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FLEXIBLE POLYMER DENTURES - CONTEMPORARY SOLUTIONS FOR SUPERIOR ESTHETIC AND COMFORT

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Abstract: The method for making flexible polymer partial dentures provides the opportunity to obtain dental devices, in a very short period of time, without multiple try-in appointments. The materials are fully biocompatible and do not contain allergic monomers, their durability is large, they are flexible and practically unbreakable. Obtaining a prosthetic solution of this type without the presence of metal retention elements (clasps and attachments), without hard and rigid acrylate mass, present remarkable and contemporary therapeutic and prophylactic solution.
The aim of the paper is to present different prosthetic solutions for the patients with flexible prostheses made from the Bre. Flex material. Bre.flex is a nylon-based thermoplastic material, composed of nylon PA 12 (polyamide). Nylon exhibits high physical strength, heat resistance, and chemical resistance. The material, after heating, passes into a plastic state and is injected under pressure into a mold for definite formation of the prosthesis. Due to the low melting temperature, the material exhibits excellent flow characteristics and can be safely injected up to a thickness of 0.5 mm under a pressure of 7.0 to 7.5 bar. The high pressure reduces shrinkage and ensures extended dimensional stability so that precision-fit dentures are obtained and accumulation of plaque is avoided. It can be easily modified to increase stiffness and wear resistance. Nylon resin can be semi-translucent and provides excellent esthetics but it is difficult to readjust the dentures and provide smooth and polish surfaces after correction.
These dentures in our patients represent an immediate solution only a few hours after the extraction of the teeth, a temporary solution after implant therapy until the end of the period of ossification and permanent prosthesis in patients who do not like preparation of the adjacent teeth for retention elements (attachments) or visible metal parts characteristic for classic and cast metal removable partial denture. Flexible polymer partial dentures present a highly esthetic solution, they are very thin, and through elastic clasps provide good retention and stabilization of the device during the masticatory process, giving the opportunity for greater comfort in the exploitation and faster and shorter adaptation period.
Keywords: Flexible partial dentures, elastic clasps, bre flex

1. INTRODUCTION

The therapeutic protocol in patients with partial or total edentulousness depends on both the dentist and the wishes and needs of the patients. Rehabilitation and the consequences of lost teeth such as poor mastication, phonetics and aesthetics are of primary importance for patients seeking help in dental practices. Today there are many different therapeutic modalities, and these are fixed prosthetic constructions such as crowns or bridges, acrylic removable partial and total dentures, implants, etc. Each of these prosthetic solutions has its advantages and disadvantages, and the right choice is not always easy. For years, the partial and total edentulousness in patients has been successfully treated with the development of removable partial and total prostheses made of different types of dental materials.
Although the ideal material for their manufacturing is not yet available on the market, certain requirements are standardized and some of them are: the material has to be biocompatible, nontoxic, not to be saturated in saliva, beverages and food, to have good aesthetics, high strength and resistance to fracture of the base and teeth, has a high modulus of elasticity, thermal expansion similar to that of dental tissues, to be dimensionally stable, to have the possibility for easy correction and adaptation, the possibility of easy maintenance of hygiene etc [1]. According to ISO standard 1567: 1997, polymers as materials for manufacturing of the base of the dental prostheses with respect to the composition and manner of polymerization are divided into four groups. The removable partial dentures most commonly use materials from the group PMMA (polymethyl-methacrylate) as powder and liquid, which are polymerized by a chemical reaction under pressure and temperature. If the prosthesis has a metal base and a minor and mayor connectors made of steel alloys and resin saddles with denture teeth fitted on a hard acrylic base, then it is a cast metal removable partial denture that has both materials in its composition [2].
Although these dental prostheses are commonly used and possess satisfactory aesthetics and function, they also have many unwanted features. The possibility of developing an allergic reaction to acrylates and their residual monomer or to nickel from metallic alloys put these products in the group of poorly biocompatible. The material often shows

signs of porosity with the possibility of imbibition of food residues and colonization of various microorganisms (fungi and bacteria), acrylates have low strength and can be easily broken, dimensionally are unstable at high temperature, etc. [3]. What presents a weak element in these prostheses is the manner in which the connection with adjacent tooth teeth is achieved, their retention and stabilization component. Classical acrylic partial prostheses have wired clasps with an elastic handle placed in under-cut places under the tooth's equator and thus make the prosthesis lying in the patient's mouth. The clasp itself is quite non-aesthetic because it possesses gray color from the metal, often breaks down, deforms and fails to fulfill its basic function [4].

The materials with improved composition and characteristics are imperative in every medical branch, and an important part in prosthodontics too. Thermoplastic polymer materials for the first time in dentistry were presented in 1950, but the rapid injection system was developed ten years later. Yet even in recent years, they achieved their place in everyday practice. Thermoplastic polymers or nylon plastics possess long-lasting durability, stability, melting resistance and fatigue of the material, as well as a minimal amount of residual monomer responsible for allergy [5]. They are without any porosity of the structure, showing less accumulation of biological material on their surface, less coloring and unpleasant odor after a certain period of wear. These polymers have a wide range of indications in mobile partial and total prostheses, temporary crowns and bridges, obturators and speech correction apparatuses, orthodontic retainers and brackets, impression cast, occlusal splints, sleep disturbance appliances, abutments and superstructures over implants [6].

The aim of this paper is to present several clinical cases of patients with various constructive solutions from flexible polymer prostheses. At the same time, we wanted to make an analysis and evaluation of the performance of thermoplastic products, as well as their advantages and disadvantages in terms of conventional acrylate PMMA prostheses.

2. MATERIAL AND METHODS

Materials for flexible thermoplastic prostheses - polymers (nylon)

The term thermoplastic refers to a plastic material which, at a certain temperature, becomes subject to changes in its shape, so that after cooling it returns to solid state. Flexible means the ability of the material to elastically deform and return to the same shape. Flexible thermoplastic polymers used for dental prostheses, depending on the application, can be divided into several groups: polymers for making prostheses (partial and total), temporary and permanent crowns and bridges, telescopic crowns and attachments. Bre.flex (Bredent, Germany) is a thermoplastic polymeric material made of nylon, PA 12 (polyamide) used for manufacturing partial prostheses. Bre.crystal is a thermoplastic polymer material used for manufacturing partial and total PMMA -based prostheses with high strength, resistance and a modulus of elasticity with minimum residual monomer concentrations of 0, 2%. There are other thermoplastic polymer systems Valplast (Valpalst Int. Corp. USA), Flexiplast (Bredent Germany), Lucitone FRS, Flexite, Flexite plus, Flexite M.P. Sun flex, pro flex, etc. Nylon is a material that shows great physical strength, a density of 1.04 g / cm^3, heat resistance and chemical stability. It is easily modified in order to improve the hardening phase and the resistance to wear. The material - polymer Polyan IC comes in the form of pellets which can be in three colors depending on the place of application (colorless, pink and dye color). Using the special color key, you the desired color can be selected.

Figure 1. Pellets and injection pressure device

Methods and procedures for flexible thermoplastic prostheses

There are two different types of polymers according to the method of production, which are polymers for compact injection and polymers for the compression system. The injection mold system is a method that provides less polymerization shrinkage and produces more precise constructions with greater homogeneity of the material [7]. The preheating temperature of this type of nylon is 222 ° C and after 15 minutes it becomes plastic and is easily shaped after injection under pressure into the thermo press 400 injection apparatus (Figure no. 1). Due to the low melting

temperature, it has good traction characteristics and can be injected to a thickness of 0.5 mm at a pressure of 7.0 to 7.5 bar [8].

The high injection pressure of the polymer material reduces the contraction and thus ensures prolonged dimensional stability for more precise and fitted prosthesis characterized by reduced accumulation of plaque on the surfaces. The nylon itself is a semi-transparent and therefore gives excellent aesthetics, although it is harder to re-adapt and to obtain smooth and polished surfaces after corrections.

What is important to note is that the connection with the artificial acrylate teeth is not chemical, and it is always necessary to provide an appropriate mechanical connection with retention grooves and undercuts.

Case reports

Flexible polymeric immediate - interim dental prosthesis

A 35-year-old female patient with ceramic fused to porcelain bridges in the upper and lower jaw, which had been placed in the mouth more than ten years ago, came with the requirement to establish continuity of the upper left dental arch. During the first visit, clinical examination with anamnestic data on dental and general health status was taken. We took photos for evaluation of the intra and extraoral situation and occlusion, for determination of the tooth color and to evaluate patient's periodontal status. Paraclinical examination with radiograph status of both dental arches was also taken, and the patients signed approval document-consent for public presentation of the therapeutical process.

During the inspection, a fracture of the two last abutment teeth 23 and 24 on the cantilever bridge was found, as a consequence of a larger masticatory load for longer time period, on the extension pontics retained on one side by the abutment teeth. After eight years, due to appearance of pain under the crowns, the teeth 23 and 24 were endodontically treated, as seen from the existing perforations of the occlusal surfaces of the two crowns in the abutment teeth (Fig. 2).

Figure 2. Intraoral situation prior extractions and dismantled extension Bridge

Cutting of the bridge connector between teeth 22 and 23 was performed. The preliminary anatomical impressions for further treatment with removable partial flexible prosthesis were taken in the same visit. (Figure no. 3) The remaining roots in the upper jaw on the left side were extracted, due to the chronic exacerbated apical periodontitis diagnosed upon the clinical examination and X-ray finding.

The immediate or interim removable prosthesis is a denture placed in the mouth immediately after the extraction of the natural teeth [9]. Conventional or classical immediate prosthesis is often a definite prosthetic therapeutic solution, and it will have multiple functions during the period of healing of the extraction wounds. It will be a protective strain to control post-bleeding and will control and protect the formation of the blood coagulum in the two alveoli. In this way, the healing and healing phase is shorter and easier to tolerate, and the patient's discomfort is lower.

Figure 3. Preliminary anatomical impressions for a flexible partial prosthesis

In the same visit, the color of the remaining teeth and the future prosthesis was determined. Because the patient disagreed with the offered implant-prosthodontics therapy solution, we suggested a polymeric flexible partial prosthesis as an immediate, but also a permanent solution for the terminal edentulousness in the upper jaw, in which there were no longer any conditions for the re-construction with a fixed bridge construction (Fig. No 4).

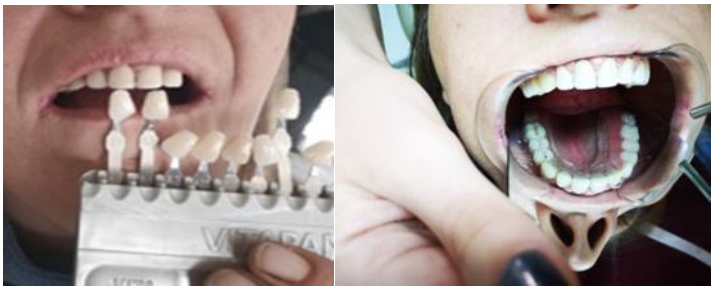

Figure 4. Color determination for flexible polymeric prosthesis and finished denture in upper jaw

Flexible polymeric prostheses are characterized by high elasticity, toughness and the ability to reduce the large palatal connector. The retention elements are flexible clasps made of transparent flexible polymeric material together with a part of the prosthesis base which, as an extended endless clasp, also provides its stabilization. Aesthetic, phonetic, retention and stabilization performance are met and the patient is fully rehabilitated after the first visit (Figure 5). With this, the patients are relieved of a period of edentulousness, and at the same time provided with a continuous social life without changes in the performance of normal everyday tasks [10], [11].

Figure 5. Occlusal appearance of the denture and frontal view of the patient with denture fitted-in

The patient was given instructions for continuously wearing of the prosthesis for 3 consecutive days and overnight. The first control check-up was made after 24 hours, within a week from extractions when the post-extraction suture was removed, and after one month. During all control examinations, the patient did not have any subjective and objective difficulty from the prosthesis. She confirmed that she quickly adapt to the prosthesis and was satisfied with the aesthetic appearance. During control checks there was no need for correction of the teeth and prosthesis. After definite wound healing after a period of 3 months and the formation of the definitive shape of the alveolar ridge, the patient did not need to be subjected to preadaptation to the supporting structures, since the greater part of the distal portion of the base and the saddle of the prosthesis lied on 15 years edentulousness alveolar ridge. Relining of the basal part is required when there is a greater resorption of the alveolar bone after the recovery period of the extraction wounds [12], [13].

Flexible polymeric permanent prosthesis

A 50-year-old female patient with the remaining 4 roots wit periodontal changes indicated for extraction, requested an implant prosthetic solution, which was contraindicated due to the extensive resorption of the maxillary bone and the lowered floor of the two maxillary sinuses. From the clinical examination and radiographic status, it was found out that due to the weak bone support of the remaining three frontal teeth on the right side, the case could not be solved with a new combined fixed-mobile solution (a three-member bridge with an cast metal removable partial denture). Flexible polymer subtotal prosthesis in the upper jaw with preserved remaining three frontal teeth was a

therapeutic solution for the patient, who due to travel and inability to control visits, was the fastest and most optimal (Figure 6).

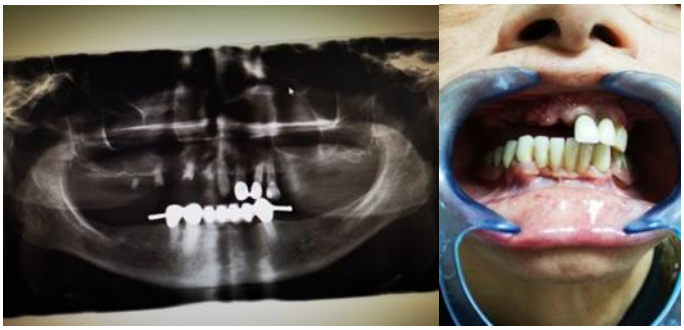

Figure 6. The patient's radiological status before the onset of prosthetic therapy and intraoral display after the extraction of the radices

The denture was made after a period of primary healing of the extraction wounds and the formation of the alveolar ridge. Mouth preparation was not required for fabrication of flexible partial dentures as required for removable cast partial denture. The working process is almost identical to the phases of making acrylic conventional prostheses. First, it begins with a preliminary anatomical impression with an irreversible hydrocolloid material from the upper and lower jaw. Then a master model with wax occlusal rims was created, for recording of the lost inter jaw relations and mounting the casts on the articulator. Then we chose the artificial teeth of appropriate size and color, and try prosthesis with teeth arranged in a wax up. Afterwards the sprue former was attached to make the channels for flowing of the fluid resin into mold, and making a defining flexible prosthesis (Figure 7).

Figure 7. An overview of an upper master model with a flexible base h and teeth placed in a wax and definite flexible polymer partial prosthesis

What makes these products different from the conventional ones is that the retention elements are flexible transparent hooks which at the same time represent a very good aesthetic solution. In our patient with only maxillary frontal teeth left, no other work can achieve the appropriate aesthetics such as transparent hooks of this type of material (Figure no.8)

Another great advantage is the flexibility of a large connector that acts as a stress absorber, with the flexible base itself hovering over the tissue of the oral mucosa and allowing adequate stress distribution [14]. Due to the minimal load on the ankle-carrier of the retention element, no further changes in the mobility of the remaining retention teeth with parodontally compromised status were expected [15].

Figure 8. Final presentation of the patient with flexible prosthesis in the upper jaw

Indications and contraindications for making flexible prostheses

In everyday practice these prostheses have a wide range of indications, that is, they can be made as conventional prostheses in all classes of partial and total edentulousness. When the presence of strongly expressed bone and undercut sites are present in the mouth, especially when the changes are bilaterally present, in patients with exostoses, these prostheses are more easily adapted due to the flexible surfaces that easily penetrate the undercut place [16].

Due to the minimal concentration of the monomer, they are indicated in patients with allergic to classical acrylate masses, in patients who are allergic to nickel and other elements of steel alloys. For aesthetic reasons when retention teeth are frontal teeth especially in the upper jaw, in patients with microstomy, systemic diseases (scleroderma) and other diseases with limited mouth opening and in patients with pronounced and undercut maxillary tuberosity [17].

However, in some cases flexible prostheses are contraindicated for the manufacture, like in deep bite patients with an overbite of the front teeth above 4mm, in patients with very small interocclusal distance less than 4mm, when there are bilateral free distal extended saddles with edges of the alveolar ridge as sharp as a knife, and when there is very small number of teeth with minimal undercurrents [18], [19].

Advantages and disadvantages of flexible prostheses

Contemporary flexible prostheses are commonly indicated when conventional cannot meet patients' requirements regarding aesthetics and comfort in wearing. The advantage of the dentures is in the aesthetic performance, and their retention elements with pink or translucent color. In deeply undercut places and expressed torus, the flexibility helps and facilitates loading and unloading of the device. These prostheses do not require or require only minimal preparation of hard and soft tissues for the occlusal seats. The material of the prostheses is so firm that they are practically unbreakable, and can be performed with very small thickness, which gives maximum wear comfort. The manufacturing process allows the dentures to have a high precision and a faster adaptation period. Prostheses are also biocompatible and with no possibility of allergic reactions. [20], [21], [22]. However, these dentures, despite all the advantages they possess, have some certain disadvantages, and in Kennedy I and II class, control of the stress that passes through the flexible base cannot be made. After a certain period of wear of about a year, discoloration of the prosthesis can sometimes be seen. Sometimes the acrylate teeth can be detached from the base because they don't accomplish a chemical bond with saddle resin.

The prostheses are actually not so long-term, that is, most authors consider them only as temporary solution, but not durable constructions. Compared with cast metal dentures, they still show shorter life expectancy and usage [23].

If there is a need for relining and corrections of the flexible materials used, this cannot be done [24]. When there is a need for the finishing and grinding of these prostheses, care masks and vacuum systems need to be carefully observed and used. In contrast to conventional acrylate prostheses in these materials, it is recommended the use of green carbide burs at a speed of 20-25,000 rpm with continuous movement [25]. If the grinding body is kept for a long time at one place, the plastic can be melted and therefore it is carried out with constant movement of the instrument on the surface (Figure 9).

Figure 9. Treatment of a flexible prosthesis

3. CONCLUSION

The method of injection of flexible polymer partial prostheses provides the possibility of obtaining dental devices, in a very short period of time, after the first visit of the patient. Despite certain limitations, deficiencies and the higher cost, flexible thermoplastic prostheses after an appropriate diagnosis, treatment plan and appropriate technical preparation, are an opportunity to replace the more commonly used conventional products by offering better aesthetics, easier and faster adaptation and better quality of life.

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