Medical Communication

Biosci. Biotech. Res. Comm. 10(1): 109-113 (2017)

BBRC
Bioscience Biotechnology Research Communications

A comparative analysis of splinted and non-splint in open-tray impression techniques on different angled implants

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ABSTRACT

Due to the effect of various impression techniques on accuracy of final cast dimensions and controversies about the best techniques, this study was performed to compare the Splinted and non-splint in open-tray impression techniques on 15 and 25º angled implants. At first steel model in 8 cm diameter and 3 cm height were made with 4 holes to stabilize 4 implants. Two central implants had 12 cm interspace from each other and 17 mm from angled implants. Central implants were perpendicular and the other implants had the divergence of 15 and 25º. The implants and Teries were fabricated using acrylate and polymeric acryl. A total of 30 tery were fabricated (n= 15 in each group). In group A, Open tray with splinted impression copings and group B with splinted impression copings non-splinted. Then, Splinted and non-splint in open-tray impression techniques were evaluated. Each casts were measured by coordinated measuring machine device for implant position. The content of dimensional changes in transfer of implant positions was reported in for the four interspaces (A_1, A_2, A_3 and A_4). According to the results, changes in transfer of implant in A_1, A_2, A_3 and A_4 positions were 19.014±0.04, 15.763±0.01, 62.619±0.05 and 54.019±0.05mm, respectively in Splinted group. In the non-splinted group changes in transfer of implant positions were 18.896±0.05, 15.772±0.01, 62.664±0.02 and 54.063±0.02mm for A_1, A_2, A_3 and A_4 positions, respectively. According to the results, significant difference detected in in dimensional accuracy of the resultant casts made from Splinted and non-Splinted impression techniques ($P<0.05$). These results suggested splinted impression technique is recommended for angulated implants.

KEY WORDS: IMPRESSION TECHNIQUE, DIMENSIONAL CHANGES, IMPLANT

ARTICLE INFORMATION:

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Received 27th Nov, 2016
Accepted after revision 26th March, 2017
BBRC Print ISSN: 0974-6455
Online ISSN: 2321-4007 CODEN: USA BBRCBA
Thomson Reuters ISI ESC and Crossref Indexed Journal
NAAS Journal Score 2017: 4.31 Cosmos IF : 4.006

Online Contents Available at: http//www.bbrc.in/

INTRODUCTION

A variety of impression techniques for the fabrication of implant supported prosthesis have evolved in the past decade. Selection of a specific technique depends on the evaluation of a particular patient and the clinical situation present. In the fabrication of implants, the primary objective of impression making is to record and transfer the relationship between the non-yielding, osseointegrated fixture abutments and reproduce the relationship in the master cast (Nayar et al. 2014). Prosthesis misfit may lead to mechanical and biological problems in supporting implants. Mechanical complications that might arise from prosthesis misfit include screw loosening, abutment or implant screw fracture and occlusal inaccuracy (Ebadian et al. 2015).

The first step to ensure the passive fit of the implant-supported framework is accurate recording of the implants' positions and distances through the impression procedure (Conrad et al. 2007). There are many potential factors which influence the accuracy of implant-supported superstructures such as mandibular flexure, impression technique, impression material and fit tolerance between intra-oral abutments using the impression copings (Assuncao et al. 2004). Various techniques have been suggested to achieve an accurate master cast (Assuncao et al. 2004). Dental impression is used to produce a positive replica of the structure for use as a permanent record or in the production of a dental restoration or prosthesis (Alikhasi et al. 2013). Most of implant impression techniques, such as, pick-up, and transfer techniques and splint and non-splint techniques, have been introduced, in search of the most accurate technique. In certain clinical situation, some of the factor such as the angulations or depth of implants, may affect the accuracy of the implant impressions (Prakash and Chowdhary, 2016).

An inaccurate impression may result in prosthesis misfit, which may cause biological and mechanical complications. Various mechanical complications such as loosening of screw, fracture of screw or implant and occlusal inaccuracy may have been arisen from prosthesis misfit (Prithviraj et al. 2011). Along with the evolution of acrylic resin metal implant supported fixed complete denture for an edentulous jaw, the splint technique for an implant impression was introduced (Lee et al. 2011). It is reported the splint technique have greater accuracy as compared to the non-splint technique (Prakash and Chowdhary, 2016).

Some of problems faced with the splint technique are fracture of the connection between the splint material and the impression copings and distortion of the splint materials. The metal-splinted direct technique produced the most accurate casts, then the acrylic resin-splinted direct, indirect and unsplinted direct techniques (Papaspyridakos et al. 2011).Despite researches were done on accuracy of Splinted and non-splint in open-tray impression techniques, scarce information exist on accuracy of these techniques on angled implants. Due to the effect of various impression techniques on accuracy of final cast dimensions and controversies about the best techniques, this study was performed to compare the Splinted and non-splint in open-tray impression techniques on 15 and 25^o angled implants.

MATERIAL AND METHODS

At first steel model in 8 cm diameter and 3 cm height were made with 4 holes to stabilize 4 implants. Two central implants had 12 cm interspace from each other and 17 mm from angled implants. Central implants were perpendicular and the other implants had the divergence of 15 and 25^o. The implants and Teries were fabricated using acrylate and polymeric acryl. A total of 30 tery were fabricated (n= 15 in each group). In group A, Open tray with splinted impression copings and group B with splinted impression copings non-splinted. Polyether impression material (3m ESPE Impregum, USA) with 4 mm thickness was used to make the impression. In order to make the main casts, stone plaster type IV were used.

THE POSITIONING OF THE INTERSPACES

A_1: distance between anteroposterior analogous
A_2: distance between distal-lateral proximal left and right analogous
A_3: distance between mediolateral distal left and right analogous
A_4: distance between mediolateral distal left and right analogous

Then, Splinted and non-splint in open-tray impression techniques were evaluated. Each casts were measured by coordinated measuring machine (CMM) device for implant position. (Zeiss, Industrial Mess Technique, Oberkochen, Germany). The accuracy of CMM for the x, y and z axes was <0.0001 mm. The same operator used probe head and single probe in all measurements. Umess software (SW, Umess UNIX/ LINUX, Zeiss, Oberkochen, Germany) was used for geometric transformation and data collection. The content of dimensional changes in transfer of implant positions was reported in for the four interspaces (A_1, A_2, A_3 and A_4).

STATISTICAL ANALYSIS

The operator was blind about test groups. Multivariate two-way analysis of variance (ANOVA) was undertaken to determine whether significant differences existed

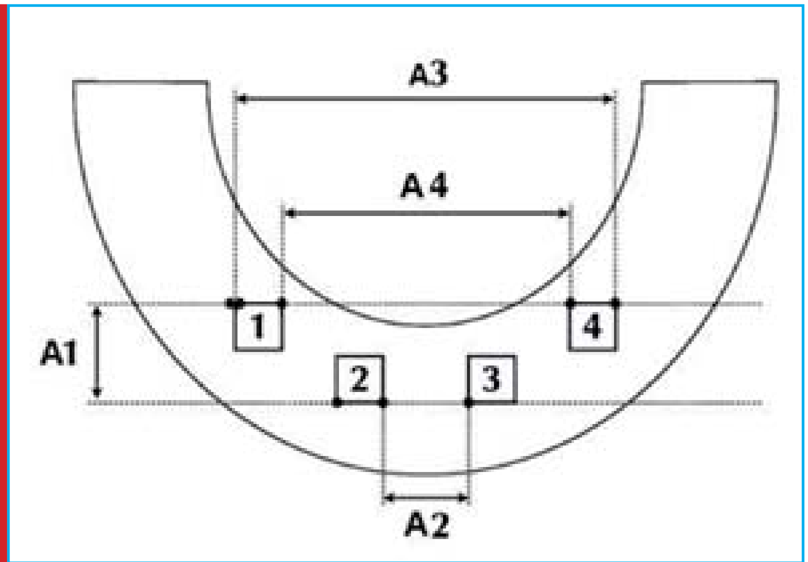

FIGURE 1. The positioning of the interspaces

between groups and one sample t-test was used to compare the test groups with master model ($P<0.05$).

RESULTS

According to the results (table 1), significant difference detected in interspace of perpendicular and angled implant during casting by Splinted (19.014±0.04) and non-Splinted (18.896±0.05) impression techniques in A_1 position (P=0.0001).

As seen in table 2, no significant difference detected on interspace of perpendicular implant during casting by Splinted (15.763±0.01) and non-Splinted (15.772±0.01) impression techniques in A_2 position (P=0.143).

Based on the results (table 3), interspace of 15 and 25° angled implant during casting by Splinted and non-Splinted impression techniques in A_3 position were 62.619±0.05 and 62.664±0.02, respectively (P=0.005).

A significant difference detected for interspace of 15 and 25° angled implant during casting by Splinted (54.019±0.05) and non-Splinted impression (54.063±0.02) techniques in A_4 position (P=0.005) (table 4).

The results (table 5) of the changes in interspace of perpendicular and angled implant using Splinted and non-Splinted impression techniques in A_1 position is presented in table 5. No significant difference detected using splinted (0.01 mm) impression technique in A_1 position (P=0.13) while significant change observed using non-Splinted (0.999 mm) impression (P=0.0001).

Table 1. interspace of perpendicular and angled implant during casting by Splinted and non-Splinted impression techniques in A1 position

	Mean ± SD (mm)	P. Value
splinted	19.014±0.04	0.0001
Non-splinted	18.896±0.05	

Table 2. interspace of perpendicular implant during casting by Splinted and non-Splinted impression techniques in A2 position

	Mean ± SD (mm)	P. Value
splinted	15.763±0.01	0.143
Non-splinted	15.772±0.01	

Table 3. interspace of 15 and 25° angled implant during casting by Splinted and non-Splinted impression techniques in A3 position

	Mean ± SD (mm)	P. Value
splinted	62.619±0.05	0.005
Non-splinted	62.664±0.02	

Table 4: interspace of 15 and 25° angled implant during casting by Splinted and non-Splinted impression techniques in A4 position

	Mean ± SD (mm)	P. Value
splinted	54.019±0.05	0.005
Non-splinted	54.063±0.02	

Table 5. the changes in interspace of perpendicular and angled implant using Splinted and non-Splinted impression techniques in A1 position

	Difference (mm)	P. Value
splinted	0.01	0.13
Non-splinted	0.999	0.0001

Table 6. the changes in interspace of perpendicular implant using Splinted and non-Splinted impression techniques in A2 position		
	Difference (mm)	**P. Value**
splinted	0.2	0.45
Non-splinted	0.3	0.45

Table 7. the changes in interspace of 15 and 25° angled implant using Splinted and non-Splinted impression techniques in A3 position		
	Difference (mm)	**P. Value**
splinted	0.02	0.45
Non-splinted	0.03	0.45

Table 8. the changes in interspace of 15 and 25° angled implant using Splinted and non-Splinted impression techniques in A4 position		
	Difference (mm)	**P. Value**
splinted	0.01	0.45
Non-splinted	0.054	0.0001

As seen in table 6, no significant difference detected on implant position using splinted (0.2 mm) and non-Splinted impression (0.3 mm) techniques in A_2 position (P=0.45).

Furthermore, no significant difference detected on changes in interspace of 15 and 25° angled implant using splinted (0.02 mm) and non-Splinted (0.03 mm) impression techniques in A_3 position

No significant differences detected on interspace changes of 15 and 25° angled implant using Splinted (0.01 mm) impression (P=0.45) while significant difference detected using non-Splinted impression (0.054 mm) (P=0.0001).

DISCUSSION

Based on the results, it seems, splinted impression technique is recommended for angulated implants. Many clinical studies emphasize the passive fit of implant-supported superstructures for the long-term success of treatment. The mean change in distances between analogues in samples in the anteroposterior direction was more than mediolateral direction compared with the original model (Lee et al. 2008). Some studies reported a higher accuracy for open impression technique than closed impression technique when impression was made from 4 or more implants (Papaspyridakos et al. 2012). Many studies have recommended splinting of implants to increase the accuracy of the impression, although the success of this technique is questionable (Lee et al. 2008). Splinting can be done with different materials such as autopolymerized acrylic resins, light-polymerized acrylic resins or dental stones (Holst et al. 2007). Splinting with acrylic resin may be difficult and time-consuming and distortion of this material may be a problem (Holst et al. 2007).

In a study, Balouch (2013) in a study, based on their report dimensional changes were 129 ± 37 and 143.5 ± 43.67μ in closed tray and open tray, while coefficient of variation in closed-tray and open tray were reported to be 27.2 and 30.4%, respectively. Closed impression technique had less dimensional changes in comparison with open tray method, so this study suggests that closed tray impression technique is more accurate (Balouch 2013).

Among the impression making methods presented in the literature, the splinted technique has gained popularity and has proven to be the most accurate (Assunção et al. 2008). The splinted direct techniques use square transfer copings, connected to each other with a rigid material, in a customized open impression tray. Although different materials have been tested to splint impression copings, such as composite resin, impression plaster, and stainless steel pins; acrylic resin, alone or in combination with dental floss, is the material used most often to prevent individual coping movements during the impression-making procedure (Del Acqua et al. 2010). Even though there was no consistent result for higher accuracy with any one technique as opposed to the other, splint or non-splint, more number of studies has reported increased accurate implant impressions with the splint technique than with the non-splint technique (Vigolo et al. 2005).

The accuracy of a splinted impression technique depends upon its resistance to deformation under the forces of impression material. Thus, theoretically, a technique that uses a more rigid splint material would produce a more accurate master cast. Therefore, the rigidity and dimensional stability of a metal framework in combination with impression plaster might make it a good choice for splinting the impression copings (Lee et al. 2008). The splinting technique using light cured acrylic resin was significantly less accurate than by using autopolymerizing resin or by impression plaster. This may be caused by the incomplete polymerization of the light cured acrylic resin; another reason may be that the shrinkage during polymerization of the light cured acrylic resin creates stresses at the impression coping acrylic resin interface (Assunção et al. 2008). Also, Daoudi et al. (2004) compared the closed tray technique at the implant level with the open tray technique at the abutment level for single tooth implants and found the open tray technique to be superior and more predictable. Furthermore, Carr (1992) compared the open and closed tray techniques with a 5 implant mandibular cast where the interabutment divergence angles were all less than 15 degrees. The open tray technique was found to be superior as it provided the most accurate working cast.

Some of the studies that advocated the splinting technique over the non-splinted technique have shown further that splinting with autopolymerized acrylic resin, sectioned post-setting, and rejoined, yielded the best results within the various splinting group combinations. However, this finding was not applicable to all studies that examined the effect (Rustum Baig, 2014). Splinted direct technique was found to be the most accurate for multi-unit situations with two highly unparallel (20- to 25-degree divergence) implants. This finding was, however, in disagreement with a few other studies that showed no correlation between direct splint and non-splint (Filho et al. 2009). With regards to the tray type and material, rigid custom trays81 or modified metal stock trays82 produced more accurate impressions in comparison with the polycarbonate (plastic) stock trays. On the reuse of impression copings, it has been shown recently that the impression accuracy is unaffected when copings were reused up to ten times (Alikhasi et al. 2013). Some non-splint techniques have shown improved accuracy in comparison to splinted methods, achieved through impression coping modification prior to impression making (Lee et al. 2008). In conclusion, these results suggested splinted impression technique is recommended for angulated implants.

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