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Esthetic Removable Partial Dentures Constructed by Recycling Acetal Resin (Case Report)

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KEYWORDS

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ABSTRACT:

To reduce environmental biohazards, technicians should be educated with safe biological waste disposal procedures and dental material recycling. The best and most suitable preference treatment for these individuals to replace their missing teeth with improved aesthetics is thought to be aesthetic removable partial dentures, or RPDs. The clasp assemblies' display was one of the main issues with RPDs. Acetal resins have superior dimensional stability and reduced creep at higher pressing temperatures compared to nylon. An in vitro study found that acetal occlusal rests can support distal-extension RPDs for up to three years.

Various scientific investigations have experimented with numerous approaches to recycle and reuse the resources they use on every day. In this article made removable partial denture from re-injected acetal resin, constructed the restorations according to manufacturer instructions and collected the reused acetal resin by cutting sprue injected acetal by using a cuter.

The result of this study that found the acetal resin can be re-injected and reused in any case without any problems.

1. Introduction

Different studies in various fields of science have tried other methods to recycle and reuse the materials used in their daily life [1, 2]. In dentistry, many studies suggested reusing or recycling dental materials such as dental amalgam [3], orthodontic brackets [4], phosphate-bonded investment material [5]; Zircon waste resulting from CAD-CAM [6]; and recycled PMMA and monomer [7].

Early in the 1990s, dental advancement was made possible by the employment of acetal resin, which has been used for the framework of a complete partial denture in addition to tooth-colored clasps [8]. Acetal resins are created when formaldehyde is polymerized. An oxygen molecule connects a chain of alternating methyl groups to form the homopolymer polyoxymethylene (POM) [9, 10]. Acetal resins have superior dimensional stability and reduced creep at higher pressing temperatures compared to nylon. An in vitro study found that acetal occlusal rests can support distal-extension RPDs for up to three years [11].

Adequate mechanical qualities to prevent denture breakage due to cyclic deformation are essential requirements for denture base material [12] or slam against anything solid. It has been demonstrated that the forces produced during mastication cause denture bases to flex [13], placing the acrylic polymer under internal strains that could cause cracks to grow and, ultimately, the denture to break [14].

In an attempt to solve the unpleasantness of Co-Cr clasps, thermoplastic resin clasps are being sought after. As a result, RPD retaining and supporting components have been built using polyoxymethylene (POM) [15]. The flexibility of the polyoxymethylene clasp would enable the retainer to be positioned in deeper occlusal rests on the abutment teeth [15, 16].

The clasp assembly display was one of the main issues with RPDs. One of the numerous modern solutions to this problem is to etch the retainer's arm and cover it with a coating of resin that matches the colour of the tooth. Furthermore, because these aesthetic retainers' outward look is so important, their mechanical qualities are crucial to their effectiveness and intraoral use [17].

2. Objectives

In the present study, re-injection acetal resin use in removable partial denture for three patients has been evaluated

3. Methods

Case Report

History and Findings/Diagnosis

Old female patients reported the chief complaint of replacing missing teeth in the upper and lower jaw. The patients were of similar age groups and had the same medical history; Social, drug, and history of habits were not significant. Construction of the prostheses according the manufacture instruction, which made according to studied groups

Following a lengthy discussion, a treatment plan was developed and the patients were informed of the findings. Oral hygiene recommendations were given along with scaling. After stabilizing the carious lesion on the abutment teeth, occlusal amalgam was used to repair the carious lesion.

Sample grouping

Removable partial dentures were made according to study groups for a number of patients and followed up on their condition. The study group classified to:

Group I: Control group (100% New acetal material), Group II: 75% New acetal material + 25% Reused acetal material, Group III: 50% New acetal material + 50% Reused acetal material, Group IV: 25% New acetal material + 75% Reused acetal material, Group V: 100% Reused acetal material and Group VI: Re-injection two times of reused acetal material.

Reused acetal resin collection

A method to collect the reused material by cutting the waste sprue injected acetal, procedure of cutting the sprue by using a cutter to avoid heat generation. Pieces after cutting are equal to the size of the original material (new material) to facilitate their melting with new material.

Construction of Samples

An ideal RPD situation with a standardized undercut was created as a research case. The 0.5 mm and 0.75 mm undercuts were chosen to mimic the situations in which clasps should be positioned closer to the gingival edge and require a larger depth for a more aesthetically pleasing outcome. The 0.25 mm undercut gauge was chosen because it mimics the undercut often used for Co-Cr clasps. The flexibility of the clasp is determined by its length, thickness, section, and material; a more flexible clasp offers less retention [18, 19].

Impression making, bite rims, analysis the occlusion, arrangement teeth and waxing, after complete the check step so flasking done.

Hard dental die-stone moulding material Type IV (Zermach, Germany) was used to mould the wax patterns, and the mixture was made in accordance with the manufacturer's instructions (W/P: 20 ml / 100 g). The position of samples and direction of sprues should be in a way that enables the soft acetal to flow easily during injection under adjusted pressure. Otherwise, the acetal material will be deficient.

Wax was removed with a wax extraction equipment following flasking and wax pattern inlay. The mold cavity was subsequently cleaned using detergent solutions and hot water. After allowing the mold to dry for 30 seconds, a single coating of appropriate separating material for thermopressing (Vertex, Germany) was applied to the mold's surface, and it was allowed to dry overnight [19].

The acetal resin removable partial dentures (Evidsun dent, shade A2, Russian) were made according to the manufacturer's instructions. The mould was injected with heated, softened acetal resin, which was then cured at 220 o C for 20 minutes with a 7-bar injection pressure. The samples were deflasked, polished with thermal resin finishing burs [20], after complete the all sample and insertion in patient mouth as shown in figure 1., figure 2., figure 3., figure 4., figure 5. And figure 6.

Figure 1. Control group (100% new) for upper acetal partial denture of patient No.1

Figure 2. Group II (75% new+ 25% reused) for lower acetal partial denture of patient No.1

Figure 3. Group III (50% new+ 50% reused) of upper acetal partial denture of patient No.2

Figure 4. Group IV (25% new+75% reused) for lower acetal partial denture of patient No.2

Figure 5. Group V (100% reused) for upper acetal partial denture of patient No.3

Figure 6. Group VI (re-injection two times) for lower acetal partial denture of patient No 3

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4. Discussions

One of the most crucial RPD requirements is the distribution, reciprocity, and retention of strength and flexibility in balance. The retention and stability of the prosthesis are known to be decreased by the clasps' persistent deformation brought on by repetitive stresses during RPD insertion and removal. New materials, material heat and chemical treatments, and clasp designs have all been created to lessen clasp distortion [15, 21]. According to research by [22], The colonization of microorganisms on mucosa and on a denture, base made of metal or acetal resin grew over time. The mucosa under an acetal denture basis maintained more germs than the mucosa under a metallic denture base. For patients at a high risk of infection, the study recommended short-span bonded saddle dentures made of Co-Cr. Acetal partial denture frameworks are preferred for use with implant-supported RPD over metal frameworks in order to maintain bone surrounding the implant, according to [23]. The gloss of acetal resin was less affected by water, peroxides, and sodium chloride solution (5.25%) than that of acrylic resin. Acetal resin showed results that were clinically acceptable for water and peroxide solutions, whereas acrylic resin showed results that were unsuitable. It is not recommended to immerse acetal resin in a 5.25% sodium chloride solution due to the observed greater sorption that is clinically unacceptable [24]. Acetal resins are an excellent choice for preserving vertical dimension during temporary restorative therapy because they resist occlusal wear [25]. Thermoplastic acrylic and polycarbonate, which have inherent translucency and liveliness, may provide superior results for temporary, short-term restorations than acetal [10]. Thermoplastic acetal resins display superior dimensional stability and less creep when pressed at temperatures greater than those of nylon. In vitro studies have shown that acetal occlusal rests can maintain distal-extension RPDs for a maximum of three years. Acetal RPDs have the same configuration as metal framework RPDs, but they are larger and bulkier [26]. Polyoxymethylene have a higher surface luster than nylons, reduce creep, and offer better abrasion resistance. In addition, acetal decreases the sorption of water. Acetal resin's increased stiffness allows for the support of traditional clasp designs, connectors, and other components, though some correction is necessary [27]; Turner investigated the flexural properties of acetal resin to determine the best design for a removable partial denture clasp constructed from acetal resin. suggested that the dimensions of the acetal clasp be 40% larger in cross-sectional area and 30% shorter than those of cast metal in order to resemble a cast cobalt chromium clasp in regard to stiffness. Thermoplastic acetal resins are highly strong, flexible, and resistant to breaking and wear. For partial denture frameworks, they are recommended. implant abutments, occlusal splints, and prefabricated clasps for partial dentures. When used in temporary restorative therapy, acetal resins resist occlusal wear and preserve the vertical dimension. Nevertheless, they do not have the inherent translucency of polycarbonate and acrylic thermoplastic polymers [27, 28].

Acetal resins have superior dimensional stability and less creep at temperatures greater than those of nylon when pressed. An in vitro study found that acetal occlusal rests can support distal-extension RPDs for up to three years [11]. Acetal resin clasps had negligible impact. The retentive force of the cast Co-Cr clasp dropped from 12.4 N to 8.1 N. The retentive force of the acetal resin clasp decreased from 5.2 N to 4.03 N at the conclusion of the trial [29]. The retentive forces necessary for clasp retention have been the subject of a few investigations. According to one study, the retentive force needed for PRDPs to work and be retained well ranges from 3 to 7.5 N, however another study revealed that 5 N could provide an acceptable degree of retention [19, 30]. In the present study, the retention force of re-injection two times clasp shows the higher retentive force this may be due to more of the acetal material being exposed to heat and injection several times, and the flexibility decreases. It is possible for thermoplastic clasps to attain clinically satisfactory retention at dimensions that are different from those of metal clasps; a thicker clasp might be necessary in order to engage a deeper undercut [31]. This could be necessary due to the relatively low rigidity of the thermoplastic material compared to metals and alloys, and may reduce the possibility of traumatic overloading [27, 32]. Since clasps with deep undercuts have less flexibility, a higher modulus of elasticity results in less deflection. As a result, the clasps' retentive forces gradually diminish, they show signs of plastic deformation, and they may break when being used [19].

In the present study the most esthetic partial denture required to used thermoplastic acetal and reused acetal resin is possible without any different when compare with new acetal so in this study recommended to re-injection acetal resin and reusing as denture base and esthetic clasp

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