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Evaluation of effect of implant angulation and implant number on the dimensional accuracy of definitive casts

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***Abstract*---**Background: The location of dental implants is detailed and relocated on a working stone cast with the purpose of developing implant supported prosthesis. The present study was conducted to evaluate effect of implant angulation and implant number on the dimensional accuracy of definitive casts. Materials & Methods: 7 definitive casts with implant analogs placed in a triangular pattern were made from dental stone. Following groups were made. Group I (control group): All three implants are perpendicular to the plane of the cast. Group II: Implant numbers 1 and 3 are at 5° convergence to the center implant (implant number 2). Group III: Implant numbers 1 and 3 are at 5° divergence to the center implant (implant number 2). Group IV: Implant numbers 1 and 3 are at 10° convergence to the center implant (implant number 2). Group V: Implant numbers 1 and

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3 are at 10° divergence to the center implant (implant number 2). Group VI: Implant numbers 1 and 3 are at 15° convergence to the center implant (implant number 2). Group VII: Implant numbers 1 and 3 are at 15° divergence to the center implant (implant number 2). Implant analogs were secured in all definitive casts with cyanoacrylate. Results: We found that while analyzing the impact of dental implant number and the correlative effect between dental implant number and dental implant angulation, significant results were obtained (P< 0.05). We observed that significant results were obtained while comparing the effect of parallel group from 5° divergence and 10° convergence groups (P< 0.05). Conclusion: The close proximity of implant angulation toward the right-angled direction results in higher precision of implant. Accurate implant impressions can be made using an open tray technique for three implants angled up to 15°.

***Keywords*---**Casts, divergence, implant angulation.

Introduction

Dental implants are one of the superior inventions in the field of dentistry. For ensuring successful dental implant treatment, accurate impression procedures are necessary for passively fitting prosthesis.[1] Impression covering all aspects of dental implants is the foremost point in order to achieve better results. Inaccurate superstructure fit may result into mechanical and biologic complications affecting the functioning of dental implants. Among various complications, implant loosening, bending, and fracture of the prosthetic or implant components are important and commonly seen. Biologic complications comprised of fracture of the interface between the dental implant and the alveolar bone due to overloading physiologic tolerance levels.[2]

The location of dental implants is detailed and relocated on a working stone cast with the purpose of developing implant supported prosthesis.[3] The accurate transfer of each implant location is of utmost necessity for the precision in design and fit of implant-supported prosthesis. The major objective of fabricating implant-supported restorations is the production of superstructures that exhibit passive fit when connected to multiple abutments.[4] Imprecise superstructure fit leads to differential consequences that interrupt the utility of dental implants. One of the main requirements for obtaining a passive fit is the making of an accurate impression.[5] Two basic impression techniques are commonly used for the transfer of implant positions from an intraoral situation to a working cast: the open tray technique and the closed tray technique.[6] The present study was conducted to evaluate effect of implant angulation and implant number on the dimensional accuracy of definitive casts.

Method

Materials & Methods

The present study comprised of 7 definitive casts with implant analogs placed in a triangular pattern were made from dental stone. Following groups were made. Group I (control group): All three implants are perpendicular to the plane of the cast. Group II: Implant numbers 1 and 3 are at 5° convergence to the center implant (implant number 2). Group III: Implant numbers 1 and 3 are at 5° divergence to the center implant (implant number 2). Group IV: Implant numbers 1 and 3 are at 10° convergence to the center implant (implant number 2). Group V: Implant numbers 1 and 3 are at 10° divergence to the center implant (implant number 2). Group VI: Implant numbers 1 and 3 are at 15° convergence to the center implant (implant number 2). Group VII: Implant numbers 1 and 3 are at 15° divergence to the center implant (implant number 2). Implant analogs were secured in all definitive casts with cyanoacrylate. Three open-tray impressions of definitive casts were made in each group. Impressions were poured in type IV dental stone. Coordinates in the three planes were measured at the implant analog top surface and the base of the cast using a fine tip measuring stylus. The data were aligned and the angular differences between implant analog vectors from definitive and duplicate casts were calculated in degrees. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table I
Effect of implant number and angulation on accuracy

Effect	Degree of freedom	Mean square	P value
Main effect of implant angulation	6	0.241	0.12
Main effect of implant number	2	1.47	0.02
Interaction between implant number and angulation	12	0.37	0.01

Table I shows that while analyzing the impact of dental implant number and the correlative effect between dental implant number and dental implant angulation, significant results were obtained (P< 0.05).

Table II
Comparison of three implant numbers separately for each implant angulation

Implant angulation	Mean square	P value
15 degree divergence	0.26	0.51
10 degree divergence	8.85	0.02
5 degree divergence	0.12	0.81
Parallel	0.031	0.12
15 degree convergence	1.3	0.01
10 degree convergence	0.94	0.04
5 degree convergence	0.078	0.21

Table II shows that significant results were obtained while comparing the effect of parallel group from 5° divergence and 10° convergence groups (P< 0.05).

Discussion

It is found that integrated implants are immobile, hence it is imperative to make certain an accurate relationship on the definitive cast.[7] It is evident that impression technique, type of tray, dental stone manipulation technique, and compatibility of the cast with impression materials are few factors that affect the accuracy of the master cast.[8] There are various methods employed for the transfer of the implant positions from the intraoral position to a working cast. The open tray technique and the closed tray technique are commonly used methods.[9] The technique of open tray encompasses implant fastening to an impression handling with a screw and through impression tray's opening cut. In the closed tray technique, there is no detachment of the tray after the removal of impression.[10] The present study was conducted to evaluate effect of implant angulation and implant number on the dimensional accuracy of definitive casts.

We found that while analyzing the impact of dental implant number and the correlative effect between dental implant number and dental implant angulation, significant results were obtained (P< 0.05). Narayane et al[11] determined the effect of implant angulation and implant number on the dimensional precision of implant definitive casts. Three definitive casts with implant analogs placed in a triangular pattern were made from dental stone. Group I was control group, Group II in which implant numbers 1 and 3 were at 5° convergence to the implant number 2. Group III in which implant numbers 1 and 3 are at 5° divergence to the implant number 2. Group IV in which implant numbers 1 and 3 are at 10° convergence to the implant number 2. Implant analogs were secured in all the definitive casts with cyanoacrylate. Three open tray impressions of the definitive cast were obtained and poured in Type IV dental stone. Coordinates in the three planes were measured at implant analog top surface and base of the cast using a fine tip measuring stylus. The data were aligned and angular differences between implant analog vectors from definitive and duplicate casts were measured. There was a significant correlation between dental implant number and dental implant angulation (P < 0.05). There was a significant result when comparing the effect of the parallel group from 5° divergence and 10° convergence groups. A significant result while comparing the parallel group with 5° divergence and 10° convergence

was obtained whereas while comparing 5° divergence, 5° divergence, and 10° convergence a nonsignificant difference was obtained (P > 0.05).

We observed that significant results were obtained while comparing the effect of parallel group from 5° divergence and 10° convergence groups (P< 0.05). Kaur et al[12] analyzed the impact of implant angulation and implant number on the dimensional accuracy of definitive casts. Seven definitive casts with implant analogs placed in a triangular pattern were made from dental stone. The groups were as follows: group 1 (control group) all implant analogs perpendicular to the plane of the cast; the center implant analog (implant 2) being at 90° to the plane of the cast in all groups and implant analogs number 1 and 3 arranged in 5°, 10°, or 15° divergence from or convergence to the center implant (implant number 2). Three open-tray impressions of definitive casts were made in each group. Impressions were poured in type IV dental stone. Coordinates in the three planes were measured at the implant analog top surface and the base of the cast using a fine tip measuring stylus. The data were aligned and the angular differences between implant analog vectors from definitive and duplicate casts were calculated in degrees. The impact of implant number on the dimensional accuracy of definitive casts was significant whereas for implant angulation it was nonsignificant. The correlation of angulation and the number of the implant did not show an interpretable pattern. The precision of duplicate casts (compared to definitive casts) is not affected by the combined interaction of implant number and implant angulation.

The study carried by Choi et al[13] evaluated the accuracy of two implant–level impression techniques (direct non-splinted and splinted). They concluded that the accuracy of implant-level impressions for internal-connection implant restorations was similar for the direct non-splinted and splinted techniques in settings with divergence up to 8°.

Conclusion

Authors found that the close proximity of implant angulation toward the right-angled direction results in higher precision of implant. Accurate implant impressions can be made using an open tray technique for three implants angled up to 15°.

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