Case Report

Fabricating an Implant-Supported Crown with Impression Scanning Technology

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Abstract

Computer-aided design and computer-aided manufacturing (CAD/CAM) technology automates the fabrication process of implant-supported prostheses. For the CAD/CAM fabrication of implant-supported crowns, virtual models must be generated by capturing of the intraoral situation with intraoral scanners or by digitizing stone casts with laboratory scanners. This article describes a novel method for creating virtual models with impression scanning technology. By using this workflow, an implant-supported crown is rapidly fabricated without intraoral scanning and cast scanning which needs additional time for fabricating stone casts.

Keywords: CAD/CAM, Digital workflow, Implant prosthesis, Impression scanning, Scan body

Ⅰ. Introduction

Computer−aided design and computer−aided manufacturing (CAD/CAM) technology has been widely used in implant prosthodontics[1]. A systematic review concluded that survival rates of CAD/CAM fabricated implant−supported crowns were comparable to those of conventionally fabricated implant−supported crowns and implant survival was unaffected by the fabrication technique[2].

The CAD/CAM fabrication requires accurate virtual models[3–5]. Virtual models are either directly captured intraorally with intraoral scanners or extraorally through scanning of stone casts with laboratory scanners[3–5]. Intraoral scanning systems have numerous benefits for clinicians, such as accurate digitization with real−time visualization, easy and selective rescan process on wrong scanned areas, data fusion, and enhanced patient comfort[3, 5–9]. However, between five and ten percent of clinicians use intraoral scanners[7]. In other words, most clinicians still use conventional impression materials due to their high detail accuracy and relative cost−efficiency[7, 9, 10]. However, additional time and effort are required for vacuum mixing, impression pouring, and waiting for the stone to set[11].

Continuous technological improvement in digital dentistry generates new workflows[5].

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Impression scanning technology has been recently developed and it shows a good accuracy, repeatability, and reproducibility[12–17]. Matta et al.[15] anticipated that the impression scanning method can be a clinical alternative when intraoral scanners cannot be used. However, up to date, no clinical report for fabricating an implant–supported crown with the impression scanning method is available. In addition, a dental CAD program for fabricating an implant–supported crown with the impression scanning method has not been developed yet. The purpose of this case report is to introduce a novel approach for fabricating an implant–supported crown with impression scanning and CAD/CAM technologies.

II. Case Report

A healthy 59–year–old man presented for the replacement of a missing mandibular left second molar. A bone level implant (s–Clean Tapered II Implants; Dentis, Daegu, Korea) was placed and a short scan

Fig. 1. Placed scanbody at the mandibular left second molar site.

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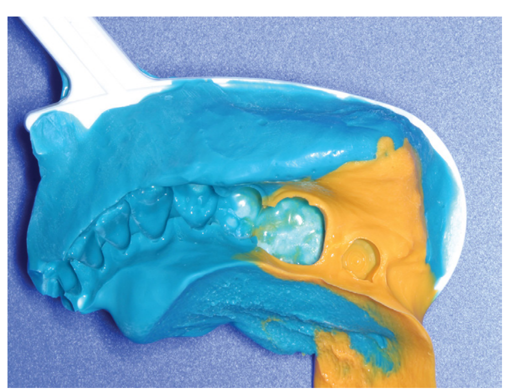

Fig. 2. Closed-mouth impression of the mandibular left dentition and scanbody.

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body (H–Scan Body; Dio Implant Inc, Busan, Korea) was secured. After osseointegration and the soft tissue healing (Fig. 1), a closed–mouth tray (Chiyou Bite Tray; Asia Dental, Daegu, Korea) was evaluated intraorally and the patient was instructed to close into maximal intercuspation[18–20]. A closed–mouth impression was made with polyvinyl siloxane materials (Aquasil Ultra LV, Aquasil Ultra XLV; Dentsply Sirona, Milford, USA) (Fig. 2).

In a laboratory, the tray handle was fixed on a scan plate by using putty silicone (blue eco; DETAX GmbH, Ettlingen, Germany). The impression was placed into a laboratory scanner (D700; 3Shape, Copenhagen, Denmark). The first order was made with CAD software (3Shape Dental System; 3Shape). An icon of the mandibular left second molar was selected on the screen. A crown module was applied. Therefore, the CAD software regards the scan body as an abutment tooth that required a crown

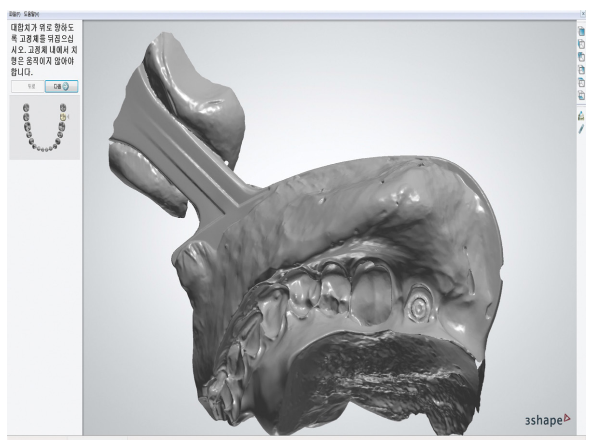

Fig. 3. Software view of the closed-mouth impression.

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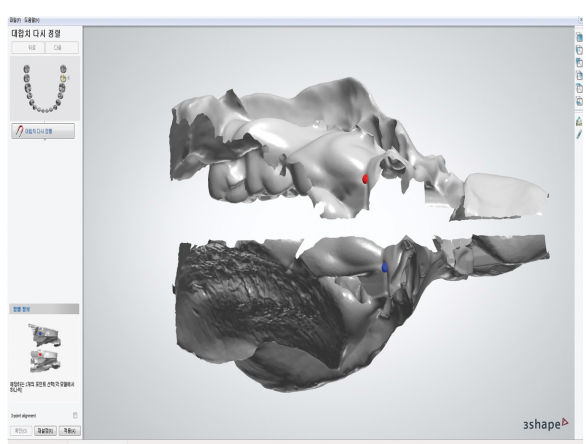

Fig. 4. Software view of the maxillary and mandibular impressions, lingual view. Note the red and blue points which are the same area on the close-mouth impressions.

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restoration. The scan setting was “Impression” and “Posterior triple tray”. Impression scanning was performed with the laboratory scanner (Fig. 3). The maxillary and mandibular impressions were aligned with a best-fit algorithm (Figs. 4 and 5)[4]. The next process step for the design of a crown was not proceeded and the scan data were saved.

The second order was created for the virtual design of an implant-supported crown. An icon of the mandibular left second molar was chosen. An implant restoration module was applied. “Abutment”, “Anatomy”, and “Zirkon” were clicked. The object type of scan settings was “Digital impression”. Therefore, the CAD software regarded that the scan data was obtained from an intraoral scanner system. Information of the implant and scan body was registered in the second order. The impression scan data were opened (Fig. 6). Library data of the scanbody was superimposed on its captured image from the impression with a 3-point matching technique (Fig. 7)[4,21]. A customized abutment and a crown restoration

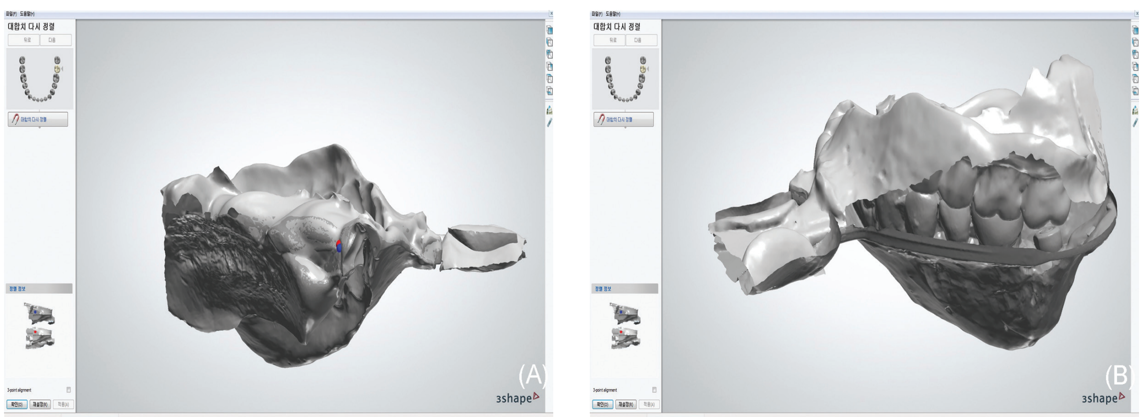

Fig. 5. **Software view of the closed-mouth impression after alignment. A, Lingual view. B, Buccal view.**

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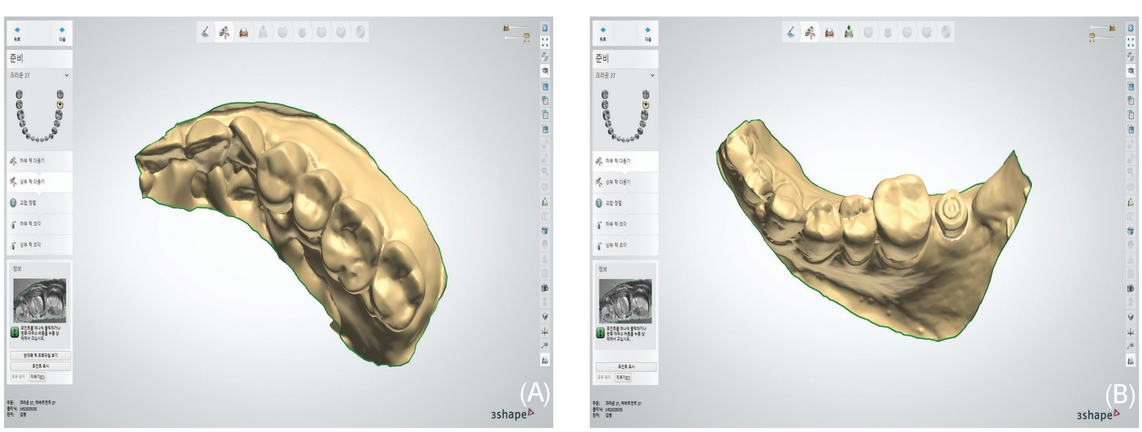

Fig. 6. **Software view of scan data. A, Maxillary left dentition. B, Mandibular left dentition and scanbody.**

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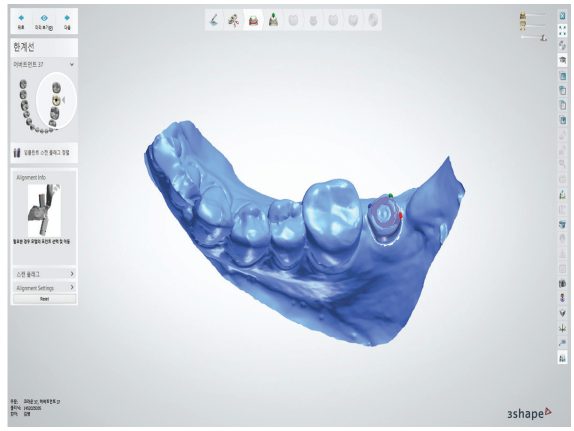

Fig. 7. Software view of the superimposed image of the scan body with 3-point matching technique.

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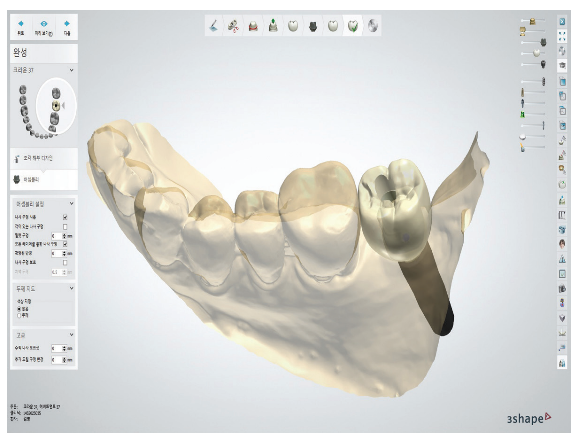

Fig. 8. Software view of the CAD design of an implant-supported crown.

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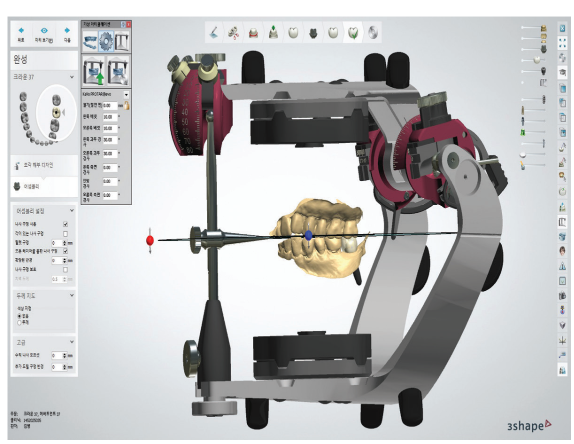

Fig. 9. Software view of the virtual mounting.

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were designed (Fig. 8)[22, 23]. The arches were arbitrarily mounted in a virtual articulator and the eccentric occlusion was evaluated (Fig. 9)[3, 24]. The finished design was transferred to a 5-axis milling machine (Arum 5X-200; DoowonID Co, Daejeon, Korea). A customized titanium abutment and a zirconia crown were milled (Fig. 10). The milled crown was sintered in a furnace (Austromat μSiC; Dekema Dental-Keramiköfen GmbH, Freilassing, Germany).

The customized abutment was secured with a torque of 35Ncm (Fig. 11). The screw access channel was filled with polytetrafluoroethylene tape (ePTFE NASA SEAL; Han Yang Chemical Co, Incheon, Korea) and composite resin (UniFil LoFlo Plus; GC Corp, Tokyo, Japan)[25]. The definitive crown was luted with definitive cement (RelyX Ultimate Adhesive Resin Cement; 3M ESPE, St Paul, USA) (Fig. 12).

Fig. 10. Milled abutment and zirconia crown.

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Fig. 11. CAD/CAM abutment in place.

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Fig. 12. **Definitive restoration in place, 2 weeks after placement.**

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Ⅲ. Discussion

Fabrication of the implant-supported crown by using the impression scanning method was described. By using this technique, the intraoral situation is accurately transferred without an intraoral scanner and a stone cast. Therefore, the implant-supported crown is rapidly fabricated with the streamlined process.

Although the impression scanning method has shown a good accuracy and repeatability, scanning deep concave surfaces of the impression may be technically challenging[12-17]. Therefore, the selective removal of the vestibule area in the impression is recommended. Another disadvantage is that creating the 2 separate orders is required as a module for fabricating an implant-supported crown with impression scanning is not developed. Impression scanning is available only when fixed dental prostheses for natural teeth are indicated. As the scan body is regarded as the tooth in the first order of the CAD program, the impression scanning is available. As the impression scan data is regarded as intraoral scan data in the second order, the scan body information can be registered. Therefore, further improvements of the CAD program are necessary so that the data acquisition and design process can be performed in a single order. In addition, the precision of impression scanning with regard to the scan body dimension, the scan body angulation, and the scan body distance should be investigated[4, 15].

Ⅳ. Conclusion

For the CAD/CAM fabrication of the implant-supported crown, impression scanning can be a clinical alternative to intraoral scanning and cast scanning. The presented technique also simplifies the clinical and laboratory procedure. However, continuous software development is necessary for user convenience.

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