AESTHETIC DESIGNS IN REMOVABLE PARTIAL DENTURES

Francisco Góis\(^{(1)}\), Margarida Sampaio-Fernandes\(^{(1)}\), Patrícia Fonseca\(^{(1)}\), Bruno Henriques\(^{(2)}\), João Sampaio-Fernandes\(^{(1)}\)

\(^{(1)}\)Faculty of Dental Medicine, University of Porto, Porto, Portugal
\(^{(2)}\)Mechanical Engineering Department, University of Minho, Portugal
\(^{(1)}\)Email: franciscofsgois@gmail.com

ABSTRACT

The objectives of this work are to review the aesthetic designs currently available in removable partial dentures (RPD) and discuss their clinical applications. Covering metal structures with ceramic or resins, and technopolymer or acetate resins clasps are alternatives that commonly fail and present significant disadvantages. Coating a cobalt-chromium framework with white powder paints revealed promissory results but further research is needed.

Keywords: aesthetic, dental prosthesis, removable partial dentures.

INTRODUCTION

Several treatment options exist to restore a partially edentulous mouth (Khan, 2005). Recently, implants and fixed prosthodontics have gained the attention over removable prosthodontics as a treatment option in partially edentulous conditions. However sometimes financial, anatomic, psychological, or medical considerations of the patients require the oral rehabilitation with removable prosthesis (Shah, 2013; Chu, 2002). Removable partial dentures (RPD) are still an effective and affordable treatment option to restore function and aesthetics (Khan, 2005; Chu, 2002). Nowadays, it is unrealistic to assume that patients will tolerate a poor appearance, just because an acceptable mastication is achieved with the rehabilitation (Rossi, 2001).

There are some aesthetic considerations to which a clinician must place emphasis during the planning and fabrication of prosthesis to provide the desirable outcome for the patient and their expectations (Shah, 2013). In order to achieve an aesthetic RPD, the treatment can be divided in several phases: diagnosis and treatment planning, surveying, mouth preparation, framework design, prosthetic teeth and denture base resin and flanges (Shah, 2013). Regarding the phase of framework design, which is clinician responsibility, there are several options and alternatives (Thomas, 2011). Several techniques are available for a conventional metal framework in order to make them more aesthetic, which include: alternative path of insertion, more aesthetic position of the retainers, use of extra-coronal adhesive attachments, masking of clasps with tooth-colored materials, and others (Thomas, 2011). Non-metal materials, like flexible thermoplastic resins, can be useful in specific cases (Singh, 2013).

Masticatory function and aesthetic are prime considerations in developing the design of prosthesis in addition to replacing teeth, restoring function and improving aesthetic (Rossi, 2001). This work aims to review the aesthetic designs currently available in RPDs and discuss their clinical applications.
MATERIAL AND METHODS

A dental literature search in MEDLINE and PubMed was performed for articles published in English with no publication year limit. The articles referring to aesthetic problems and solutions in removable partial denture were included in this work.

RESULTS

The current literature search revealed that, considering the aesthetic problem there are different ways to design a RPD, depending on the clinical case and anatomic conditions.

The path of insertion of a RPD can mask and minimize the need of some direct retainers, such as clasps. Rotational, dual or curved are the described alternative paths of insertion that may suit some clinical cases (Khan, 2005).

Today, frameworks for RPDs can be made of metallic and/or non-metallic materials. Metal frameworks are more used and can be done with different alloys such as cobalt-chromium, gold or titanium (Sandu, 2007; Khan, 2005). In some cases and types of clasps, wrought wire can also be used (Khan, 2005). Alternative to metal, acetyl resin can be used as dental frameworks (Thomas, 2011; Khan, 2005) or combined with a metal framework to provide aesthetic on visible metal components, such as clasps. Another possible combination is with nylon clasps (Nascimento, 2013). Flexible dentures, made of another resin named superpolyamides can also be a viable treatment option in limited situations (Singh, 2013).

Regarding clasps design there are several possibilities that clinician and technician can choose. Its selection depends on anatomic conditions, abutments and undercuts positions, edentulous areas and function requirements. Generally, they can be classified in two main groups: suprabulge and infrabulge. The first ones have an occlusal approach, and the second ones have a gingival approach. On suprabulge clasps we can find circumferential, back action, equipoise, hidden, flexible lingual, and ball clasps. While on infrabulge clasps we found bar-clasp, palatal I-bar, RLS-system, twin-flex (Khan, 2005) and round-rest distal depression clasp (Shah, 2013).

Circumferential and back action clasps use the distal undercut for retention (Khan, 2005), while hidden clasps use mesial or distal undercuts (Shah, 2013; Khan 2005). Equipoise system has a lingual back action clasp that uses the distal and lingual part of the abutment teeth for retention (Shah, 2013; Khan, 2005). Similar process is taken on flexible lingual clasp (Khan, 2005). Ball-clasp uses embrasure between two teeth for retention (Khan, 2005).

Bar-clasps and I-bar clasps can be used on palatal, lingual or buccal surface of the teeth, while RLS-system, twin-flex or round-rest distal depression clasp are used on palatal or lingual surfaces (Khan, 2005). These systems can also use the distal surface for retention (Khan,
2005) or can choose between mesial and distal surface, like on the twin-flex clasps (Khan, 2005; Shah, 2013).

In certain cases, where undercuts do not satisfy the required retention or to gain aesthetic, the use of composite restorations or fixed crowns can be seen as alternatives (Khan, 2005).

In order to improve aesthetic, metallic clasps can be masked using ceramics or resins (composite, acetyl resins) by macro/micromechanical retention (Shah, 2013; Chu, 2002; Rossi, 2001). Electrostatic coating/painting of the framework with epoxy powder inks is another option suggested by Nascimento et al, and studied by the authors of this work. Additionally other types of powder inks like polyester and hybrid (epoxy + polyester) are being studied.

DISCUSSION

RPD has to respect some biomechanical requirements, such as retention, stability and support. The design has to follow these requirements enhancing the achievement of an aesthetic rehabilitation (Khan, 2005; Shah, 2013).

After diagnosis and treatment planning, the phase of surveying is indispensable for the decisions regarding the design of a RPD (Shah, 2013). In this phase the possible paths of insertion, the location and depth of the remaining teeth undercuts, parallelism of guide planes can be studied (Khan, 2005). Surveying allows determining the location of clasp arms and arrangement of prosthetic artificial teeth to derive maximum aesthetic (Shah, 2013).

Alternative paths of insertion allow one part of the framework to be seated first followed by the remainder, decreasing the need of clasps. Rotational path of insertion is the most used technique. It is indicated most often in cases of missing anterior teeth, and has the advantage of not being dislodged with the force perpendicular to the plane of occlusion. Guide planes are important to establish a secure passive retention, in order to prepare the remaining teeth, which sometimes can present a problem to the clinician (Khan, 2005).

Extra-coronal direct retainers are not pleasing for patients concerned about aesthetic and are the only framework components of a RPD that can be placed on visible surfaces of the teeth (Shah, 2013). Depending on the edentulous situation, there are clasps more aesthetic than others and which one has clinical indications. Usually, infrabulge clasps have more potential to be hidden in the distobuccal aspect of a tooth (Khan, 2005). Additionally, the clasps approaching the undercut from distal surfaces are less visible than mesially approaching clasps (Khan, 2005).

Suprabulge clasps are potentially more visible than infrabulge clasps. Commonly used, circumferential clasp encircles more than 180 degrees and therefore it is not desirable for anterior teeth (Khan, 2005). For distal extension situations, the equipoise system is a good aesthetic option (Shah, 2013) and a back-action clasp, normally attached to premolars, can
Also be chosen. Hidden clasp is a good option for the anterior teeth rehabilitation (Kennedy Class IV cases). Useful when teeth have no natural buccal undercut or short clinical crown, ball-clasp can be a viable solution. Limited to the mandible RPD, flexible lingual clasps can be an option when a buccal arm is not desirable, but the abutment teeth need to be crowned.

Infrabulge clasps have a gingival approach and are not recommended, if a buccal arm is present, in patients with a high smile-line and with prominent canine eminence. Bar-clasp, typically used on RPI-system, is another option on a distal extension RPD. In other situation palatal or labial I-bar can be used; they are shorter and more rigid. Alternative to RPI-system, RLS-system can be a good solution when teeth lack of buccal undercut or when aesthetically desirable (Khan, 2005). The twin-flex clasp is a flexible wire-soldered clasp and can be another option on distal extensions, but galvanic corrosion can occur (Khan, 2005; Shah, 2013). A round-rest distal depression clasp is suggested as an aesthetic alternative on maxillary abutment anterior teeth because no metal is shown on facial surface (Shah, 2013).

The use of fixed crowns or shaping enamel surface and the use of composites to improve aesthetic and retention of a RPD are viable solutions when is possible. It can increase the cost of an oral rehabilitation, but avoid the use of clasps or allow their placement on a less visible position (Khan, 2005).

Technopolymer frameworks are manufactured from thermoplastic acetal resin (polyoxymethylene), which has a highly crystalline structure that ensures greater flexibility, high transverse strength and radiolucency. The disadvantages include bulkiness, lack of adjustability, need for special equipment and increased cost (Khan, 2005). Several tooth shades are available, but long-term studies must be conducted (Khan, 2005; Thomas, 2011). Acetal resin can also be used only on clasps (Khan, 2005; Thomas, 2011; Shah, 2013), as well as nylon clasps (Nascimento, 2013) and attached to a metal framework. However, studies showed that the deformation of these direct retainers metal free clasps were higher than their metal alloy counterparts, which may adversely affect their clinical performance and lead to the loss of retentive characteristics (Khan, 2005).

A flexible denture has aesthetic advantages over a conventional RPD. It is an alternative option when patients are allergic to acrylic, but its limitations do not satisfy all clinical cases. It is difficult to repair and to clean (Singh, 2013).

Covering metal structures with the resource of ceramics, acetate resins and nylon has been reported. Commonly these alternatives failed due to complete or cohesive fractures (Nascimento, 2013), specially in clasps which are more demanding in terms of flexibility and are continuously subjected to wear and fatigue (Sandu, 2007).

Other method to mask the luster of dental clasps has been studied and consists on coating cobalt-chromium alloy with white powder inks. These resin powder inks, mainly composed by polyamide resins, present optimal and unique features in terms of physical behavior and aesthetic. In preliminary mechanical tests and biocompatibility in vitro assay, on our laboratory, powder inks showed an adequate cell response with cultured human fibroblastic cells, supporting its potential application in biomedical areas.
CONCLUSION

A well-designed RPD must offer good support, stability and retention to allow for comfort, masticatory function and health (Chu, 2002).

Despite the alternative designs available for the RPD metal frameworks, the metallic luster of some visible components present a challenge for the clinician in order to satisfy patient’s need of an aesthetic rehabilitation (Shah, 2013; Thomas, 2011). Alternative clasps, metal free clasps and masking of metal clasps with resins/composites are different ways of improving aesthetic (Shah, 2013), especially when framework is visible during function. Studies show that deformation in free-metal frameworks is higher than in metal alloys (Khan, 2005), and the materials available for masking metal frameworks fail early due to fracture or chipping (Chu, 2002; Nascimento, 2012).

The painting of conventional metallic components with powder inks seems to be a valid option compared to other masking technics. Preliminary tests and observations revealed promissory results for a future clinical testing. This option maintains the conventional metallic framework and their inherent mechanical characteristics. However, it can add other complications related to the painting resistance in the oral conditions. Further research on the laboratory technique and clinical efficacy is needed.

REFERENCES


