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Correlation between the data quality of digital impressions and surface topography of prepared teeth

KEYWORDS
CAD/CAM;
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Surface topography

Advancements in digital dentistry and the development of intraoral optical scanners (IOS) have provided clinicians with an increasingly accurate and efficient alternative to analog impressions.[1,2] Clinicians can transfer the digital impressions to external laboratories digitally through various file formats, the most common mode of transfer being the standard tessellation language (STL) file format.[3,4] There are many benefits to STL file formatting, including its open-source formatting allowing for cross-compatibility with myriad scanning and manufacturing technologies and its smaller file size for faster saving and transferring of data. Despite the benefits of this format, clinicians should be aware of its limitations when choosing to save STL files in different sizes.

IOS scan the topography of prepared teeth and generate a digital impression using a mesh of variously sized triangles.[5] Increased number of smaller triangles and their triangulation points create finer surface topography and a more accurate representation of the actual tooth surface. When files are compressed from full to moderate or small sizes, the IOS systems fuse smaller triangles together to form larger triangles in a more simplified mesh, ultimately creating a lower resolution and poorer quality digital impression. The purpose of this study was to analyze the relationship between the surface topography of prepared tooth surfaces and data quality of digital impressions from intraoral scanners.

Seven mandibular typodonts with missing left second premolars were used in this study. Each typodont had two abutment teeth (left first premolar and left first molar), which were fabricated in a dental laboratory by using computer aided design/computer aided manufacturing (CAD/CAM) technology. All typodonts were scanned by using an intraoral scanner (Cerec Omnicam, Dentsply Sirona, Charlotte, NC, USA) to obtain digital impressions and to design a 3-unit fixed dental prosthesis for each model (Fig. 1A and B). After scanning, STL files of each digital impression were generated and exported from the software program by using 3 different resolutions: high (Group H), medium (Group M), and low (Group L). All 21 STL files (7 high resolution STL files [Group H], 7 medium resolution STL files [Group M], and 7 low resolution STL files [Group L]) were exported to an open-source 3D inspection and mesh-processing software (Meshlab, ISTI-CNR, Rome, Italy) to determine and compare surface topography of prepared teeth (Fig. 1C–E). This software program prepares models for 3D printing by offering features for processing raw data and tools for editing, inspecting, rendering, and converting meshes. Using this software, the surface topography of each prepared tooth was measured by counting the number of triangulation points on the 3D surface image of each STL file (Fig. 1F–I).

After obtaining these measurements, statistical analysis was performed with a software program (SPSS for Windows, IBM Corp., Somers, NY, USA). To compare the surface topography of the 3 different digital impression

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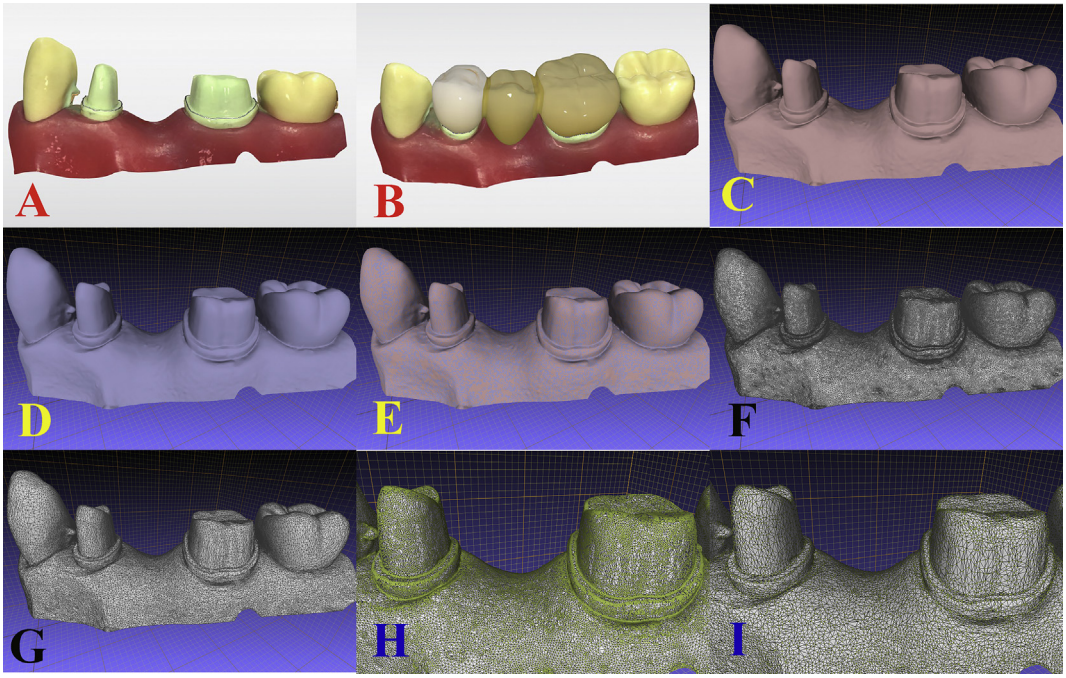

Figure 1 Digital workflow of a CAD/CAM fixed dental prosthesis. (A) Digital impression of the prepared abutment teeth. (B) Digital design of proposed restoration. Views of high resolution (C) and low resolution (D) STL files of the same digital impression by using a 3D mesh processing software program. View of superimposed (E) STL files showing discrepancy in surface topography. Mesh views of high resolution (F) and low resolution (G) STL files of the same digital impression. Triangulation points on 3D surface image of the high resolution (H) and low resolution (I) STL files of the abutment teeth.

resolutions, collected data of the number of triangulation points of each group were compared by using a paired t-test. $P < 0.05$ was considered to be statistically significant. Pearson's correlation coefficient was used to analyze the correlation between surface topography and digital impression resolutions.

The mean ($\pm$SD = standard deviation) number of triangulation points on the prepared teeth surfaces (7 premolars + 7 M) were 802,155 $\pm$ 90,520 dots in Group H, 604,335 $\pm$ 65,341 dots in Group M, and 205,044 $\pm$ 15,057 dots in Group L. Statistically significant differences were found between Group H and M ($p < 0.05$), Group H and L ($p < 0.001$), and Group M and L ($p < 0.01$). Statistically significant positive correlations were also noted between Group H and M ($r = 0.69$), Group H and L ($r = 0.87$), and Group M and L ($r = 0.80$).

The results of this study indicate that there are strong correlations between the data quality of digital impressions and surface topography of prepared teeth. Therefore, it is suggested that in order to yield more accurate CAD/CAM restorations, clinicians should transfer digital impression files to external dental laboratories by using high resolution file formats.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

References

1. Turkyilmaz I, Lakhia S, Tarrida LG, Varvara G. The battle of file formats from intraoral optical scanners. *Int J Prosthodont (IJP)* 2020;33:369–71.
2. Zhivago P, Turkyilmaz I. A comprehensive digital approach to enhance smiles using an intraoral optical scanner and advanced 3-D sculpting software. *J Dent Sci* 2021;16:784–5.
3. Ren X, Son K, Lee KB. Accuracy of proximal and occlusal contacts of single implant crowns fabricated using different digital scan methods: an in vitro study. *Materials* 2021;14:2843.
4. Jahangiri L, Akiva G, Lakhia S, Turkyilmaz I. Understanding the complexities of digital dentistry integration in high-volume dental institutions. *Br Dent J* 2020;229:166–8.
5. Turkyilmaz I, Wilkins GN, Benli M. Relationship between the data quality of digital scans from intraoral scanners and surface topography of prepared teeth. *J Dent Sci* 2022;17:592–4. https://doi.org/10.1016/j.jds.2021.06.003.

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