CASE REPORT

Comparative aspects in manufacturing the metal framework of RPD. Case management

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Abstract
Removable partial dentures are rarely used due to their complexity and difficult specific clinical and lab steps in the treatment of the patient with class I and II Kennedy edentulism. In the present study through two clinical cases, it was shown that both the clinical and lab steps and the manufacturing cost of these types of prosthetic reconstructions could be reduced. For this purpose, new techniques in manufacturing the wax pattern of the removable part of the RPD have been developed in order to facilitate the lab steps and to gain time. This technique is easier, less time consuming and cheaper than classical techniques, and probably equal in term of precision than other more recent techniques.
Keywords: removable partial denture, framework, wax pattern, acrylic resin pattern.

Introduction

Although class I and II Kennedy partial edentulous arches are often encountered and despite the good outcome of prosthetic treatments trough RPD, this type of denture is not as frequently used as expected, due to its complexity and to the arduous specific clinical and lab steps [1].

At the same time, the manufacturing costs are not to be neglected, even if they are generally lower than those of implant-supported reconstructions [2, 3].

Considering the aspects mentioned above, and keeping in mind the fact that the implant-supported reconstructions also have their limits and contraindications, we can state that lowering the manufacturing costs of RPD's would contribute to the increase of the share of rehabilitation using these devices. Because secondary costs are related to the oral and systemic health consequences of wearing RPDs, a significant need exists to advance the materials and technologies associated with these devices [4, 5, 6].

Case report

Clinical presentation

Two patients were considered for this study. After pro-prosthetic and pre-prosthetic treatment, the class I and II Kennedy edentulous arches were treated using RPD.

One patient latero/lateral-terminal edentulous spaces on the upper jaw and termino-terminal edentulous spaces on the lower jaw (case 1),

7 X X X 3 2 1 I 1 2 3 4 X 6 X – case 1
X X 5 4 3 2 1 I 1 2 3 X X X X

while the second patient had latero/terminal edentulous spaces on the upper jaw.

7 X X X 3 2 1 I 1 2 3 X X X – case 2

Case management

Case 1. Maxillary and class II Kennedy subclass 2 and Kennedy class I mandibular edentulous arches were both treated with RPD anchored with Bredent Vario-Kugel-Snap-SG system.

For the cast metal framework, an alternative lab technique was used that employs an acrylic resin pattern.

Case 2. Mandibular class, I Kennedy edentulous arch was treated with RPD anchored with Rhein 83 attachments, using the classic wax pattern technique and duplicated cast for obtaining the metal framework of the removable part of the reconstruction [7].

Clinical outcome

Figure 1. Impressions for working arch, opposing arch and occlusion-case 1; Pouring of the working cast for both arches; Case 1

Figure 2. Master cast with removable dies, detached from the base. E-Light cured trays fabricated for the second impression- case1.

Figure 3. Mandibular (A self-standing joint) and maxillary (C self-standing joint) wax pattern of the copings

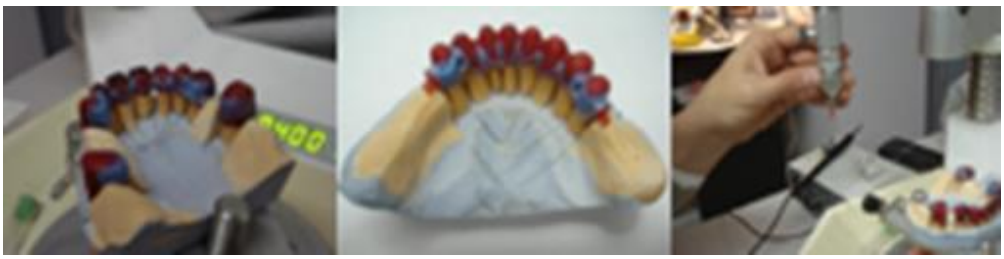

Figure 4. Vario Kugel attached to both wax patterns (upper and lower jaw)-case1

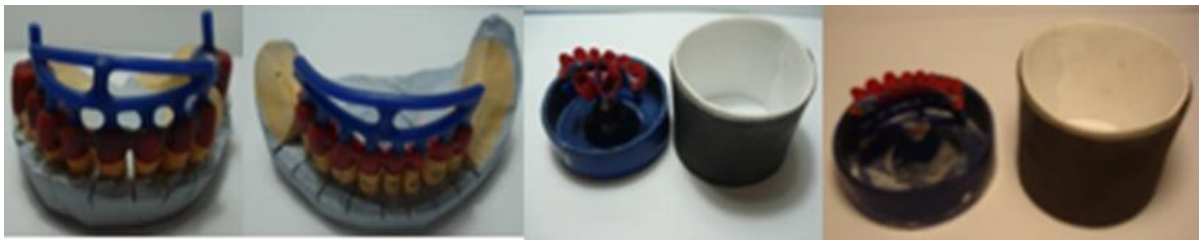

Figure 5. Preparing for investing: spruing and attaching the wax pattern to the sprue former- case1

Figure 6. Preheating, casting and divesting of the fixed part of the RPD- case1.

Figure 7. Casted copings for upper and lower arch; framework set on the; detail of the casted attachment.

Figure 8. Drawing on the master cast - limits of the maxillary major connector; master cast with fixed casted framework and retentive clips; Second silicone impressions using the custom trays

Figure 9. Acrylic pattern fabrication of the removable part of the framework; finishing of the major connector (acrylic pattern)

Figure 10. Spruing of the acrylic pattern of the removable part of the RPD and preparing for investing

Figure 11. Detensioning of the pattern (A); recovering the casted framewor; sandblasting after divesting

Figure 12. Cleaned framework- aspect after sandblasting; detail of the casted attachment

Figure 13. Complete seating on the master cast of the metallic fixed and removable parts of the prosthetic reconstructions

Figure 14. Ceramic layered on the fixed metal framework; Aspect of the removable and fixed parts of the RPD on the master casts

Figure 15. Wax pattern of the saddles with mounted acrylic teeth; finishing of the acrylic component of the RPD); completed RPD on the master cast

Figure 16. Mucosal and oral aspect of the completed maxillary reconstructions; mucosal aspect of the completed mandibular RPD.

For case 1 (figures 1-16), the impression was taken using putty and fluid PVS.

Class IV plaster (Convertin Hart®) was used for pouring the working cast (with removable dies with Dowel pins) after the impressions were washed and disinfected. The dies were obtained by sectioning the casts. The segments were removed and numbered and then prepared for the wax pattern copings.

The maxillary and mandibular cast were poured the second time, and light cured trays were fabricated on the second poured cast for both arches. A thin wax layer was used as a spacer to provide enough space for the impression material and to ensure a facile detachment of the tray.

Plastic foil technique was used to obtain the wax copings of the FPD, and finally, the copings were joint by means of self-curing acrylic resin, because of its volumetric changes during setting, lower than those of the wax during cooling. A surveyor (Amman®) and 2 ° wax cutter mounted onto the hand-piece were used identify the proximal tooth surfaces to be made parallel to act as guiding planes for placement and removal to establish the perfect

parallelism between the elements of the wax pattern and to set a common insertion path on the required zones were the Bredent® Vario-Kugel-Snap-SG system (case1)/extra-coronal attachments (case 2). With the help of the surveyor and a special device, the attachment systems were carried in place. The male parts were fastened and placed in the right position on the wax pattern, the arm of the surveyor was locked, and with an electric spatula, melted wax was applied to secure the components of the wax pattern.

After all details of the wax patterns of the fixed part of the reconstructions were achieved, sprues were attached, the wax patterns were decreased, and positioned onto the sprue formers while adequate casting rings were selected. Investing, burnout at 950ºC, casting using Biodur® alloy/ and devesting followed. The next step was to apply the working cast to the surveyor's table and to adjust the slider of the opposing arm with a bur having the same 20 tapers as the cutter mounted in the hand-piece used for the wax pattern.

The metal framework of the fixed part of the reconstructions was finished, and try-in in the office followed. The silicone impressions along with the metal framework of the fixed part of the reconstructions were sent at the lab, for proceeding with the technical steps. Extra-hard plaster class IV was used for pouring the working dies on which the wax patterns of the removable parts of the RPD are to be made. After fitting the sliding interlock system onto the male part, the design of the removable part was established, and drawings of the main connector and saddles were made on the working cast.

A thin layer of wax was used for spacing and also for eliminating undercuts between the castable male of the attachments and the edentulous ridge. For case 1 the pattern of the removable part of the RPD is made out of self-curing acrylic seated within the previously drawn limits on the lubricated master cast. The acrylic resin is deposited with a brush, and almost the entire framework is built. More complex elements such as mixed saddles are made out of wax and hardened by applying a thin layer of acrylic resin. A calibrated sheet of wax has been deposited on the oral surface of the main connector to give it a proper texture. The acrylic pattern can be lifted of the working cast, due to its structural strength, and finished using the handpiece and burs.

Onto the areas of the pattern were composite teeth are to be constructed, micro-retention beads are scattered.

The acrylic pattern is then sprued and attached on the sprue former, stress relief is accomplished, and then the pattern is degreased and invested. After burnout, both maxillary and mandibular frameworks were cast using Trillium alloy (Cr-Co alloy, 395 Vickers hardness, 1371ºC melting point), divested and sandblasted for removing of the investment material and the oxide layer.

In order to better appreciate the precision of the casted frameworks after blasting, they were placed over the fixed part (without the retention clips). The remaining vertical distance for achieving the complete insertion was about 1 mm (without forcing). Considering the 2 ° tapering of the bur used at finishing of the fixed part, an+0.04 mm error results in the area of the opposing arm, which represents the porosity of the investment material and a small mismatch between the thermal expansion of the investment material and the shrinkage of the used alloy. After finishing, the removable part was inserted perfectly without having any horizontal mobility.

On the copings of the fixed part of the reconstructions, Vita ceramic material was layered (including the second dentin layer and enamel), while over the removable part, on top of the retentive clips of the attachment, composite resin was layered to obtain the artificial teeth.

On the distal saddles, acrylic artificial teeth were mounted in MI. Retentive clips were also set into the attachments.

Try-in of the wax pattern of the removable part was achieved in the office: static and dynamic occlusion, as well as esthetics and phonetics, were checked.

For case 2 (figures 17-23) PVS was used for the impression of the arch to be reconstructed. Moldano® type III plaster was used for pouring the model on which the copings for the fixed part of the RPD were made, using the dipping technique. With cervical wax, the

marginal fit of the copings was improved, while blue wax was added on the palatal and lingual faces of the copings to create a relatively high oral collar where finishing with help a surveyor (Denshine® JT09) is to be done. Using the surveyor, the attachment was positioned on the proximal faces of the copings, facing the edentulous spaces. Wax patterns were prepared for investing and invested. After the stages of preheating, heating, obtaining the mold, the copings were cast using Heraenium® NA alloy.

The copings were sent for try-in in the office and being set on the abutments, and the custom tray was used for the second impression of the upper arch. The fixed part of the RPD was detached along with the silicone impression material (Elite-Zhermack®) and sent to the lab. After pouring the master cast using extra hard plaster the edentulous spaces, sensitive areas beneath the main connector and areas in contact with the soft tissue was released by using the block out wax.

Duplicating the master cast was done by using a flask and Elite Double 22 duplication silicone (Zhermack®). The X20 Speed (Whip Mix) refractory material was poured into the impression, and the drawing of the removable part was transferred onto the duplicated cast. Hardening procedure of the cast was then followed by wax pattern fabrication (preformed Bego wax pattern parts), including the castable female, spruing, investing, burnout, casting (Heraenium® CE), divesting, finishing of the removable metal framework, try-in on the cast and fitting with the fixed part of the prosthetic reconstruction. The framework was sent to the office for try-in.

After sandblasting with aluminum oxide, sintering for creating the oxide layer, opaque (wash opaque and opaque), dentin, enamel layers were applied onto the copings, using Noritake® ceramic material.

During the try-in in the office, the complete seating of the removable part of the framework onto the fixed part of the reconstruction was checked. Also, aesthetics for the frontal reconstructions was assessed and with the help of the wax rims manufactured in the lab and intermaxillary relationships were established.

When returning in the lab, the wax pattern for the acrylic saddles was modeled out of red wax, and the acrylic teeth were set on the saddle (distal and in the lateral area). Again try-in followed. Intermaxillary relationships were checked for the fixed and removable part, as well as phonetics and aesthetics. The thermo-polymerization of the saddles (Superacryl Plus-Spofa®) were finished and again try-in in the mouth followed. In the end polishing of the acrylic part and final glaze for the fixed reconstruction was achieved.

Figure 17. Impression of the upper arch; working cast of the upper jaw; Wax patterns of the fixed parts of the RPD

Figure 18. Preformed attachments; wax pattern with attachments on the abutments limiting the edentulous space

Figure 19. Metal framework set on the master cast (A, B, C); Surveying (C); aspect of the fixed parts

Figure 20. Metal framework-fixed part on the cast; releasing of the master cast- case 2

Figure 21. Duplication of the master cast; duplicated cast made out of investment material; wax pattern fabrication- classical method; spruing of the wax pattern; casted framework- case 2.

Figure 22. Layering of ceramic material and firing stage; completed fixed part seated together with the removable part on the cast-case 2.

Figure 23. Completed reconstruction off and on the master cast-case 2.

Discussion

New techniques in manufacturing the wax pattern of the removable part of the RPD have been developed in order to facilitate the lab steps and to gain time. The technique mentioned above is easier, less time consuming and cheaper than classical techniques, and probably equal in term of precision than other more recent techniques.

Digital technology (CAD-CAM) and its application to the design and fabrication of a single tooth to a complete-arch prosthesis is advancing rapidly. Computer-aided design and computer-aided manufacturing (CAD-CAM) systems are being widely used in the design and fabrication of fixed, implant, and removable prostheses. After scanning, drawing with a pencil/spatula on the virtual working cast the design future framework is possible, the software being able to replicate the boundaries of the pencil [8, 9]. 3D printing is the final stage for obtaining the framework. The complexity of technical stages in manufacturing RPD increases the difficulty in obtaining faultless reconstructions, is time-consuming and often generates mistakes [10, 11]. That is why we tend to shorten working times or even eliminate intermediate stages. Thus, new materials have appeared on the market, which tends to modify, at least in part, the work style and the technical steps. This category includes materials (self or light curing) used in direct modeling on the model [2].

Conclusions

The wax or acrylic pattern represents the final form of the future cast, made out of materials which can be burnt out completely. The classical technique implies duplicating the master cast, using the same material as for investing. By using these materials, certain intermediate steps are eliminated, thus shortening time and saving materials that are usually not cheap. This technique also has the advantage that the pattern may be somewhat tested on the master cast to predict the behavior of the future casted framework, by assessing its behavior from a static and dynamic point of view.

Conflict of interest: None to declare.

References

1. Preshaw M, Walls AW, Jakubovics NS, Moynihan PJ, Jepson NJ, Loewy Z. Association of removable partial denture use with oral and systemic health. J Dent. 2011 Nov;39(11):711-9.
2. Bohnenkamp DM. Removable partial dentures: clinical concepts Dent Clin North Am. 2014 Jan;58(1):69-89.
3. Davenport JC, Basker RM, Heath JR, Ralph JP, Glantz PO. The removable partial denture equation Br Dent J. 2000 Oct 28;189(8):414-24
4. Becker CM, Kaiser DA, Goldfogel MH. Evolution of removable partial denture design. J Prosthodont. 1994 Sep;3(3):158-66.
5. Alla RK, Swamy R, Vyas R, Konakanchi A. Conventional and contemporary polymers for the fabrication of denture prosthesis: part I-overview, composition and properties Int J Appl Dent Sci, 2015; 1(4): 82-89
6. Bilgin MS, Baytaroglu EN, Erdem A, Dilber E. A review of computer-aided design/computer-aided manufacture techniques for removable denture fabrication Eur J Dent. 2016 Apr-Jun;10(2):286-91.
7. Carr AB, McGivney GP, Brown DT. McCracken's Removable Partial Prosthodontics, Ed. Elsevier Mosby, 2005 St. Louis, Missouri
8. http://www.cadbludental.com/applications/removable-partials.html
9. http://www.3shapedental.com/restoration/dental-lab/cad-design/removable-partial-design.aspx
10. Douglass CW, Watson AJ. Future needs for fixed and removable partial dentures in the United States J Prosthet Dent. 2002 Jan;87(1):9-14.
11. Benso B, Kovalik AC, Jorge JH, Campanha NH. Failures in the rehabilitation treatment with removable partial dentures Acta Odontol Scand. 2013 Nov;71(6):1351-5.

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