Fabrication of a precision retained cobalt-chrome maxillary partial denture in articulation with a personalised complete mandibular denture

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Fabrication of a Precision Retained Cobalt-Chrome Maxillary Partial Denture in Articulation with a Personalised Complete Mandibular Denture

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SUMMARY

The success of a denture is mostly interpreted from two main standpoints, these being the function and the appearance of the restoration to satisfy a patient’s needs. The primary concern of a dental technician and a dentist is often with the function such as stability, retention, fit and masticatory purposes in the oral environment, and aspects of the aesthetics, such as denture base contour and the shade of the base, as well as the shade of the porcelain metal-fused crowns to simulate the preserved teeth, especially on the anterior region, are often neglected.

The introduction of denture base stains has changed the perception of negligence of aesthetics. This article focuses not only on the fabrication of a precision retained Cobalt-Chrome maxillary partial denture but also on the personalised complete denture using denture base stains. The patient’s condition is due to the drifting of the teeth and bleeding soft tissues which results in teeth extraction. The standard procedures are then followed to fabricate the prosthesis.

INTRODUCTION

Preservation of the natural teeth is essential, although the latest technological era has changed the dental world around. Most patients’ priority is aesthetics. Improvements have led to better patients’ treatment with good results in both aesthetics and function.

The edentulous spaces which occur as a result of teeth loss may be filled using a fixed prosthesis, such as a metal ceramic bridge, or a removable prosthesis, such as a partial denture. The choice is influenced by many factors relating to the nature of the teeth loss and the wishes of the patient. However, although a patient’s wishes are the essential consideration, the clinical decision on the
final prosthesis must be taken into consideration. In this case, the patient’s maxillary arch is partially edentulous while her mandibular arch is completely edentulous. Combination bridgework with a precision attachment removable denture is ideal for the maxilla using personalised conventional complete denture with selective labial tinting to simulate the patient’s gingiva.

DISCUSSION

Patient History

The patient is a 38-year old female. She went to consult a dentist due to periodontal inflammation. The dentist brought to her attention that she was bruxing excessively. Her badly damaged teeth were then extracted. A year later, she was referred to the Dentistry Faculty of UWC due to her complaints of drifting teeth and bleeding soft tissues. The teeth had started migrating into the edentulous spaces as they became mobile. She then received clinical treatment. Her excessively mobile teeth were extracted in both arches preserving only the maxillary 1·1, 1·5, 1·7, 2·1, 2·7 and 2·8.

A periodontal excisional flap procedure was performed on the preserved teeth to stabilise them before they were prepared for crown.1, 2 These teeth were preserved mainly to retain and support the maxillary Cobalt-Chrome partial denture. After 72 hours, the sutures were removed for complete healing to take place, which took approximately 6 months. The maxillary 1·7 and 2·8 were then prepared for gold crowns by milling for attachments on both mesial and distal abutments. The grooves were milled parallel and perpendicular to the sagittal plane to prolong the lifespan of the attachment and for easy and smooth insertion of the maxillary Cobalt-Chrome
partial denture framework. The crowns were also milled to reduce their bulk since they are fabricated of the metal. The attachments were placed on the distal and mesial surfaces of the crowns in order to eliminate a pivot action of the prosthesis under occlusal load or masticatory forces. The forces applied to the abutments would be balanced and the underlying saddle areas would not be placed under pressure. The other anterior tooth was prepared for porcelain metal-fused crown (see Figure 1).

Figure 1: Maxillary arch

Technical Treatment Option

The patient has a partial maxillary arch and an edentulous mandible. A personalised complete denture was the chosen option for the mandibular arch and there were three options for restoration of the maxillary arch:
1. A partial denture retained by clasps on the standing premolar and the posterior gold crowns. The reason for the placement of the clasps in the posterior region was to maintain aesthetics as possible.

2. Metal ceramic bridges, were retained by abutments prepared from the preserved teeth, with implants to provide maximum retention of the prosthesis.

3. Last but not least, chosen option which was crown and bridge (metal ceramic crown), Cobalt-Chrome partial denture retained by precision milled attachments on the posterior gold crowns for retention and support of the denture. The main reasons for this choice were that it was inexpensive and affordable for the patient, compared to the second option with implants. Implants are not an option in most cases for patients because of financial reasons.

The patient’s concern about the appearance of the clasps which were not aesthetically pleasing resulted in the first option, a partial denture retained by clasps being the least expensive option out of the three options that he had to choose from.

Although this restorative appliance has been chosen it is not the ideal option because of the following disadvantages:

3.1 Different metals were used to fabricate the maxillary prosthesis. The gold crowns, although in the posterior region, might not be aesthetically pleasing when the patient opens her mouth. The patient might also not be satisfied by the clasps of the Cobalt-Chrome framework, even though the crowns are on the posterior region.
3.2 Implants are mostly recommended for stabilising dentures or bridges if there is adequate alveolar bone in the patient’s mouth and, for this reason, they are superior, making this prosthesis inferior because it does not offer as much retention as implants.

3.3 The precautionary measures and the manufacturer’s instructions must be followed for the success of the Cobalt-Chrome framework. If any of these is neglected, there is a high possibility of ill fitting Cobalt-Chrome framework which, at times, is beyond repair even if soldered or welded.

3.4 The connectors might be an irritant to the underlying soft tissue, causing tissue injury due to long bone undercuts near abutments and risk of periodontal problems.\(^1\)

3.5 In some cases, a patient’s acceptance of a different prosthesis is poor because it is their first time to wear the prosthesis. In this case it was considered that the patient might poorly accept this prosthesis because she had never worn any prosthesis before, especially because the connectors cover soft tissues such as palate.\(^4\)

3.6 A full acrylic denture causes resorption, if worn for many years and, as a result, a full acrylic denture may cause bone resorption on the mandible.\(^3, 8\)

**Problems Experienced**

During the fabrication of any prosthesis, every detail must be taken into consideration to avoid inconveniences. One of the most important cautions is following the manufacturer’s instructions. During the fabrication of the maxillary 2·8 gold crown there were impurities of the investment material trapped in the mould as a result of sharp edges on the wax sprues. These
impurities were trapped in the casting and therefore caused porosity in the maxillary 2·8 gold crown. This crown had to be refabricated.

The Cobalt-Chrome metal ingots melt at a very high temperature. The low melting temperature of these ingots caused a miscast of the Cobalt-Chrome framework. This could not be soldered nor welded, therefore another framework had to be made, which was time consuming.

To maintain the strength of the porcelain, porcelain must be vibrated to bring its particles together while eliminating some of the build-up liquid particles to avoid cracking of the porcelain during firing cycle. Porcelain should be vibrated carefully and, in this case, this was neglected which led to incorrect shading of porcelain after firing. The anterior metal ceramic crown had to be refrabricated as a result of this negligence.

**Future Treatment Option**

Although a precision retained Cobalt-Chrome maxillary partial denture was chosen, the use of different metals in the oral environment will subject to galvanic corrosion as time proceeds, which limits the life expectancy of the prosthesis to 5 to 10 years. This will definitely lead to the need for the patient to use another advanced prosthesis. At the moment, the patient’s background is limited to the use of implants due to her financial status but in future she would definitely prefer a full oral rehabilitation that will last her a life time. The use of implants offers properties such as, good biocompatibility, excellent retention and outstanding stability.

**Technical Procedures:**

From the above patient history, the condition of the patient after surgery allowed for the precision retained attachment maxillary partial denture with the milled gold crowns on the
posterior region. Secondary milled gold crowns were for support and retention of a maxillary Cobalt-Chrome framework and ease of mastication. The patient is fully edentulous on her mandibular arch therefore a personalised conventional acrylic denture was fabricated for her. Her demands will be met by labial tinting of the mandibular denture to simulate her soft tissues.

There were three different treatment phases followed during the fabrication of the prosthesis and all the procedures were standard. In each phase, there were different materials used. Following is an image showing some of the materials which were used to fabricate the prosthesis (Figure 2).

![Figure 2: Materials for fabricating the prosthesis](image)

In the first phase treatment, a metal ceramic crown was fabricated on a 2:1 using wax to build up metal substructure. The substructure was invested in Hi-Temp investment which was in a form of powder and mixed with the investment liquid following the manufacturer’s instructions. The substructure was cast in VMK® ingots and finished in IPS® Inline porcelain. This porcelain came
in a form of powder and different shades, build-up liquid, stain and glaze and the stain and glaze liquid. The 1·7 and 2·8 crowns were fabricated in wax, invested with Beauty-Cast investment powder mixed with cold tap water. The crowns were then cast in gold mainly because gold is a soft metal making it easy to mill and does not wear the opposing teeth as a full metal ceramic bridge would.

In the second phase treatment, a model was duplicated using agar impression material (gel) to make a refractory model.

Caution: A protective mask was worn when mixing Cobalt-Chrome investment material because it is hazardous. The mask prevented the inhalation of the powder.

A skeletal Cobalt-Chrome metal framework was fabricated on the maxilla using different kinds of wax forms (stippled wax, profile wax, grid wax, sprue wax and prefabricated wax clasps). Cobalt-Chrome investment powder and liquid were mixed to invest the wax framework. The investment powder and liquid were mixed according to the manufacturer’s instructions.

In the third phase treatment, maxillary and mandibular dentures were fabricated in base plate wax and acrylic teeth. The acrylic teeth were selected following the shade of the porcelain crown and the standing teeth. A matrix was made using lab putty for maxillary waxed denture because it was going to be finished in acrylic through cold-curing technique. The other alternative to making a matrix for a maxillary partial denture would be using plaster. It can be mixed to soft putty and placed on the model and denture but a thin layer of a lubricant (Vaseline) must be applied for the ease of removal after hardening.
Plaster is stable more than the lab putty but the only disadvantage is that there is a high possibility of it breaking when removed from the model to boil out the wax. The mandibular denture was finished in heat-cure acrylic with labial gum tinting with the different tinting stains and fibres. Acrylic is in a form of monomer and polymer which are mixed according to the manufacturer’s instructions or on the size of denture that is cured.

The following standard procedures were used to fabricate porcelain retained attachment prosthesis and a personalised conventional denture:

Model Preparation

After the models were poured in alginate impression material, maxillary 2·1, 1·7 and 2·8 were prepared for the fabrication of the crowns using the burs and a scalper. The soft tissue was trimmed to expose the gingival margins. The hardener was used to harden the dies. The spacer was used to create spacer for the cement that was going to be used during the placement of the crowns in the patient’s mouth by the dentist. The mandibular model was poured and trimmed prior to articulation for the fabrication of a complete conventional denture.

Processing and Finishing

On the 2·1 a metal ceramic crown was fabricated with a collar. The substructure was waxed up and cast in metal and trimmed to 2mm thickness using the burs, stones and a cutting wheel for building porcelain. Before building porcelain the substructure was sandblast and degassed by the use acetone in the hygroscopic bath for 10 minutes. This was done to eliminate the oxides and impurities on the surface of the substructure that would lead to failure of bond between the metal substructure and porcelain. If acetone is not available distilled water can also be used to degass
the substructure. Further degassing was carried out in the furnace prior to opaque placement. The
crown was finished in porcelain, trimmed and shaped to simulate the preserved 1.1. For esthetics
it was stained and glazed using the paint brushes. The stain and glaze mixing liquid supplied
make the crowns dull after firing stain and glaze. To prevent this I mixed stain and glaze with
porcelain build-up liquid instead of the stain and glaze mixing liquid. This resulted in a more
outstanding staining and glazing.

On the 1.7 and 2.8 crowns were fabricated in wax and cast in gold. They were primarily milled
in wax and secondarily milled after casting them. They were milled on the mesial, distal and
palatal surfaces (Figure 3). The grooves were made parallel to the table of the milling machine
that was used. The grooves were milled to create a seat for the Cobalt-Chrome framework, in
order to support, stabilise and retain the framework during the function of the prosthesis. The
collar of metal ceramic crown and gold crowns were polished with the paste and the brushes.

Figure 3: Polished milled gold crown
Before Cobalt-Chrome framework was fabricated the model was duplicated in the agar impression material (gel) and the refractory model poured. When the refractory model dried it was placed in the oven for 45 minutes, at the temperature of 200°C and dipped for 10 seconds, prior to second dipping for 250°C. The investment material in a form of powder and liquid was vacuum mixed according to the manufacturer’s instructions. After the burnout of wax in the oven at the temperature of 250°C the mould was placed in the furnace for 2 hours and cast through open flame method at the temperature of 1050°C.

Precautionary measures were taken to avoid shrinkage and deformation of the framework. It was left to cool down for an hour. It was then divested, trimmed, sandblast and placed in the hydrolytic bath for 3 seconds to eliminate oxides and some of the stretches on the framework. The framework was finished and polished.

After the placement of the crowns and Cobalt-Chrome framework, the dentures were fabricate in wax and finished in acrylic. The maxillary denture was cold-cured in the pressure pot for 20 minutes, after which it was trimmed and polished. The mandibular denture was heat-cured for 2 hours, with the labial gum tinting and selective stippling to simulate the patient’s soft tissues. It was trimmed and polished (see Figure 4 (A) and (B)).

After the flash was removed very little polishing was done on the finished mandibular denture, mainly on the peripheral borders and the posterior region to preserve the stippling and pumicing the tinting on the labial surface.
Denture Tinting

The complete mandibular denture in wax was invested after the try-in. The first stage flanking was completed to expose the full coverage of the wax. Light pink, light and dark brown, purple stains as well as fibres were placed into the mould through “salt and pepper technique” and most importantly considering the needs of the patient for aesthetics. The denture was cured in acrylic, finished and polished, (see Figure 4(B)).

Figure 4 (A): Maxillary finished prosthesis

Figure 4 (B): Mandibular finished denture
CONCLUSION

The patient was most concerned about the appearance of the visible clasps. Milled attachments offer superior aesthetics and function, as no metal from attachments were visible. Furthermore, the partial denture is securely mounted in the mouth.

The patient’s quality of life was improved tremendously, the dentures fitted well and she is very happy with her treatment, especially with her personalised mandibular denture to simulate her soft tissues. The goal of importance was to restore the missing oral dentition and this prosthesis satisfied this purpose.
REFERENCES


