping is present when securing the implant analog, and the blind attachment of the implant analog to the impression coping.

Branemark *et al*. emphasized the importance of using impression copings that are splinted with dental floss scaffolding covered with auto-polymerizing acrylic resin for transfer impression. Nowadays, this same technique has been employed by others with minor modifications and has proven to be a secure impression procedure.[15&16]

In another prospective, impressions can be made at the abutment level or at the implant level using 2 methods of direct (open tray or pickup) and indirect (closed tray or reposition) techniques. [17] The implant level technique can provide multiple benefits, including facilitation of temporary restoration provision, easier abutment selection in the laboratory, [18] and availability of a variety of abutment types. Although several studies have reported the accuracy of the implant level impression technique, [11, 12,19-21] no concurrence is found in the literature regarding the most accurate impression technique. Little is known about the effect of imprecise impressions on the marginal discrepancy of implant supported prosthesis.

Although many published studies have examined the effects of various factors on the accuracy of implant impressions at the implant level.[22-28] Scarce

data on implant impression accuracy at the abutment level are available, especially for complete-arch impressions. [29-32]

When observing impression techniques related to angulated implants it was evident that, according to many in vitro studies implant angulations significantly affect the accuracy of traditional implant impression procedures with elastomeric impression materials. [33- 37]

The logical reason was that since the implants are angulated the path of impression removal is hindered resulting in disfigured impressions.

In a recent study Al- Abdullah. K et al showed that definitive casts fabricated with Encode abutment impressions and Robocast technology were less accurate than those created through the traditional splinted pickup impression technique with models incorporating internal-connection implants that diverged by 10 or 30 degrees. [38]

More studies will be needed to develop suitable impression and accurate definitive cast fabrication techniques with angulated implants.

In this study an attempt was made to shed light on the accuracy of an abutment level impression in mandibular "All On Four" cases, where the distal implants are angulated.

MATERIALS AND METHODS

Five completely edentulous patients were selected for the study, each was provided with four self tapping implants *(Osteoseal, screw implants, San Diego, USA)* in the mandibular arch they were placed using computer guided stents at the laterals and second premolars, where at the premolars they were angulated at $25^{0,}$ to follow the "All On Four" implant distribution.

After 3 months the implants were uncovered and healing abutments placed. After complete tissue healing straight trans-mucosal abutments *(Osteoseal, San Diego, USA)* were screwed onto the implants in the laterals, and angulated trans- mucosal abutments designed for "All On Four" prosthetic restoration were screwed on the angulated premolar implants. (Fig. 1)

Two impressions were taken for each patient using the same special tray and impression material, polyvinyl siloxane- (PVS), *(Imprint, 3M ESPE, USA):*

Control impression: In this impression no transfer copings or analogues were used, a simple direct impression of the trans-mucosal abutments using a special tray and PVS impression material. This impression was made to produce a stone cast for a control group. (Fig 2&3)

Abutment level impression: Impression copings were screwed on the trans-mucosal abutments followed by plastic pickup caps. The impression was taken using a special tray and PVS impression material. Once the impression material set the impression was removed and the plastic pickup caps were picked up inside the impression.(Fig 4,5&6) The impression copings and trans mucosal abutments were unscrewed from the patients' mouth and attached to implant analogues and then replaced into the plastic pickup caps inside the impression. (Fig 7)

Both impressions were poured by type IV dental stone using a vacuum mixer and vibrator. Both impressions were poured at the same time, room temperature and humidity. (Fig 3&8)

The casts were then trimmed and grouped into two groups; control group with 5 control casts obtained from the direct abutment impressions, and abutment level group with 5 casts obtained from the abutment level impressions.

All casts were photographed using the same digital camera at the same angulation and distance from the casts.

Fig. (1) All on Four implant configuration with transmucosal abutments.

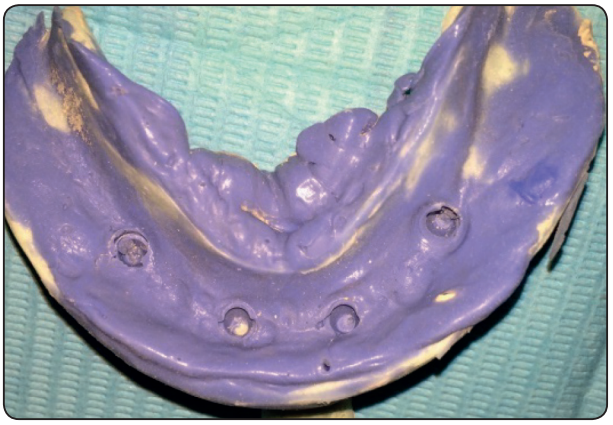

Fig. (2) Direct abutment impression of transmucosal abutments.

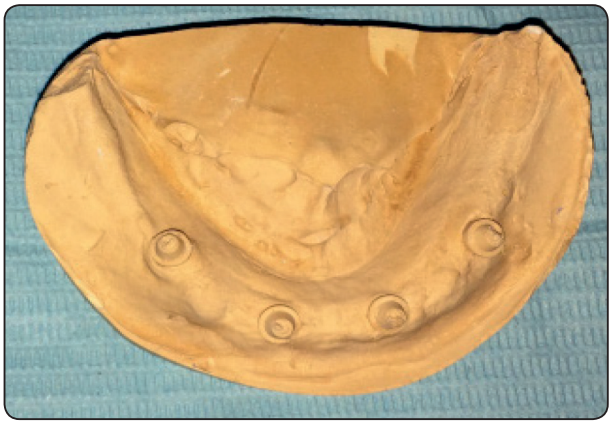

Fig. (3) Control group stone cast.

Fig. (4) From bottom to top, angulated trans-mucosal abutment, impression coping and plastic pick up cap.

Fig. (5) Impression pickup plastic caps intraorally on impression cones.

Fig. (6) Pickup plastic caps picked up inside the impression.

Fig. (7) Implant analogues in place.

Fig. (8) The abutment level impression group stone cast with assembled trans mucosal abutments.

RESULTS

This study was classified as case-control study and was performed to evaluate the accuracy of different implant impression techniques (Casts produced by direct impression of the trans-mucosal abutments as a control group and those produced by abutment level impression were considered as study group).

Linear measurements were obtained from each cast poured from each impression, as showed in figure (9) and (10). Surface area measurements were also calculated for both groups.

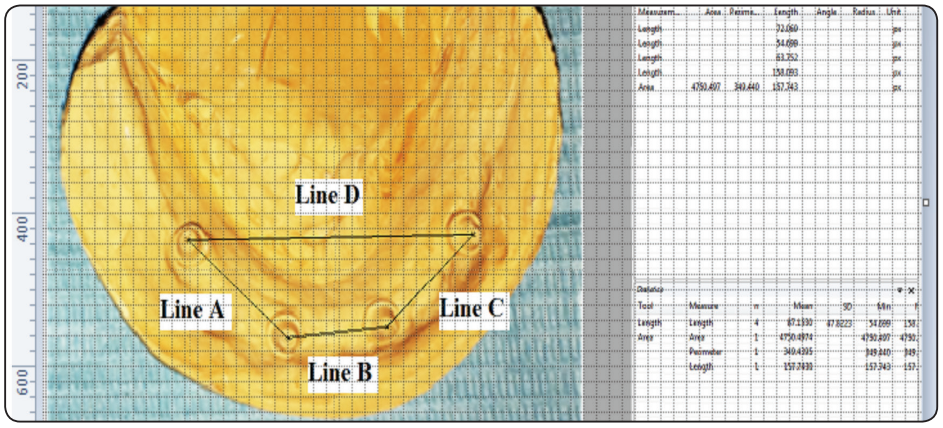

Fig. (9) Poured Cast of direct impression (Control group).

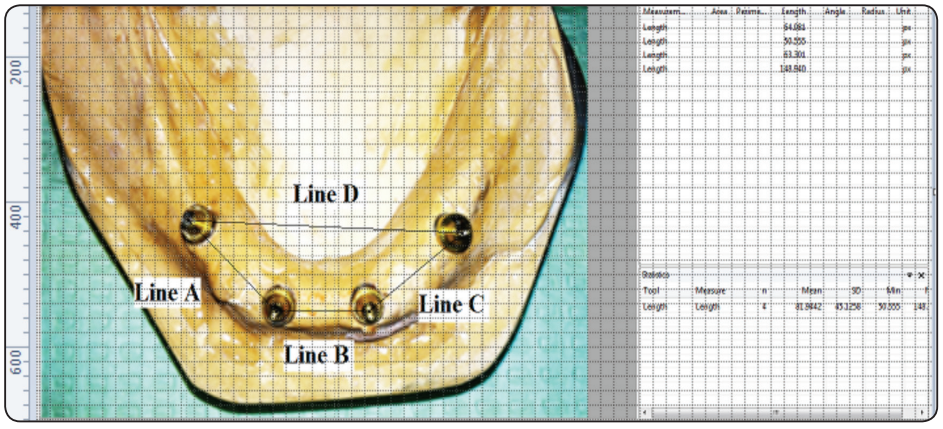

Fig. (10) Poured Cast of abutment level impression.

Using Digimizer® Software V. 4.3.1, the length of the lines and the surface area between those lines were calculated in pixels, where each pixel which are equivalent to 0.8mm, as shown in figures (9) and (10).

Linear Measurements

Table (1) demonstrated a descriptive study of the measurements between the different impressions plotted as means and standard deviations.

Table (1) and figure (11) demonstrated using independent t-test as there was a significant difference between the measurements of both impression techniques, as (P-value < 0.05).

TABLE (1): Descriptive and comparative study of the measurements between different impression techniques:

	Control Group		Study Group		Diff	P-value
	M	SD	M	SD		
Line A	72.069	0.042	64.981	0.053	7.088	0.00**
Line B	54.699	0.075	50.555	0.098	4.144	0.00**
Line C	63.752	0.114	63.301	0.031	0.451	0.00**
Line D	158.09	0.094	148.94	0.085	9.15	0.00**

M; Mean, SD; Standard deviation, Diff; Difference, P; Probability Level **significant difference

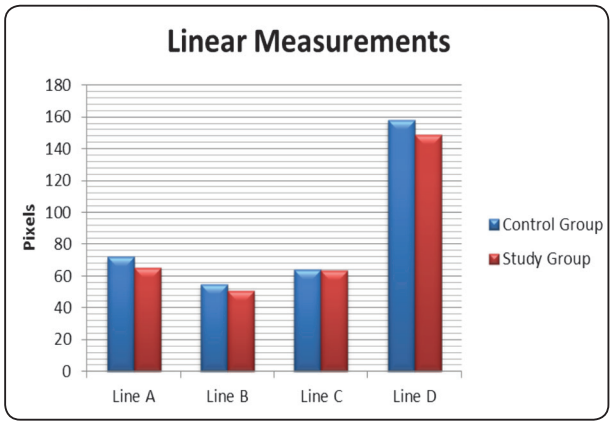

Fig. (11): Comparative study of the linear measurements between different impression techniques.

Surface Area Measurements

Table (2) demonstrated a descriptive study of the measurements between the different impressions plotted as means and standard deviations.

Table (2) and figure (12) demonstrated using independent t-test as there was a significant difference between the measurements of both impression techniques, as (P-value < 0.05).

TABLE (2): Descriptive and comparative study of the surface area measurements between different impression techniques:

Surface Area Measurement		M	SD	Diff	P-value
Groups	**Control Group**	4750.497	0.644	627.04	0.00**
	Study Group	4123.461	0.729		

M; Mean, SD; Standard deviation, Diff; Difference, P; Probability Level **significant difference

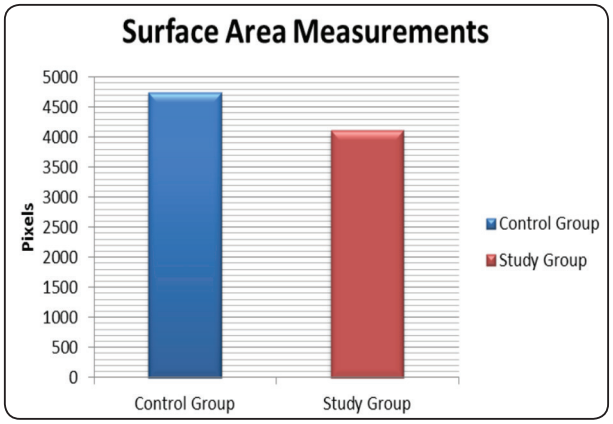

Fig. (12): Comparative study of the surface area measurements between different impression techniques

DISCUSSION

In light of various options available for impression making, an understanding of which method offers the most precise result is needed. A variety of factors have an influence on the precision of each impression technique, including flawless manipulation of impression materials, the materials

used for impression making, the materials used for pouring dental stone, and appropriate timing of cast fabrications. [39]

In the current study it was evident that the abutment level impression showed a significant statistical variation from the original abutment positions in the patients' mouth. This is attributed to the lack of parallelism between the implants which leads to undesirable path of impression withdrawal which is considered as a cause of impression distortion.

Whereas most of the previous *in vitro* investigations have evaluated the impression accuracy under the ideal condition with parallel implants, fewer studies have assessed the influence of nonparallel implants especially with four or more implants.

Moreover, previous studies failed to arrive at a clear consensus over impression materials and angulations. Some studies showed that when two or three implants are required, angulation of the implant has no adverse effect on the accuracy of impression. Assuncao *et al*. [40] reported better results for the parallel situations compared to the 10,15 and 25° angulations. [41]

CONCLUSION

In angulated implant cases (All On Four), the position of abutments on a cast produced by the abutment level impression used showed statistically significant difference from the original abutments' position in the patients' mouth. However whether such discrepancy will affect passive fit of the restoration or not is another question that requires further research.

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