

THE EFFECT OF TWO DIFFERENT IMPRESSION TECHNIQUES ON THE PASSIVITY OF FIT OF IMPLANT SUPPORTED PROSTHESIS PLACED IN COMPLETELY EDENTULOUS MAXILLAE

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ABSTRACT

Background: The target of this clinical study was to compare and analyze two different open tray impression techniques on the passivity of fit of implant supported prosthesis placed in completely edentulous maxillae

Materials and Methods: In this clinical study, patients were divided into two equal groups: Group I, Open tray impression technique was performed where non-splinting of the Temporary titanium abutments was performed while in Group II, Open tray impression technique was performed where splinting of the Temporary titanium abutments with DuraLay acrylic resin was done. The results of this paper involved checking each abutment's passivity of fit in the framework. The Presence of any lack of Passivity was denoted the number 1 while passively fit abutments were denoted the number 0. Results for both Groups I and II were then tabulated, calculated and statistically analysed.

Results: The results of this study revealed that the total number of non-passive abutments for group I were (8) abutments, while for group II only (1) abutment showed lack of passivity. Using Chi square test for detection of significance between both groups regarding passivity count, results revealed that there was a statistically significant difference between both groups (P-value < 0.05)

Conclusion: Within the limitations of this study, it can be concluded that splinting of the transfer abutments with acrylic resin renders a more accurate reproduction of the impression details hence contributing to more passive implant supported superstructure frameworks.

KEYWORDS: Passive Fit, Passivity, impression techniques, open tray, splinted transfer

INTRODUCTION

To restore the patient's normal facial contour, comfort, esthetics, speech, function and health is one of the primary goals of modern implant dentistry.

^[1] Passive fit (synonymous with "perfect fit") is

considered to be one of the most important criteria for the preservation of a healthy bone to implant contact. To create a strain-free superstructure, Taylor et al. ^[2] concluded that a framework should, ideally speaking, produce utter zero strain on the

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supporting implant and surrounding bone structures in the absence of any functional loading. However, it has been reported that an absolute passive fit is impossible to attain. One study reported that great loads were transmitted from the implant abutments and fixation screws, causing loosening or fracture, if the peripheral gaps between the framework and abutments were beyond a certain level^[3]. Bio-mechanical complications such as screw loosening, abutment and/or implant fracture, bone loss, soft tissue alterations and even loss of osseointegration can be the result of an ill fitting superstructure.^[4-6]

However, A finite element analysis study revealed a certain level of misfit seems to be tolerated by the bone hence supporting the hypothesis that there is no strong correlation between framework misfit and stress in implant/bone^[7]. Detection of marginal gaps can be performed using an explorer, enhanced lighting and magnification as well as the presence of pain or tension as indicated by the patient^[8]. Hellden and Derand^[9] advised that the detection of any gap is an indication that sectioning and soldering (or welding) is required.

Various procedures have been developed to minimize prosthetic misfit which may have resulted from the numerous technical steps and the distortion of the materials used^[10-12]. These include; different post casting techniques such as soldering and electronic discharge machining as reported by Guichet et al., Romero et al. and Jemt and Lekholm^[13-15]. Management of impressions as described by Vigolo et al.^[16], verification indices and casts by Schneider et al.^[17] and the introduction of the intra-oral luting phase as reported by Longoni et al, Aparicio and Longoni et al^[18-20]. Alternatively, very effective “high-tech” combined approaches have been proposed such as spark erosion technique by Renner and Contreras et al.^[21, 22].

Impression distortions and faults during dental laboratory processes significantly contribute to the appearance of misfits in implant prosthesis.

Numerous reasons behind the lack of precise implant impressions have been examined in the dental literature as the impression materials and techniques utilized, splinting of impression transfers as well as implant angulations and depth^[23-25]. Certainly, a number of authors reported better accuracy when a closed tray technique was performed^[26,27], while others support open tray techniques with splinting of the impression transfer^[28, 29] or without the need to splint^[30]. Several studies show no differences between open tray versus closed tray technique^[31,32] as well as splinted versus un-splinted technique^[33, 34].

Polyethers (PE) and polyvinylsiloxanes (PVS) are both considered to be from the best impression materials for implant impression taking^[23, 35]. Many authors recommend the use of PE for edentulous maxilla and mandibles^[35]. When deciding on the material to produce the most accurate impressions of implants possible, Polyether was recommended for direct technique while Polyether and vinyl siloxanether VSE were recommended for indirect impression techniques^[36].

Other authors believe that the digital impression might offer a superior substitute to conventional impressions for the construction of passively fit full-arch implant-supported prostheses^[37]. Another study revealed that metal splinted impression coping produced more precise impressions than closed-tray snap-fit transfer and open-tray non-splinted impression coping techniques.^[38] Another study also agreed that the transfers splinted with acrylic resin open tray technique was the most accurate impression technique for multiple implants when comparing it with closed tray technique^[39].

MATERIALS AND METHODS

Fourteen patients were selected from the outpatient clinic of the Prosthodontics Department, Faculty of Oral and Dental Medicine, Cairo University. Patients were with Completely Edentulous Maxillae

showing normal maxillo-mandibular relationship (Class I Angle classification), with no para-functional habits and systemically free from any medical conditions.

For each patient, conventional complete dentures were constructed and then duplicated to obtain radio-opaque radiographic stents. The patients were radiographed using Cone Beam Computed Tomographic (CBCT) scanning machine (Sanora 3D Soredex, Helsinki, Finland) to obtain DICOM files whereby coronal and sagittal reformatting and panoramic views were obtained. The preferred implant locations were recognised through the radiolucent canals formerly drilled at the prosthetic teeth centers within the radiographic stent. Bone height, width and density were evaluated at the six prospective locations which were; the lateral incisor/Canine region, first premolar and first molar for being satisfactory. The 3D virtual stent were generated as STL (Sterolithographic) files to be sent for 3D printing (Invision Si2, USA) to build the final computer guided stent from a photo curable resin material.

Implant Installation

Before starting the surgical procedure, the perioral region and surgical stent of the patient were adequately disinfected and the surgical instruments were sterilized. The stent was fixed in place using three fixation screws and osteotomies were then prepared using the classical drilling sequence (pilot, intermediate and final drills) with copious amount of sterile saline irrigation. The implants were then inserted into the osteotomies till manual tightening met resistance and then further fastening was finalized with a ratchet. 30 Ncm was the optimal primary stability to be achieved using a Torque wrench and then the stent was removed. The patient's maxillary denture was relieved opposing each Implant site and each patient was allowed to wear his denture for 4 months until satisfactory osseointegration was obtained.

Impression Taking

After 4 months, the patients were recalled and the Implants were checked for adequate osseointegration using "Osstell" ISQ device (Osstell AB, Gamlestadvägen 3B, SE415 02, Sweden.).

Patients were divided into two equal groups: In Group I: Open tray impression technique was performed where non-splinting of the Temporary titanium abutments or transfer copings was performed. The Temporary Titanium Abutments were screwed over each implant and a conventional open tray impression technique was performed with medium body polyether rubber base impression material (Impregum, 3M ESPE, AG Dental Products D-82229 Seefeld, Germany). In this study, the radiographic stents were modified by opening a window at areas of the implants and used as a special tray. As in Group II: Open tray impression technique was performed where splinting of the Temporary titanium abutments was performed. Temporary Titanium abutments were screwed over the implants in the patients mouth and then connected together with dental floss (scaffold material) and then splinted together using DuraLay resin material to produce a splinted jig. In this study, the radiographic stents were modified by opening a window at areas of the implants and used as a special tray. An open tray impression technique was then performed and again the implant analogues were screwed over the temporary titanium abutments.

The impressions for both groups were then poured using a Double- Pour technique with extra-hard stone (Super-Col Type IV, COE, Laboratories, Inc. Chicago, IL) to obtain The Master casts. Multiple scores were made on the facial aspect of the model to produce a putty index on the facial and occlusal aspects of the scan appliance.

Temporary Titanium abutments were then screwed over the implant analogues within the master cast, connected with dental floss (scaffold material) and then splinted together using DuraLay

resin material (DuraLay™, Reliance, Dental MFG Co. Worth, IL, USA) to produce a verification index. The verification index was then tried in the patient's mouth and screwed over the implants. The frameworks of both groups were checked individually for fit and passivity using the following three techniques:

The Single screw test ^[10] also known as the Sheffield test ^[40]: involved screwing the framework from the most distal abutment and check for possible lifting of the framework on the other side of the framework which if present, indicated lack of passivity of this framework. In case the framework remained stable in place, the middle screw was then placed, and so forth of the rest of the screws. After placing screws one by one, a final 180 degree turn is performed to reach a torque of 10 Ncm for complete screw seating. If more than a half turn (180 degrees) was needed to provide seating of the screw, the framework was considered misfit ^[10].

1. Probe and Lighting: the presence of any gap as detected by a probe and appropriate lighting indicated that sectioning with a disc, re-connecting with Duralay resin and soldering was performed.
2. Peri-Apical x-rays: were also performed to check the complete seating of the frameworks.

The results of this paper involved checking each abutment passive fit in the framework. The Presence of any lack of Passivity by any of three above mentioned methods was denoted the number 1 while passively fit abutments were denoted the number 0. Results for both Groups I and II were then tabulated, calculated and statistically analysed. After these data were collected, areas which were detected with lack of passivity were sectioned then re-connected intraorally again using Duralay. After complete set of the Duralay, passive fit was then checked finally using the above three mentioned techniques. In the sectioned cases, new open tray

impressions were finally produced and poured to obtain the final master casts over which the metal frameworks were to be constructed.

Framework Construction & Final Prostheses Delivery

Plastic castable abutments (Plastic burnouts⁴, ImplantDirect™ LLC Spectra-System Dental Implants Calabasas Hills CA, USA) were fastened to the analogues and connected with Duralay resin to form a rigid frame. The Final waxed up pattern was then invested and cast into chrome cobalt alloy. The frameworks were checked individually for fit and passivity using the above mentioned techniques on both the master casts and patients' mouths. The recognition of any gap is a sign that splitting with a disc and re-attaching with Duralay resin and soldering (or welding) is required.

Bite registration and acrylic teeth were set following the IPO guidelines in reference with Misch ^[11]. Visio-lign Veneering (Visio-lign, Bredent GmbH & Co.KG, WeissenhornerSenden, Germany) light cured system was used to construct the gingiva using a free-hand technique. The final screw-retained implant supported prostheses were then delivered intra-orally and final occlusal alterations were performed. The prosthetic screws were tightened at 30Ncm with a torque wrench.

Statistical analysis and methods

Data analysis was performed using Statistical Analysis Systems SPSS software (version 20: SPSS Inc). Probability values ≤ 0.05 to indicate significant relationships between variables. Qualitative data were explored for normality by checking the data distribution and using Shapiro-Wilk tests Passivity and non-passivity data showed normal distribution. Data were presented as numbers. Chi Square test was used to compare the non-passive abutments count between group I and II.

RESULTS

In this study, a total of six implants were installed in two groups of seven patients to demonstrate the effect of non-splinting of the temporary titanium abutments; Group I and splinting of the temporary titanium abutments with Duralay acrylic resin; Group II on the accuracy of open tray impression techniques. The temporary titanium abutments/implants were nominated from 1 to 6 starting from the right hand side of each patient to their left hand side. The accuracy of the impression was indicated by examining the passivity of abutments within a verification jig constructed especially for this purpose. The results of this paper involved checking each abutment passive fit using a precise protocol mentioned in details in the previous section. The Presence of any lack of Passive abutments by any of three above mentioned methods were denoted

the number 1 while passively fit abutments were denoted the number 0. Results for both Groups I and II were then tabulated, calculated and statistically analysed. Further statistical analysis was then performed in Group I to evaluate the passivity in relation to the location of each abutment.

As listed in Table 1 and shown in figure 1, the number of non-passive abutments for group I were (8) abutments, while for group II only (1) abutment showed lack of passivity. Consequently, The total number of sectioning sites in Group I were 10 in comparison with only 2 sectioning sites in group II. Using Chi square test for detection of significance between both groups regarding passivity count, it revealed that there was a statistically significant difference between both groups as P-value < 0.05 as shown in table 1 and figure 1.

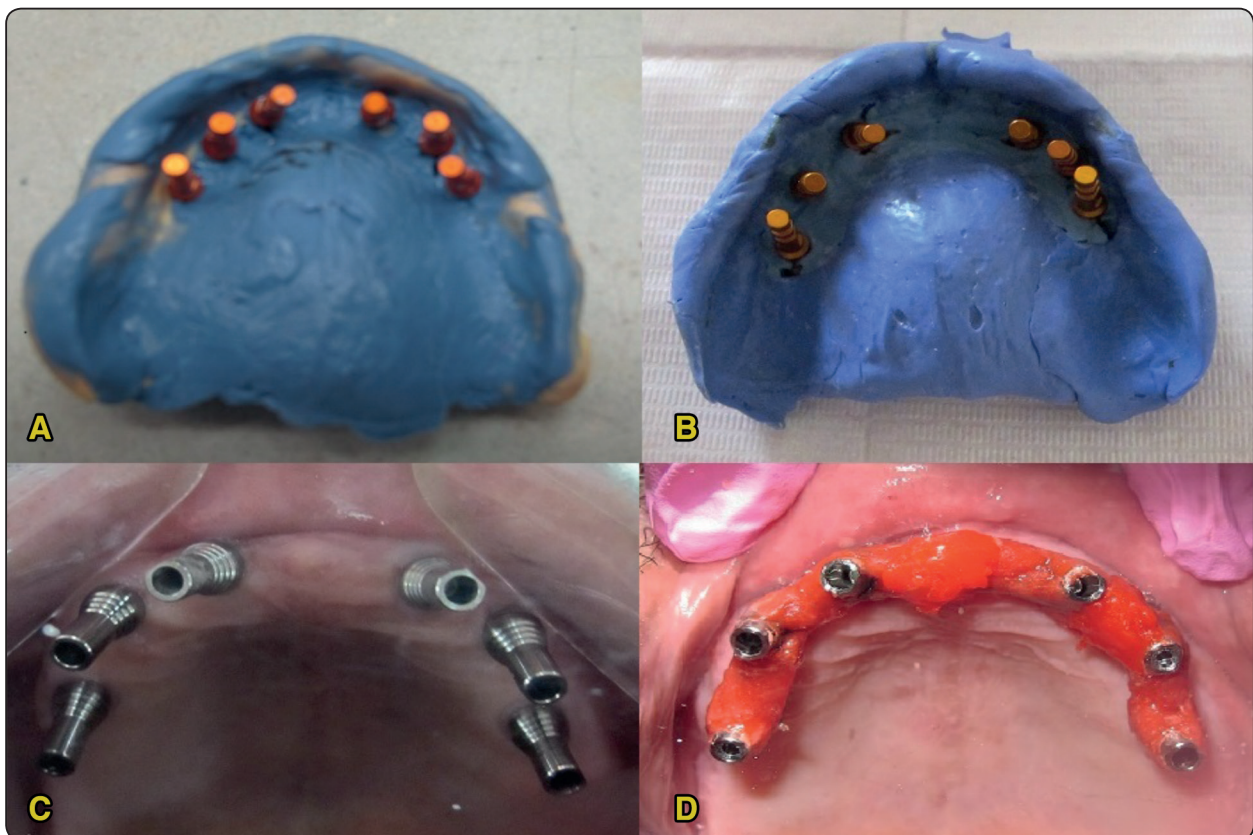


Fig. (1) A: Final Impression for Group I. B: Titanium Transfer Copings Unsplinted in Group I. C: Final Impression for Group II. D: Titanium Transfer Copings splinted with Duralay Acrylic resin Group II



Fig. (2) Non-Passive verification jig sectioned

TABLE (1): Chi Square test between group I and group II:

Groups	Passivity Absence	Passivity Presence	P-Value	No. of Sectioning Sites
Group I	8	34	0.013**	10
Group II	1	41		2

P: Probability Level

**** Significant Difference**

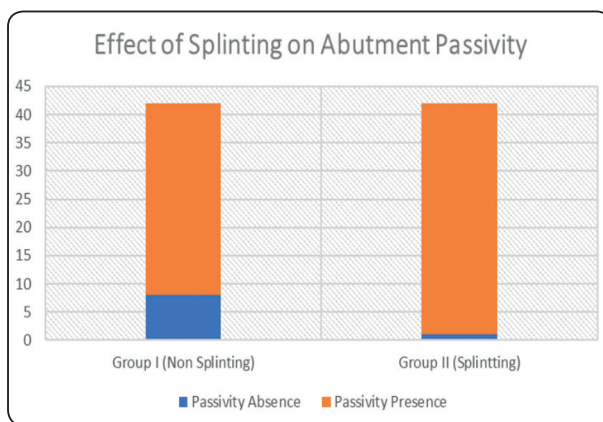


Fig. (3): Bar Chart revealing Passivity Count of Group I and Group II

Regarding group I (the non-splinted abutments), Chi Square test was performed to detect the significance between different abutments positions among the studied cases. The study revealed that there was a statistically significant difference

between all implants within group I as P-value ≤ 0.05 , as shown in table 2 and figure 2. Multiple comparisons revealed insignificant difference between abutments (1), (5) and (6). Additionally, analysis revealed statistically insignificant difference between abutments (2) and (3).

TABLE (2): Chi Square test between different abutment/implant positions among group I.

Group I (Non-Splinting)	No. of Non Passive Abutments	P-value
Implant (1)	2 ^a	0.05**
Implant (2)	1 ^b	
Implant (3)	1 ^b	
Implant (4)	0 ^c	
Implant (5)	2 ^a	
Implant (6)	2 ^a	

M; Mean, SD; Standard Deviation, P; Probability Level

**** Significant difference**

Values with same superscript letter were insignificant different

Values with different superscript letter were significant different

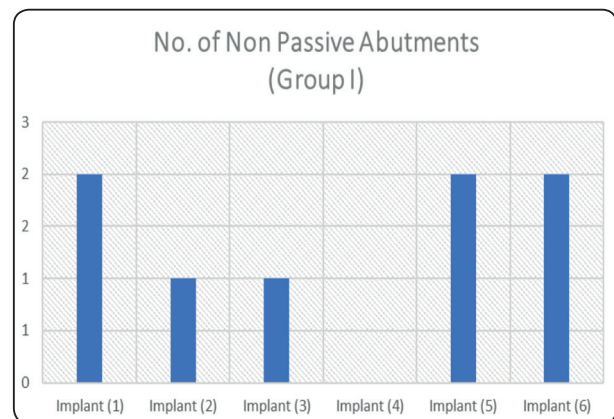


Fig. (4): Bar Chart revealing Passivity Count of Different Implants within Group I

DISCUSSION

In this work, two different types of open tray impression techniques were chosen to be analysed and studied. The first technique was studied in Group I where Open tray impression technique was performed leaving the Temporary titanium abutments or transfer copings without being splinted together. The Temporary Titanium Abutments were screwed over each implant and a conventional open tray impression technique was performed using medium body polyether rubber base impression material. This Technique was recommended by Burawi et al.[30] who concluded that un-splinting of the transfer copings still rendered satisfactory final replica of the oral situation.

The second technique involved the study of Open tray impression technique where splinting of the Temporary titanium abutments or transfer copings with Duralay acrylic resin was performed prior to impression taking. Temporary Titanium abutments were screwed over the implants in the patients mouth and then connected together with dental floss (scaffold material) and then splinted together using DuraLay resin material to produce a splinted jig. Other Authors such as Naconecy et al. [28] and Vigolo et al. [30] recommended splinting of the transfer coping prior to open tray impression taking as this helped improve the final passivity of implant supported superstructures.

The Final Impression material utilized for both groups of the current study was medium body polyether rubber base impression material (Impregum, 3M ESPE, AG Dental Products D-82229 Seefeld, Germany). Many studies (23, 35, 36) recommended the use of Polyether impression material as it rendered accurate details of the oral situation and offered highly dimensionally stable final impressions.

The frameworks for all groups were checked individually for fit and passivity using the single screw test following the technique recommended by

Sahin and Cehreli [12]. The method was performed by fastening the framework from the most distal abutment and check for potential lifting of the framework on the other side hence indicating absence of passivity of this framework.

Results of this study revealed that the number of non-passive abutments for group I were (8) abutments, while for group II only (1) abutment showed lack of passivity. Consequently, The total number of sectioning sites in Group I were 10 in comparison with only 2 sectioning sites in group II. This was in accordance with several studies (28, 29, 38, 39) that supported the idea of splinting the transfer copings prior to impression taking as this helped standardize and lock the spatial relationship of the transfer copings with each other and with their underlying implants; hence rendering a more secure relationship with each coping and its implant during the process of unscrewing the copings during open tray impression taking. This also added the advantage of eliminating any errors that might result from the process of impression taking. Thus, Lack of passivity in the final frameworks would probably be from the any subsequent step of framework construction as for example errors of the casting procedure.

On further analysis of the results obtained from group I which contained the more striking number of non-passive abutments, results revealed that there was a statistically significant difference between all implants within group I as P-value ≤ 0.05 , as shown in table 2 and figure 2. Multiple comparisons revealed insignificant difference between abutments (1,5,6). Additionally, analysis revealed statistically insignificant difference between abutments (2) and (3). Within the limitation of this study due to the small sample size, this study have highlighted the fact that there seems to be more lack of passivity in the most posterior and distal abutments. This might be due to the difficulty of accessibility of the access screw during the step of unscrewing of the

transfer coping during the process of impression retrieval hence exerting more distal force on these copings explaining the reason behind the more lack of passivity in the most posterior abutments.

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