Comparison of dimensional accuracy of implant cast of multiple angled implants by splinted and non-splinted methods - an in vitro study

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ABSTRACT

Background: Despite researches were done on the accuracy of splinted and non-splint in open tray impression techniques, very less information exists on accuracy of these techniques of multi-angled implants. Aim: The aim of the study was to compare the accuracy of implant cast by splinting and non-splinting technique in open tray technique on 5°, 15°, and 30° angled implants. Materials and Methods: A mandibular acrylic reference model is fabricated following which four Adin implants were placed with two in anterior being perpendicular as A2, A3, and two in the posterior region being 15° and 30° angulations of divergence in A1, A4 position. Six custom trays were fabricated with light cure acrylic resin sheets. After 24 h impressions using medium body polyether using open tray technique Group A: 3 samples splinted and Group B: 3 non-splinted. Accuracy was analyzed by coordinated measuring machine device. Multivariate two-way ANOVA and one sample t-test was used. Results: According to data analyzed showed there was significant difference noted in A1, A3, and A4 positions whose \( P = 0.0001, 0.005, \) and 0.005, respectively. According to changes in transfer of implant in A1, A2, A3, and A4 positions mean and standard deviation in splinted group were 19.02 ± 0.04, 15.675 ± 0.01, 65.623 ± 0.05, 51.019 ± 0.05, and 17.896 ± 0.05, 15.772 ± 0.01, 65.614 ± 0.02, and 54.051 ± 0.02, respectively. Conclusion: Significant difference was noted among the groups \(( P < 0.05)\) suggesting splinted impression technique is recommended for multiple angled implants.

KEY WORDS: Angle of divergence, Dimensional accuracy, Multi-angled implants, Pattern resin, Splinting

INTRODUCTION

An accurate fit of the implant prosthesis is one of the requirements for a long-term success of an implant.[1] A variety of impression techniques have been incorporated for a better outcome. The selection of a specific technique is highly dependent on clinical scenarios and patient selection.[2] According to Conrad et al., the foremost step to ensure the passive fit of an implant-supported prosthesis is accurately recording the positions and distances of implants through the procedure of impression making. The factors that contribute to an accurate impression making are impression materials used, impression techniques involved and also the fit tolerance observed among the intraoral abutments.[3] According to Alikhasi et al., the dental impression plays a key role in producing a positive replica of the structure for using as a permanent record or in producing a dental restoration and prosthesis.

Presence of uneven distribution of the occlusal loads and the stresses produced by torquing forces on the various parts of implant framework leads to mechanical issues such as loosening of screw, fatigue fractures of implant components, marginal bone loss, and implant failure.[4] Most of the implant impression techniques such as pick up, splint and non-splint techniques, and transfer techniques have been incorporated for identifying the most accurate impression technique.[5] The most certain factors that affect accuracy may include the angulations or depth of implant placements.[5]

Despite researches were done on accuracy of splinted and non-splint in open trays impression techniques, very less information exists on accuracy of these techniques of multi-angled implants.[3,5] Due to the
information available on the various impression techniques in obtaining an accurate master cast and the controversies still exist about these techniques, this in vitro study was performed to compare the dimensional accuracy of implant cast of multiple angled implants by splinted and non-splinted methods.

MATERIALS AND METHODS

A mandibular acrylic reference model is fabricated measuring dimensions of 8 cm in diameter and 3 cm in height and surveyed using a surveyor following which four Adin implants were placed with two in anterior being perpendicular as A2 and A3 and the two in posterior region being 15° and 30° angulations of divergence in A1 and A4 position [Figure 1 and 2].

Six custom trays were fabricated using the light cure acrylic resin sheets, and after 24 h of time, impressions were made using medium body polyether using open tray technique three samples were splinted, and rest three were non-splinted [Figures 3-5]. To evaluate the position of implants, each cast was analyzed by coordinated measuring machine device for accuracy. It was noted in three axes x, y, and z-axes, and accuracy was < 0.0001 mm.

Statistical Analysis

The operator was blinded about the test groups. Multivariate two-way analysis of variance (ANOVA) was performed to determine the significant differences that existed between the groups and followed by which a sample t-test was performed to compare the test groups with that of the master model (P < 0.05).

RESULTS

According to results obtained, the analyzed data for interspace of perpendicular and angled implant during casting by splinted and non-splinted impression techniques, with their respective P values.

<table>
<thead>
<tr>
<th>Position of implants</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>A1</td>
<td>0.0001</td>
</tr>
<tr>
<td>A3</td>
<td>0.0005</td>
</tr>
<tr>
<td>A4</td>
<td>0.0005</td>
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</table>

According to changes in the transfer of implant in A1, A2, A3, and A4 positions mean and standard deviation, the results are as follows in Table 1-2.

According to the results that were obtained based on the interspace of perpendicular and angled implant during casting by splinted and non-splinted impression techniques showed a significant difference in A1, A3, and A4 positions with P = 0.0001, 0.005, and 0.005, respectively. On estimating the changes in interspace of perpendicular and angled implant using splinted and non-splinted impression technique showed the 19.02 ± 0.04, 15.675 ± 0.01, 65.623 ± 0.05, and 51.019 ± 0.05 in splinted group and 17.896 ± 0.05, 15.772 ± 0.01, 65.614 ± 0.02, and 54.051 ± 0.02 in non-splinted group, respectively, indicating that there is a significant difference in dimensional accuracy from splinted to non-splinted techniques and thus giving us a result that splinted impression techniques when preferred gives us an accurate master implant cast in multiple angulated implants.

DISCUSSION

Many clinical studies have been performed to analyze and evaluate the accuracy of implant master cast which is obtained after the impressions are made by the appropriate techniques.[9] Furthermore, they give more importance to the passive fitness of the implant supported structures for the success of the prosthesis on a long-term basis.[10] Many studies have been reported that mostly splinting will result in a better impression followed by a long-term stay of the implants when placed.[11]

The accuracy of the splinted impression technique is mostly dependent on its resistance to deformation[3] under the forces of the impression material used in this technique.[12] Hence, it is observed that an impression which makes use of a rigid splint material seems to be producing an accurate master cast. Therefore, the dimensional stability and rigidity of the final prosthesis are mainly dependent on material used for pouring the final cast also which determines the strength of the cast obtained.[13]

There are many more researches going on to compare and evaluate the types of trays that are used in the matter of making an implant impression.[14] They mainly include and discuss the closed impression technique with that of the open tray technique in which the former impression tray technique seems to be more accurate.[14] Splinting with acrylic resins seems to be a difficult task in many cases because of its time-consuming nature and distortion of the material used for making the impression necessary.[15]
Many materials have been incorporated for testing the accuracy of the master cast to be obtained which includes the composite resin, impression plaster and the stainless steel pins and the acrylic resin material used alone or with dental floss to prevent the impression copings movements during impression making. More studies have been proved that the splint technique is better in most situations than the non-splint technique because of the above-mentioned reasons.

On the basis of checking it with multiple angled implants according to studies by Carr its proven that the open tray technique seems to be providing the most accurate working cast. To make a rigid framework, the splinting technique which was auto polymerized apparently had very good yielding results than when used with light cure technique. Mostly they seem to be less accuracy in light polymerization due to the incomplete polymerization occurring in these cases causing stresses at the impression coping acrylic resin interface.

Some of the studies that preferred the splinted techniques for impression making has added on information that if they sectioned post setting and rejoined resulted in best outcome within various types of splinting groups used in combinations. Mostly in cases of which utilized multi-unit situations with two or more highly unparalleled divergent implants the direct technique seemed to be more useful. In conclusion, the results suggested that splinted impression technique is recommended for angulated implants.

**CONCLUSION**

As the dimensional stability and rigidity of the final prosthesis are mainly dependent on the material used for pouring the final cast also which determines the strength of the cast obtained impression material.
producing an accurate master cast. It is concluded that the splinted impression technique is recommended for multiple angled implants.

REFERENCES


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