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A Comparative Evaluation of Accuracy of Partially Guided and Fully Guided Surgical Guides and Assessment of any Volumetric or Dimensional Changes Occurring in them After Undergoing Sterilization Process – An In-Vitro Study

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ABSTRACT

Aims of the Study:

The aim of this in vitro study is to evaluate and compare the accuracy of 3D printed partially guided and fully guided surgical guides and assessment of any volumetric or dimensional changes occurring in them after undergoing sterilization process.

Objectives of the Study :

1. To assess the accuracy of surgical guides, both fully guided and partially guided, by transferring the virtually planned implant positions to clinical situations by superimposition of the virtual scanned model on the master model in order to determine the feasibility of the procedure of implant placement with the help of surgical guides.
2. To assess 3D printed surgical guides after undergoing different sterilization processes in order to further determine the accuracy of the procedure which largely depends on the management of surgical guides and the possible volumetric and dimensional changes when attempting to sterilize it.

Methodology: A total of eight 3D printed mandibular models made up of thermoplastic resin material, having one anterior and one posterior edentulous space were included under this study. The scanned files (CBCT and STL) were uploaded to the software and 3D implant planning was done on them for both anterior and posterior implant placement. The surgical guides fabrication was done for both fully guided and partially guided protocols.

The 3D printed models are stabilized with the help of acrylic platform as to stabilize them during sequential drilling protocols. Among eight models four models were used for fully guided implant placement (GROUP F) and four models were used under partially guided implant placement (GROUP P). With the help of the above mentioned guides, eight anterior and eight posterior implants were placed in the 3D printed mandibular models by following each protocol. To ensure standardization and minimizing the error, a single operator handled all the drilling protocols and implant placement. The lab scanning was done after the implant placement and data saved as STL format. The virtually placed implants were considered as the control group in this study. Then the master model with planned virtual implants was superimposed onto the scanned models with scan bodies attached to the initially inserted implants to evaluate the accuracy of the procedure. The Comparative evaluation was done with Geomagic Control X software. With this software angular deviation, vertical deviation and horizontal deviation in buccolingual and mesiodistal direction (in X-axis and Y-axis respectively) were measured. Surgical guides which used for the implant placement were divided into two groups for the two different sterilization protocols. In this study autoclave (121°C for 15 minutes) which comes under steam sterilization considered as GROUP 1 and chemical sterilization (80% alcohol using an incubation time of 15 min with ultrasonication) considered as GROUP 2. Both the groups were digitally scanned by using a laboratory scanner before and after sterilization processes. The scanned data was saved as STL files. The evaluation of dimensional discrepancies around the surgical guides were measured by superimposition of STL files with the help of Geomagic Control X software.

Results: Results showed a statistically significant difference between the FG implant placement and PG implant placement for the horizontal platform in X-axis and Y-axis, and angular deviation. However there was no significant difference in the vertical deviation. Results showed no statistically significant difference in pre and post sterilization of surgical guides while compared with the 3D comparing software.

Conclusion: Within the limitations of the present study, the following conclusions can be drawn:

- Implant placement with Fully guided surgical guides was significantly more accurate than the implant placement with partially guided surgical guides when compared with the virtually placed implant. Since implant placement with both showed a level of deviation, a safety zone should be always considered.
- Steam sterilization at 121°C for 15 min and 80% alcohol using an incubation time of 15 min with ultrasonic sterilization has no significant effects on dimensional changes of the 3D printed surgical guides which suggested that both methods can be used efficiently for sterilization of surgical guides.

Keywords: fully guided, partially guided, surgical guided, sterilization, 3D printing

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