Impact of different scan body geometries on the accuracy of full arch digital impression for implants placed at different angulations and depths assessed with an intraoral scanner: An in vitro study

By

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ABSTRACT

Background:

Prosthesis misfit remains a major concern in implant dentistry due to conventional dental impression techniques which have proven to be influenced by materials and techniques. These accumulative errors resulting from multiple steps involved in capturing, designing, and manufacturing an implant retained prosthesis hamper the realization of a fully passive fitting implant restoration. Conventional workflows have shown limitations related to impressions or laboratory manufacturing procedures such as dimensional accuracy, stability, polymerization time, or patient discomfort. Furthermore, the materials and multiple steps requiring manpower and manipulations are time-consuming and may increase the total cost and the risk of errors and inaccuracy of the restorations. Among other factors are number, position, depth, and angulation of implants; alveolar bone undercuts and edentulous span coverage. These accumulative errors resulting from the multiple steps involved in capturing, designing, and manufacturing an implant-retained prosthesis hamper the realization of a fully passive fitting implant restoration. Along with this, in the field of implant dentistry, standardized scan bodies, which enable a computer-based determination of the definite implant position using data obtained from digital intra oral scanners have been developed. These scan bodies come in different geometries which in turn affects the scan accuracy. Hence, This study aims to evaluate. whether the geometries of scan bodies affect the accuracy of digital intra oral impression. The study further also wants to analyze if different angulations and depths of implant affect full mouth scanning. Sufficient data are not currently available for assessing the accuracy of intra oral scanners in capturing single and multiple implant positions and factors influencing their performance.

Objectives:

To study the accuracy and precision of intra oral scanner when two different geometries of scan bodies are used.

- To compare the accuracy of digital implant impression at different implant depths.

- To compare the accuracy of digital implant impression at different implant angulations.

Methodology:

Six implant analogs at various angulations and depth were placed in a maxillary edentulous model, to mimic a routinely occurring clinical situation. The angulation and depth of implant analogs was measured with a coordinated measuring machine (CMM) having 6mm measuring probe and the measurements obtained acted as the "true" or reference, values for the study. Six corresponding scan bodies of two different geometries, group 1 with flat cylindrical scan body, group 2 with rectangular scan body was mounted onto the implant analogs. One calibrated operator independently repeated the full arch intra oral scanning 6 times for each combination to obtain a standard triangulation language (STL) mesh file for data analysis. The position of each scan body in the intra oral scanner was automatically detected using the exocad software by selecting measuring tools. The obtained measurements from an intraoral scanner were compared with their CMM counterparts. The data obtained was analysed to check the impact of different scan body geometries on the accuracy of full arch digital impression for implants placed at different angulations and depths.

Results:

There was no significant difference on comparison of deviation between the two groups with the reference group. Scan deviation in comparison between two groups with the reference group was slightly less in group 1(1.58 mm) when compared to group 2(1.93 mm) in relation to implant analog angulation and there was no scan deviation noted in comparison between two groups with the reference group in relation to implant analog depth.

Conclusion:

1. The ISB's (intraoral scan bodies) characteristics and its location play an important role in the accuracy of the digital implant impressions.
2. The geometry of the scan body has an impact on accuracy of digital impression, flat cylindrical scan bodies were slightly more accurate when compared to rectangular scan bodies.
3. Accuracy of digital impression was influenced by implant angulation and was independent of implant depth.