

# An Effective Approach for Prosthodontic Rehabilitation for A Trismus Patient Seeking Removable Partial Denture: A Clinical Report

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**Abstract Background:** Prosthodontic Rehabilitation for trismus patients with extremely restricted mouth openings by using traditional methods represent a big challenge for prosthodontists. Intra oral scanning and digitalized three dimensional CAD,CAM technology have afforded different techniques used in the construction of highly accurate virtual dentition casts. **Aim:** to improve the accuracy of aRPD framework by incorporating the digitalization technology, computer-aided design (CAD), and 3D printing. **Materials and Methods:** Multiple intraoral scans were used to reconstruct the virtual cast on which the authors planned the virtual RPD framework. Then using a 3D printing process, the titanium alloy framework was constructed, and the final RPD was fitted on the patient mouth. **Conclusions:** Digitalization technology, computer-aided design (CAD), and 3D printing and Intraoral scanning provided an accurate and effective method in the construction of a removable prosthesis for a trismus patient with severely restricted mouth opening.

**Keywords:** removable partial denture, limited mouth opening, trismus, digitalized dentistry

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## 1. Introduction

An extremely restricted opening of the oral cavity is not uncommon condition in patients with trismus. This can be as a result of head and neck injuries, and represents big challenges for the dentists specially the Prosthodontists. Limited mouth opening commonly leads to compromised impressions and prostheses [1,2]. Sufficient mouth opening is essential to allow appropriate tray alignment and insertion and obtain perfect impressions. Different modifications are necessary during impression registration for small oral cavities to achieve a successful prosthesis. The custom made separated impression tray for impression taking may represent a solution for this case. [3] but, it is still not suitable for all extremely restricted cases besides, the drawbacks of difficulty of reassembling and casting of the sectional impression. Intra oral scanning and digitalized three dimensional printing technologies had been successfully used in the construction of good and perfect digital dental models in a short time [4,5].

Digitalized three dimensional printing technologies has been used in fabricating removable partial denture frameworks,

only, inlay restorations, orthodontics, and maxillofacial surgery [7,8,9,10,11,12]

## 2. Clinical CASE Description

A 55 years old male patient asked for artificial replacement of his extracted teeth that the Prosthodontics specialty clinics at the university dental hospital of Taif University (Figure 1).



**Figure 1.** Intraoral view of patient's remaining teeth occluding on centric occluding position.

Clinical examination results revealed that the patient had an extremely restricted mouth opening with multiple missing anterior and posterior maxillary teeth (Figure 2).



Figure 2. Maximum opening position

Following detailed history taking, intraoral and extraoral examination the treatment plan had been discussed with the patient and consent form was signed by the patient. It was not possible to use the traditional or custom-made separated impression trays as a direct reason of trismus.

After intraoral examination the teeth # 15 and 26 were examined for the possibility for occlusal rest preparation as a part of the RPD design. Then the vertical dimensions were recorded, intraoral scanning was performed using an intraoral CEREC video scanning system<sup>1</sup>. The data collected from the digital scan was then united by using software<sup>2</sup> and the virtual maxillary dentition cast was fabricated (Figure 3) in the standard triangulation language file format. These information are enough to construct the final digital maxillary cast (Figure 4).

The 3 Shape Dental System software,<sup>3</sup> for the computer assisted designing was used for framework designing as it allows electronic surveying and has the ability to design several, complicated frameworks. The cast was surveyed electronically to determine the path of insertion, remove the undesired undercuts. Then the digital framework was designed and fabricated on the digitalized final cast (Figure 5).

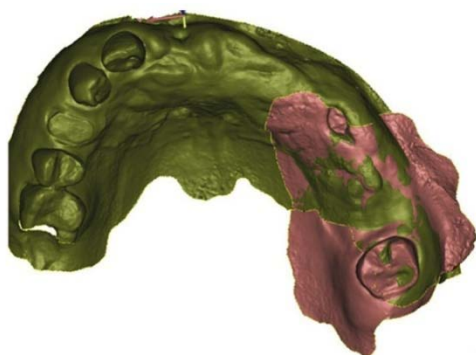


Figure 3. fabrication of the upper model by the overlapping intraoral scanning technique.

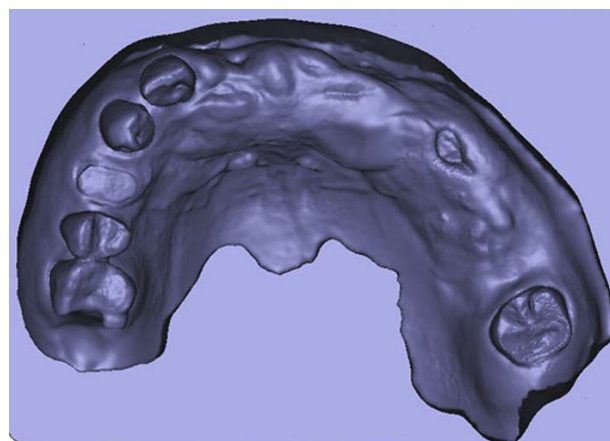


Figure 4. upper digital cast.

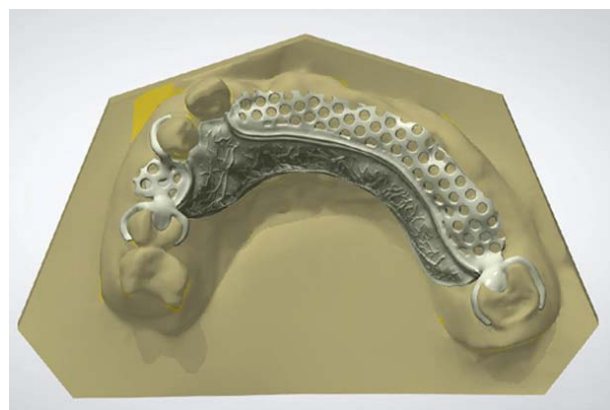


Figure 5. digitalized framework on the final cast.

ASLM machine<sup>4</sup> was used to fabricate the titanium framework using the three dimensional printing technology.



Figure 6. Titanium framework after removing from the SLM machine

The titanium framework was then annealed to increase the ductility and decrease the framework hardness and strength, thus, producing a high crack resistant material. Then the supports of the framework were removed, and checked its fit on the three dimension printing model (Figure 7). The 3D printing framework was then polished and fitted on the patient's mouth (Figure 8) and the RPD was processed (Figure 9) and finally, inserted in the patient's mouth (Figure 10).

<sup>1</sup>CEREC Omnicam, Dentsply Sirona, Sirona Dental Systems GmbH, Germany.

<sup>2</sup>Mimics 17.0, Materialise, Materialise HQ, Technologie, Leuven, Belgium.

<sup>3</sup>3Shape Dental System: 3Shape, Copenhagen Denmark.

<sup>4</sup>SLM@125: SLM SOLUTIONS GROUP AG, Germany.



Figure 7. Titanium Framework checked on the 3D printing polymer cast.



Figure 8. Try-in of the metal framework.



Figure 9. finished prosthesis.



Figure 10. insertion in the patient's mouth.

### 3. Discussion

Perfect inserting and aligning of the impression trays is a must during impression taking, this requires a wide

mouth opening. So this will be difficult to achieve in limited mouth opening patients. Baker et al [3] described a technique using sectional, customized trays for those patients. But this technique has the disadvantages of additional time, materials, and difficulty of reassembling the impression parts and casting them in addition that this method can't be used in cases of extremely restricted mouth openings. Nowadays with the advanced digitalized technologies, Prosthodontists gain the ability to fabricate precise 3D surfaces of oral structures including the mucosa and teeth and register them in a short time, this allows making highly accurate, time effective impressions.

Digital impression in one scanning process couldn't be achieved in cases of trismus with severely restricted mouth opening. Consequently, 2 sets of scanning data were overlapped and aligned to fabricate the final digital cast.

Even if some areas did not be completely scanned as a result of restricted mouth opening and the digital impression was not completed, the scanned area of the reformed digitalized model had enough details for framework designing and construction. With the help of the 3D printing technology and digital impression, the polymerized cast was built.

Designing the RPD framework was achieved using the CAD software package which has the ability to automatically block the undesired undercuts. Using the CAD software library, Suitable RPD components were selected, dragged and dropped on the dental cast. Such method decreased the laboratory work and reduced the design discrepancies.

The smooth titanium framework was treated to remove a few powder adhesions and then it is tried on the digital final polymer cast.

In the conventional RPD, the impression faults, design variation, and casting defects influence the adaptation and fit of such prostheses. Regarding the technique used in this case, the high adaptability and fit could be accredited to the extremely accurate digital scanning, precise CAD, and the exceptional SLM machine producing frameworks with high mechanical strength and dense void free cross-sections.

### 4. Conclusions

Regarding the extremely restricted mouth opening case report, digitalized scanning, computer assisted design, and three Dimensional printing technology were successfully used to fabricate a digital impression and construct a RPD alloy framework. Contrasting the conventional method, three dimensional printing technologies have the ability to construct complicated RPD frameworks.

With advancements within the digital dentistry and application of the batch production method of manufacturing, the inter-operator variability can be reduced in addition to their increased accuracy and time saving.

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