New scanning strategy for more accurate implant scanbody alignments

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ABSTRACT
This manuscript presents a more accurate methodology, compared to extant approaches, that enables errorless congruence between an implant scanbody and its counterparts in the scanbody library of a dental computer-aided design (CAD) application. The proposed method deletes corners or difficult intraoral scanning regions and selects only the remaining flat and wide scanbody planes in the library. Achieving overlaps between the portions of the actual scanbody data without distortion using an intraoral scanner is a novel development that is expected to represent a new standard in scanbody library alignment. Int J Prosthodont 2022. doi: 10.11607/ijp.7554

INTRODUCTION
The digital implant computer-aided design (CAD) procedure can be summarized as follows. First, a scanbody is used to conduct intraoral scanning. The scanbody data acquired during this stage are referred to as the “actual scanbody data.” The virtual reference data of the scanbody are created and stored in advance in the CAD application; the storage location is named as the “scanbody library.” Following the completion of the scanning process, the actual scanbody data are matched with the scanbody library to determine the exact positions of the implant fixtures.
Therefore, an accurate determination of the correspondence between the actual scanbody data and the scanbody library using a dental CAD is imperative. Various methods have been reported for an error-free scanbody alignment,\(^1\) Several recent studies\(^2,3\) have attempted to reduce errors in scanbody matching. However, no study has reported a fundamental method to achieve an error-free scanbody alignment. Herein, we introduce a new strategy to improve the accuracy of scanbody alignments, irrespective of the shape and material of the scanbody.

**NEW SCANNING STRATEGY**

The prerequisite for this strategy is a design that enables accurate manufacturing. Even an excellent design will be impracticable if it is incompatible with computer-aided manufacturing (CAM). A simple design is advantageous for manufacturing.

Another objective is to delete a part of the scanbody library. Existing scanbody libraries operate based on the fundamental assumption that the shape of the scanbody is reproduced without distortion within the CAD architecture. However, in reality, this assumption leads to substantial errors because of the necessity to match the prosthesis being reproduced with the curved surfaces that have not undergone appropriate oral scanning (Fig. 1). Therefore, the proposed strategy involves the creation of a modified library CAD file in which the portions of the scanbody, which are difficult to manufacture and intraoral scan, are deleted (Fig. 2). In other words, the scanbody library is redesigned around a wide plane, excluding its tangential portions. This produces a scanbody library file that does not capture the entire appearance of a scanbody, but only a well-defined portion of it. The use of this modified library produces excellent results even when a simple and conventional dental CAD alignment process is used.
DISCUSSION

The methodology presented herein involves a transformation of the concept of alignment between the actual scanbody data and the corresponding scanbody library. The primary limitation of earlier studies¹–⁴ is the assumption of perfect reproduction of the CAD-based design of a scanbody during manufacture. This assumption causes discrepancies in actual experimental data and renders fabricated prostheses unusable in clinical practice. Thus, in addition to enabling the manufacture of various types of scanbodies, the limitations of the existing manufacturing processes must be addressed. Therefore, a new approach is required. The premise of this study is to identify the incorrectly scanned portions of the scanbody during manufacturing (portions corresponding to minor errors) and exclude them from the matching procedure.

The proposed method allows us to process scanbodies irrespective of their shapes. The creation of a library that retains only the most accurately scanned portions of a scanbody enables the selective matching of only those portions and accurate tracking of the positions of the fabricated fixtures. Compared with this method of measuring consistency, which is already being widely applied in digital dentistry, our method exhibits highly reliable results.⁵ We expect that this concept will represent a new standard for implant library creation.

CONCLUSIONS

A relatively accurate scanning strategy for editing and using the partial data of a scanbody library during implant fabrication is introduced herein. Ensuring perfect matching based on selectively perfect intraoral scanning is the best alternative for accurately determining the positioning of implants during oral installations of fabricated dental implant fixtures.
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REFERENCES


FIGURE LEGENDS

Fig. 1. Scanning and matching results for inaccurate scanbodies. Significant errors occur owing to errors in the connection surface of the scanbody (yellow box).
Fig. 2. New scanning strategy for scanbody library. (a) Conventional scanbody library file. (b) Alignment with conventional scanbody file. (c) New scanbody library (connection parts were deleted). (d) More accurate alignment with new scanbody library.