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Case Report

# Optical Impression and Removable Partial Denture: An Accurate and Actual Solution?

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## Abstract

**Introduction:** This clinical case aimed at showing the designing procedure for Removable Partial Denture (RPD) framework from an optical impression. The patient presented partially edentulous mandibular arch (Kennedy Class III) where RPD was planned for economic reasons. Optical impression was chosen due to the presence of a strong gag reflex and a small mouth opening. The impression was then sent electronically to the dental laboratory. The RPD was then fabricated through Computer Aided Design and Manufacturing technology (CAD/CAM) using laser fusion technology for the framework.

**Discussion:** The choice of optical impression is guided by several clinical and technical arguments. In general, conventional impressions are among the most anxiogenic procedures, which could disrupt cardio-vascular balance especially in elderly subjects. Moreover, with frail patients or in presence of strong gag-reflex, dental impression often requires specific care techniques, including sedation. From a technical point of view, the conventional fabrication of RPD is often a source of errors from both the practitioner and the dental technician. Thus, the optical impression and the digital chain could reduce the risk for error. However, the optical impression does not currently record the tissue duality, and does not provide anatomo-functional impressions. Therefore, this procedure focussed only on small gap extent for which anatomical impressions remain sufficient.

**Conclusion:** From the practitioner's perspective, the development of intraoral scans is also opening interesting prospects. However, further clinical studies are needed to validate this procedure.

**Keywords:** Optical Impression, Digital, Removable Partial Denture

## Introduction

In recent years, technological advances in the field of Computer Aided Design and Manufacturing (CAD/CAM) in dentistry have decreased the inaccuracies of conventional techniques [1]. This has facilitated the fabrication of fixed prosthesis [2]. However, "classical" procedures for removable denture fabrication have existed without major modifications for more than fifty years, with many risks of errors [3-5]: henceforth, the establishment of a digital chain seems inescapable. Thus, some prosthetic laboratories have equipped themselves with a scanner and specific CAD software for Removable Partial Denture (RPD). The framework could now be designed with these processes and then milled or 3D printed [6]. To design RPD frameworks, the dental laboratory used data files generally issued from scans of plaster models from conventional impression. However, for bounded and small partially edentulous cases, optical impressions could be directly carried out in mouth and sent to the dental technician through web portal. These innovative procedures could facilitate the functional and aesthetic integration in removable prosthesis, a step which is always difficult [7]. Through the presentation of a clinical case and the 3Shape Lyra procedure, this article aimed at demonstrating the contribution of new digital technologies for partial removable prosthetic rehabilitations.

## Outline of the case report

### Presentation of the optical impression system used

The Lyra™3shape™Trios® System (L3shT) consists of an intra-oral scanner for coloured oral impressions and integrated design software with either CAD or CAD/CAM Chairside procedure. Gathered information could be sent via a specific platform. Dental technicians may use several interfaces to design the prosthesis.

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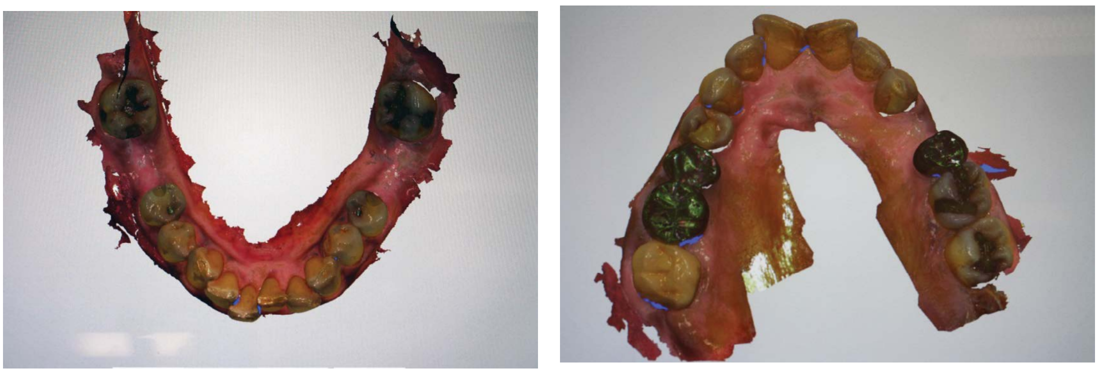
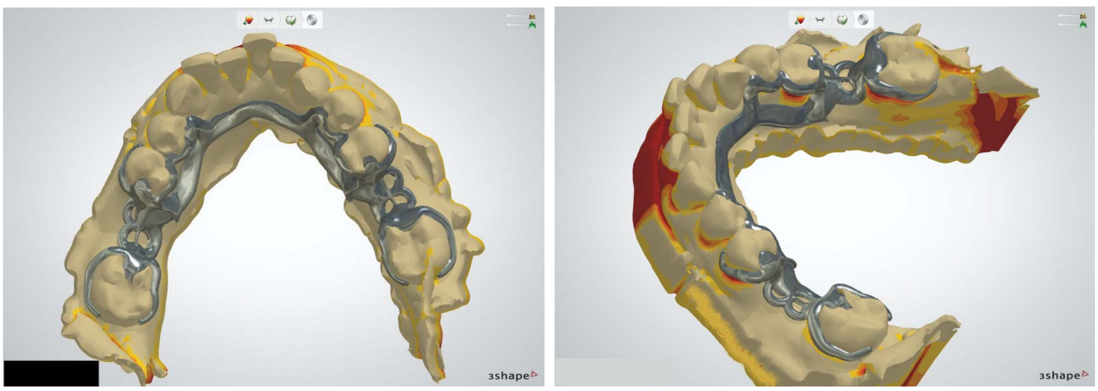
## Clinical and laboratory procedures

This clinical case, aimed at showing the procedure for designing a metal framework from an optical impression through the L3shT. Thirty-six years old male presented with removable prostheses restoring partially edentulous maxillary and mandibular arches (Kennedy Class III). The mandibular prosthesis caused him discomfort and pain (Figure 1). For economic reasons, RPD was planned. During the clinical and radiological examination, the residual teeth status did not require any special pre-prosthetic care. Ultimately, the treatment aimed at restoring the patient's function, aesthetics and oral quality of life. Optical impression was chosen due to the patient displaying a strong gag reflex and a small mouth opening. The maxillary and mandibular existing teeth were easily and quickly recorded but the edentulous sector required more dexterity and experience. However, the global virtual model was obtained in about ten minutes (Figures 2 and 3). To date, no integrated software in the L3shT is dedicated to the chair-side design of metal frameworks. For this purpose, "model" must be selected in the therapeutic choice menu and the optical impression must be transferred via the "3Shape Communicate" platform to the dental laboratory where they used specific software for RPD design (3Shape Dental System™, version 2.9.9.3). A digital (virtual) mock-up of the desired future framework was created using. During the design, it was necessary, as for conventional procedure, to choose the insertion axis first. Then the outline of the framework was drawn, the different components of framework were added (Figures 4 and 5). Once the digital model of RPD framework was obtained, it was transferred to the CAM software for processing. The next step of CAD/CAM production of metal RPD used two different technologies: subtractive (milling) or additive manufacturing (stereolithograpy (STL), 3D Printing, Laser Sintering). In additive manufacturing, the material is deposited or solidified layer by layer. In the presented case, the RPD framework was fabricated using laser fusion (SLM) procedure of a cobalt-chromium metal powder in the dental laboratory (ProX DMP 200/3D SYSTEMS). Afterwards, the Polyamide physical model was obtained using a 3D printer (P110 FORMIGA / EOS).

**Figure 1:** The patient presented partial toothless maxillary and mandibular arches (Kennedy Class III) compensated by prostheses. The mandibular prostheses caused him discomfort and pain.



**Figures 2 and 3:** Optical Impression was made with Lyra™3shape™Trios® System.




**Figures 4 and 5:** The virtual RPD framework was drawn with specific software (3shape™).

**Figure 6:** The RPD was manufactured by laser sintering and the polyamide physical model is obtained using a 3D printer. The artificial teeth and the resin saddles are polymerized according to conventional techniques.

**Figure 7:** The RPD wax- try in.

After finishing procedures, the framework was placed on the physical model to add the teeth and flanges according to the conventional techniques (Figure 6). The wax try in was satisfying in month (Figure 7) and the final RPD was easily inserted into the patient's mouth with good retention. The patient was very satisfied of this rehabilitation.

## Discussion

This case report described the digital workflow used in RPD fabrication. Indeed, currently, the optical impression does not record the tissue duality, and does not provide anatomo-functional impressions. Therefore, this procedure focussed only on small bounded saddles. Clinical studies are needed to validate this procedure. However, the first twenty clinical cases accomplished by the authors suggest promising future results.

The choice of optical impression is guided by several clinical and technical arguments. In general, conventional impressions are among the most anxiogenic procedures [8] which could disrupt cardio-vascular balance especially in elderly subjects [9]. Moreover, with frail patients or strong gag-reflex, dental impression often requires specific care techniques, including sedation [10]. From a technical point of view, the conventional fabrication of RPD is often a source of errors from both the practitioner and the dental technician [3-5]. Thus, the optical impression and the digital chain could reduce the risk for error and offer more pleasant clinical sessions for the patient.

Among other intraoral cameras, Trios_3Shape was used for this clinical case. This system is as versatile as any other system in the acquisition of dental structures and mucous elements such as edentulous ridges and palate. The learning curve for the design of a RPD framework is steeper than that of the fixed prosthesis but the interface of the CAD software is based on the same didactic system. To date, no software integrated in the L3shT is dedicated to the design of RPD frameworks. A possible evolution in the future could be the integration of simplified software allowing the drawing of RPD framework before transferring files to the dental laboratory. On the other hand, Chair-side metal framework manufacturing is not impossible. However, it would require a very highly efficient CAD/CAM system to be integrated in the dental practice.

The CAD/CAM production of metal RPD uses two different processes: subtractive manufacturing (milling) or additive manufacturing (stereo lithography, 3D printing, laser sintering). Subtractive techniques use 4-5 axes machine tools that remove material by grinding or cutting, including metal framework milling. The subtractive procedures are perfectly adapted to the fixed prosthesis. However, for reasons of manufacturing time, framework shape complexity, material cost and wear, they are more difficult to implement for the production of RPD framework.

Alternate additive manufacturing procedures [11] are more adapted to the production of metal frameworks. Additive manufacturing consists in shaping an object by adding layers of materials. Fusion of the different layers forms a 3D structure. Laser sintering and melting transform metallic powder into a solidified object. Only the Selective Laser Sintering or the Selective Laser Melting techniques are able to produce a metal framework without traditional casting. The digital chain is also not complete: the artificial teeth must be added with conventional procedure. Thus, physical model must be printed to realize this step. Bonding might be possible in the future according to procedures similar to those for complete digital denture [12-14].

## Conclusion

This case report described a digital workflow used for RPD fabrication for small edentulous rehabilitations. However, clinical studies are needed to validate this procedure.

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## Conflict of interest

The authors deny any conflict of interest related to this article.

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