Original Article

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

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ABSTRACT:
Background: Dental implants have revolutionized the field of dentistry. For ensuring successful dental implant treatment, accurate impression procedures are necessary for passively fitting prosthesis The present study was conducted to assess 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. 7 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. **Results:** Significant results were obtained while assessing the impact of dental implant number and the correlative effect between dental implant number and dental implant angulation (P< 0.05). While comparing the effect of parallel group from 5° divergence and 10° convergence groups significant results were obtained (P< 0.05). **Conclusion:** The accurate implant impressions can be made using an open tray technique for three implants angled up to 15°. The close proximity of implant angulation toward the right-angled direction results in higher precision of implant.
Key words: implant angulation, open tray technique, convergence

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INTRODUCTION

Dental implants have revolutionized 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. The location of dental implants is detailed and relocated on a working stone cast with the purpose of developing implant supported prosthesis. The accurate transfer of each implant location is of utmost necessity for the precision in design and fit of implant-supported prosthesis. One of the main

requirements for obtaining a passive fit is the making of an accurate impression.[2]

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] It is found that integrated implants are immobile, hence it is imperative to make certain an accurate relationship on the definitive cast.[3] 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.[4] 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.[5] 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.[6] The present study was conducted to assess effect of implant angulation and implant number on the dimensional accuracy of definitive casts.

MATERIALS & METHODS

The present study comprised of 7 definitive casts with implant analogs placed in a triangular pattern were made from dental stone. 7 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 Implant number and angulation

Effect	Degree of freedom	Mean square	P value
Effect of implant angulation	5	0.262	0.18
Effect of implant number	3	1.41	0.03
Interaction between implant number and angulation	10	0.39	0.02

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

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

Implant angulation	Mean square	P value
15° divergence	0.23	0.58
10° divergence	8.81	0.03
5° divergence	0.17	0.94
Parallel	0.034	0.15
15° convergence	1.4	0.01
10° convergence	0.91	0.02
5° convergence	0.076	0.29

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

DISCUSSION

Dental implants are one of the superior inventions in the field of dentistry.[7] The major objective of fabricating implant-supported restorations is the production of superstructures that exhibit passive fit when connected to multiple abutments.[8] Imprecise superstructure fit leads to differential consequences that interrupt the utility of dental implants.[9] Among various complications, implant loosening, bending, and fracture of the prosthetic or implant components are important and commonly seen.[10] Biologic complications comprised of fracture of the interface between the dental implant and the alveolar bone due to overloading physiologic tolerance levels.[11]The present study was conducted to assess the effect of implant angulation and implant number on the dimensional accuracy of definitive casts.

We found that significant results were obtained while assessing the impact of dental implant number and the correlative effect between dental implant number and

dental implant angulation. Choi et al[12] 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°.

We observed that while comparing the effect of parallel group from 5° divergence and 10° convergence groups significant results were obtained ($P< 0.05$). Kaur et al[13] determined 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. 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.

CONCLUSION

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

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