journal of prosthodontic research 62 (2018) 116–120

Contents lists available at ScienceDirect

Journal of Prosthodontic Research

journal homepage: www.elsevier.com/locate/jpor

Case Report

Development of complete dentures based on digital intraoral impressions—Case report

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ARTICLE INFO

Article history:
Received 23 January 2017
Received in revised form 19 April 2017
Accepted 24 May 2017
Available online 16 June 2017

Keywords:
Digital denture
Complete denture
Digital impression
Dental CAD/CAM

ABSTRACT

Patient: A 60-year-old man presented for refabrication of his maxillary complete denture. In this case, a digital process was chosen to replace the ill-fitted complete maxillary denture. A specialized scan retractor was used to retract the mobile tissues of the lips, cheeks and vestibule while taking a digital impression. The interocclusal record obtained in the patient's mouth was scanned in order to digitally register the occlusal vertical dimension. The denture base and teeth were designed on virtual models that were mounted at the occlusal vertical dimension, and were made using CAD/CAM technology.
Discussion: Unlike conventional impression techniques, intraoral scanning is not able to be performed while the tissue is moving. This case report used a scan retractor that facilitated stretching and fixation of the vestibular area. It also helped to retract the lips and cheeks. This report also demonstrates that virtual models at OVD can be obtained without the use of conventional stone models, flasking or processing techniques. One of the main shortcomings in the existing CAD/CAM denture fabrication technology is that it is not able to produce customized denture teeth. The present article demonstrates that the digital denture fabrication workflow can provide customized denture teeth to optimize occlusion.
Conclusion: This case demonstrated how digital complete dentures can be made without requiring conventional stone models or mounting the models in an articulator.

1. Introduction

According to the American Dental Association in 2014, more than one third of Americans did not visit a dentist at all in the past year [1]. Infrequent or inconsistent dental health care puts patients at risk of tooth loss due to advanced caries or periodontal disease. Unfortunately, despite improvements in dental technology and science, the total number of patients who are becoming edentulous has not decreased in recent years [2]. According to prospective studies in the United States, the number of patients who are fully edentulous in one or both jaws will continue to increase, from 33.6 million in 1991 to almost 38 million by 2020 [3]. This phenomenon is partially explained by a longer life expectancy. With an aging population, treating large numbers of edentulous patients is a challenge. One of the treatment options for these patients is complete dentures. However, the conventional methods of manufacturing dentures have not changed in the past 50 years. The process typically involves multiple clinical appointments and lengthy laboratory schedules, and each of the involved steps requires considerable time and material. Therefore, the whole process is subject to human processing errors, inaccuracies, and further increased time and cost [4].

Recently, computer-aided design and computer-aided manufacturing (CAD/CAM) technology has been applied to complete dentures [5,6]. Until recently, laboratory scanners were used for the digitalization process in edentulous jaws. The information needed for a CAD/CAM restoration in edentulous jaws was previously acquired extraorally based on an impression or a model cast. This technique has the same deficiencies that conventional impressions and model casting have. There is also concern given the possibility of scanning inaccuracies when using the laboratory scanner [7,8]. In order to avoid errors of the conventional CAD/CAM-production workflow, it would be more practical to perform digitalization directly in the patient's mouth using intraoral scanners. Therefore, this clinical report describes the CAD/CAM fabrication of complete dentures based on direct digital impressions of edentulous jaws taken using intraoral scanners.

2. Outline of the case

A 60-year-old man with no significant past medical history presented with an unstable complete maxillary denture. On

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http://dx.doi.org/10.1016/j.jpor.2017.05.005
1883-1958/

Fig. 1. Preoperative clinical view.

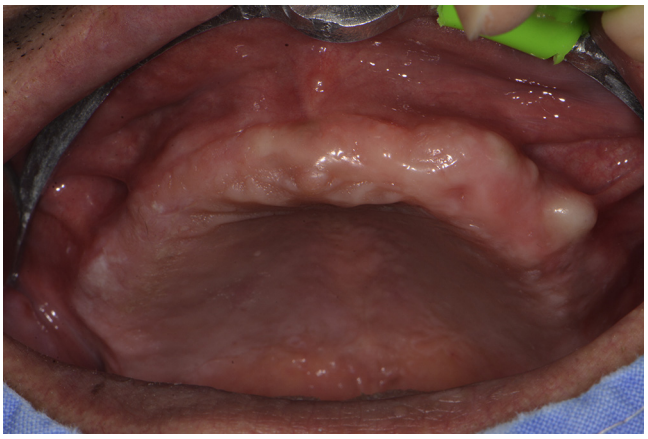

Fig. 3. Scan retractor positioned on the maxillary edentulous jaw.

Fig. 2. Specialized scan retractor for digital impressions of the maxillary edentulous jaws.

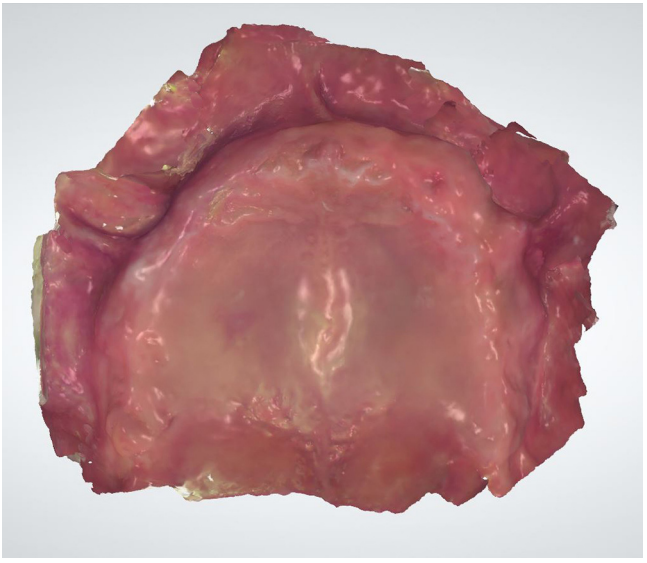

Fig. 4. Scanned image of the edentulous maxilla taken with an intraoral scanner (TRIOS) and scan retractor.

examination, the patient had multiple missing teeth in the mandibular jaw. The canine, first and second premolars, and first molar were still present in the right mandible (Fig. 1). The patient was not interested in any treatment of the mandible given financial difficulties. He was only interested in a new maxillary denture. A digital process was chosen to replace the ill-fitted complete maxillary denture.

In order to make digital intraoral impressions of the maxillary edentulous jaw, a specialized scan retractor was fabricated by a company (DIO Implant Co., Korea), having a universal size (Fig. 2). It is used to retract the mobile tissues of the lips, cheeks and vestibule. The retractor has an aluminum frame and connected handle. The frame is flexible, allowing it to fit into the vestibular area. The frame thickness should be sufficient to provide retractor rigidity while not being excessive. The handle extends vertically from the frame in the canine region and then turns anteriorly to pass over the lip with minimal interference with the oral musculature. The handle located in the canine region allows the scan head to move from the anterior to posterior alveolar ridge segment without interference.

Prior to intraoral scanning, the scan retractor was bent and adapted intraorally to fit the contours of the patient's edentulous arch. The frame should be extended bucally as far as possible to scan the labial or buccal surface of the edentulous ridge. After the scan retractor was contoured, intraoral digital impressions were acquired using an intraoral scanner (TRIOS, 3Shape A/S, Copenhagen, Denmark). First, the edentulous ridge was cleaned and completely dried of saliva. The scan retractor was then positioned on the edentulous jaw so that the frame would push the vestibule down further. This movement exposed the edentulous ridge in order to capture the greatest amount of surface area of the vestibule (Fig. 3). Scanning was performed by retracting the lip and cheek with the scanner head itself while stretching and fixing the vestibular area with the metal frame of the retractor. The scanner head was moved in a zigzag manner, starting at the distobuccal areas, following the crest to the opposite side and finally scanning the palate (Fig. 4). The scanner head was also moved in a zigzag manner to scan the mandibular arch, starting at the distal area of one side and following the jaw crest to the opposite side (Fig. 5). Any areas that were not captured fully were rescanned.

In order to record the occlusal vertical dimension (OVD), the OVD was established using bimanual manipulation of the mandible. Marks were placed on the tip of the patient's nose and on the anterior prominence of the chin. Putty(polyvinyl siloxane impression material) was used to make interocclusal records at the OVD. First, heavy-body putty was used to make a record base for the maxillary arch. The material was seated and adapted intraorally to fit the contours of the patient's maxillary edentulous arch. After placing the light-body putty over the heavy-body putty base, the record base was reseated on the maxillary