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Original Research

Evaluation of the effect of implant angulations and impression techniques on implant cast accuracy

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ABSTRACT

Aim: This study's goal was to assess the precision of implant castings made using splinted and non splinted impression methods with several parallel and nonparallel implants.

Materials and Methods:Two edentulous maxillary stainless steel models with seven implant analogues in the region of the central incisor, canine, premolar, and first molar (control groups) were employed in this experimental study. Implant analogues were positioned parallel to one another in one master model, whereas analogues were positioned with a tilt-to-longitudinal axis in another. From each model, 40 stone casts were produced utilising an open-tray, splined, and nonsplined polyether method. The distance between the experimental cast and the master cast was then measured in three dimensions using a coordinate measuring equipment. The post hoc Bonferroni test, unpaired t-test, and one-way ANOVA were employed for data analysis.

Results:The intragroup comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel splinted (Subgroup 1S) and parallel nonsplinted (Subgroup 1NS) groups was done using the unpaired t-test.The comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel nonsplinted (Subgroup 1NS) and angulated nonsplinted (Subgroup 2NS) groups was done using the unpaired t-test. The mean difference was found to be significantly less among parallel nonsplinted in comparison to angulated nonsplinted groups.

Conclusions:Comparing parallel and angulated implants, the splinted imprint technique showed more accuracy than the other technique tests.

Keywords: Accuracy, master cast, splinted.

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Introduction

In completely edentulous patients, prosthetic rehabilitation with implants is a very reliable and predictable treatment option. According to the Branemark System concept, placement of the implants should be fairly upright.[1] An overall decrease in quantity of bone makes the ideal placement of implants more difficult in the maxilla. In severely resorbed ridges, placing angulated implants is a very suitable and appropriate alternative treatment option to bone augmentation and sinus lift procedures.[2] There are several clinical advantages associated with the tilting of implants in the residual crestal bone.[3] It increases the degree of implant-to-bone contact area and thus increases the primary stability of implant. Moreover, it results in a better load distribution situation due to longer distance between the implants which allows the elimination of the cantilevers.[4]Impression technique, type of impression material, splinting or non-splinting impression copings, type of splinting material, and number and angulation of implants are the factors that affect the accuracy of impression.[5,6] Two main implant impression techniques are used for transferring the intra-oral spatial relationship of the implants to the working cast. One impression technique is the direct open tray technique that uses a custom tray with windows exposing the impression

copings. The other impression technique is the indirect technique that uses closed tray.[7] With the direct technique, both splinting and non-splinting of impression copings to improve the accuracy of impressions have been advocated.[8]
Hence, this study was conducted to evaluate the effect of implant angulations and impression techniques on implant cast accuracy.

Material and methods

By reproducing an ideal maxillary edentulous cast, two stainless steel edentulous maxillary models were created. In one master model, seven implant analogues were drilled parallel to one another, while in the other, the longitudinal axis of the implant analogues was angulated with respect to the horizontal plane. Implant analogues in the bilateral canine and premolar regions were tilted by 15°, 20°, and 30°, respectively, while implant analogues in the bilateral first molar region were tilted by D and E, respectively. One implant analogue in the central incisor region, numbered as A, was positioned parallel to the long axis of the implant master model. Angulation was measured and marked by analysing through a coordinate-measuring machine (CMM), and 3D interimplant distance of both master models was simulated. In both models, the core implant was positioned perpendicular to the surface, and in the model with angulated implants, the remaining implants diverged or converged from the central component.

Results

Table 1 depicts the summarization of the mean difference and standard deviation of inter-implant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F compared from control values on master models. A significant difference ($P < 0.001$) was found among the four subgroups. The mean difference was found to be maximum in angulated splinted group, followed by angulated splinted, parallel nonsplinted, and parallel splinted groups.

TABLE 1: depicts the summarization of the mean difference and standard deviation of inter-implant distances

Inter-implant distance	Mean difference			
	Subgroup 1NS	Subgroup 1S	Subgroup 2NS	Subgroup 2S
A-E	0.93	0.21	1.72	1.11
B-G	0.74	0.08	1.23	0.9
C-F	1.21	0.67	1.99	1.4

The intragroup comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel splinted (Subgroup 1S) and parallel nonsplinted (Subgroup 1NS) groups was done using the unpaired t-test.
The comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel nonsplinted (Subgroup 1NS) and angulated nonsplinted (Subgroup 2NS) groups was done using the unpaired t-test. The mean difference was found to be significantly less among parallel nonsplinted in comparison to angulated nonsplinted groups.

Discussion

The accuracy of implant cast is directly proportional to the impression technique which ultimately leads to passive fit implant prosthesis. There are various techniques that can be used for impression in multiple unit implant-supported prosthesis with advantages and disadvantages associated with each technique. The present study was conducted to compare the implant cast accuracy of angulated and parallel implants with splinted and nonsplinted impression technique.
In the context of the present investigation, two stainless steel master models were used with seven similar implant analogs drilled in it. According to Misch, the minimum implant number for a completely edentulous maxillary fixed prosthesis is usually seven. Stainless steel models were selected to make impressions that prevent wear and tear of model while making multiple impressions. Forty casts were obtained from impressions of master models using splinted and nonsplinted impression technique. Each sample obtained was subjected to 3D (x-axis, y-axis, and z-axis) interimplant distance analysis. The results obtained were subjected to statistical analysis, and the means of the interimplant distances obtained were compared with those of stainless steel master model.[9]
Hence, this study was conducted to evaluate the effect of implant angulations and impression techniques on implant cast accuracy.
In this study, table 1 depicts the summarization of the mean difference and standard deviation of inter-implant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F compared from control values on master models. A significant difference ($P < 0.001$) was found among the four subgroups. The mean difference was found to be maximum in angulated splinted group, followed by angulated splinted, parallel nonsplinted, and parallel splinted groups.
The intragroup comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel splinted (Subgroup 1S) and parallel nonsplinted (Subgroup 1NS) groups was done using the unpaired t-test.
The comparison of mean difference of interimplant distances such as A–E, B–G, C–F, C–G, D–F, D–E, D–G, and A–F among parallel nonsplinted (Subgroup 1NS) and angulated nonsplinted (Subgroup 2NS) groups was done using the unpaired t-test. The mean difference was found to be significantly less among parallel nonsplinted in comparison to angulated nonsplinted groups.

Studies comparing the accuracy of implant impression techniques with methods such as micrometers, Vernier calipers, strain gauges, or measuring microscopes could merely carry out two-dimensional measurements.[10,11] However, when the measurements are two dimensional only, relevant information is lost. Therefore, CMM was used as the measuring device in this study because it made three-dimensional evaluation of any distortion possible. When points from different implant casts have a common reference within a coordinate system, the 3D orientation of analogs can be recorded.[12] While in the case of 15° angulated implants, direct unsplinted technique and direct acrylic resin-splinted technique exhibited more accuracy compared to indirect technique. This was in agreement with some studies that found that direct impression technique whether splinted or not is significantly more accurate than indirect technique when angulation of implants increased up to 15°.[13,14]
Furthermore, in the case of 30° angulated implants, the direct acrylic resin-splinted technique was significantly more accurate than the direct unsplinted technique, which was significantly more accurate than the indirect technique. This finding is in agreement with several studies, which reported the superiority of the splinted technique over the non-splinted technique for making an impression of angulated internal connection implants.[15,16]

Conclusion

Comparing parallel and angulated implants, the splinted imprint technique showed more accuracy than the other technique tests.

References

1. Asawa N, Bulbule N, Kakade D, Shah R. Angulatedimplants: An alternative to bone augmentation and sinus liftprocedure: Systemic review. J Clinic Diag Res. 2015;9:10–3.
2. Patel MP, Anilkumar S, Chaukramath R, Gopalkrishnan S. Rehabilitation of edentulous maxillary arch with implant- assisted fixed complete prosthesis using multi- unit straight and angulated abutments. Eur J Prosthodont. 2016;4:37–40.
3. Oltra DP, Marti EC, Ali JA, Diago MP. Rehabilitation of the atrophic maxilla with tilted implants: Review of literature. J Oral Implantol. 2013;39:625–32.
4. Aparicio C, Perales P, Rangert B. Tilted implants as an alternative to maxillary sinus grafting: A clinical, radiologic, and periotest study. Clin Implant Dent Relat Res. 2001;3:39–49.
5. Wee AG. Comparison of impression materials for direct multi-implant impressions. J Prosthet Dent. 2000;83:323–331.
6. Ma J, Rubenstein JE. Complete arch implant impression technique. J Prosthet Dent. 2012;107:405–410.
7. Del Acqua MM, Chavez AM, Amarat AL, Compagnoni MM, Mollo FA. Comparison of impression techniques and materials for an implant-supported prosthesis. Int J Oral Maxillofac Implants. 2010;25(4):771–776.
8. Vigolo P, Fonzi F, Majzoub Z, Cordioli G. An evaluation of impression techniques for multiple internal connection implant prostheses. J Prosthet Dent. 2004;92:470–476.
9. Misch CE. 1st ed. USA: Mosby Publication; 2005. Dental Implant Prosthetics; pp. 285–90.
10. Cehreli MC, Akca K. Impression techniques and misfit induced strains on implant-supported superstructures: an in vitro study. Int J Periodontics Restorative Dent. 2006;26:379–385.
11. Mostafa TM, Elgendy MN, Kashef NA, Halim MM. Evaluation of the precision of three implant transfer impression techniques using two elastomeric impression materials. Int J Prosthodont. 2010;23:525–528.
12. Holst S, Blatz MB, Bergler M, Goellner M, Wichmann M. Influence of impression material and time on the 3-dimensional accuracy of implant impressions. Quintessence Int. 2007;38:67–73.
13. Lee YJ, Heo SJ, Koak JY, Kim SK. Accuracy of different impression techniques for internal-connection implants. Int J Oral Maxillofac Implants. 2009;24:823–830.
14. Tsagkalidis G, Tortopidis D, Mpikos P, Kaisarlis G, Koidis P. Accuracy of 3 different impression techniques for internal connection angulated implants. J Prosthet Dent. 2015;114(4):517–523.
15. Naconecy MM, Teixeira ER, Shinkai RS, Frasca LC, Cervieri A. Evaluation of the accuracy of 3 transfer techniques for implant-supported prostheses with multiple abutments. Int J Oral Maxillofac Implants. 2004;19:192–198.
16. Martínez-Rus F, García C, Santamaría A, Özcan M, Pradíes G. Accuracy of definitive casts using 4 implant-level impression techniques in a scenario of multi-implant system with different implant angulations and subgingival alignment levels. Implant Dent. 2013;22(3):268–276.