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British View ISSN 2041-3963 Volume 8 Issue 5 2023
Universal impact factor 8.528
SJIF 2022: 4.629

Comparative analysis of prosthetic dentures for the restoration of medium and large defects in the dentition.

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Abstract: Prosthetics with partial adentia is one of the most common and popular areas in prosthetic dentistry. Removable partial dentures of different materials have their own advantages and disadvantages. Depending on the material and design of removable dentures, the adaptation of patients to the prosthesis is also different. It is important to choose the type of prosthesis suitable for the size of the defect in the dentition, the location and condition of the supporting teeth, and the general condition of the patient. This review is devoted to the study of the features of prosthetics in partial adentia.

Keywords: Partial adentia, thermoplastic material, acrylic resins, partial removable denture.

One of the most common diseases in dentistry is partial adentia. According to WHO, it affects up to 75% of the population. This is a serious medical and social problem [5,19], because when the integrity of the dentition changes, the function of chewing is disturbed, which leads to diseases of the gastrointestinal tract. No less important are the consequences of partial absence of teeth: articulation and diction disorders affect the communication abilities of the patient, these disorders, along with aesthetic changes due to loss of teeth and developing atrophy of the masticatory muscles, can create a deterioration in the patient's psycho-emotional state [1,18].

Prosthetic treatment for partial loss of teeth has many options and depends on the size and topography of the defect, the age of tooth loss, the condition of the remaining teeth and tissues of the prosthetic bed, the general condition of the body, the age and profession of the patient, as well as the price of the proposed options for orthopedic treatment [22, 23].

The most "favorable" option in terms of design choice is small defects in the dentition (in the absence of 1-3 teeth). In this case, the defect can be restored with bridges, which are the most physiological and easily adaptable for the patient. With a favorable condition for implantation of the hard and soft tissues of the patient's oral cavity and his general condition as a whole, even in the presence of medium and large defects, fixed prosthetics become possible.

Significant difficulties arise when implantation is impossible for one reason or another for subsequent fixed prosthetics. In this case, we offer patients various options for removable dentures.

The purpose of this article is a comparative literature analysis of the proposed removable orthopedic structures to replace medium and large defects in the dentition.

If there is a small defect in the dentition that cannot be restored with a fixed bridge prosthesis (in the case when the abutment teeth do not meet the requirements for them), we can offer the patient a small resting or removable bridge prosthesis. When planning implantation, a small saddle prosthesis can be made as a temporary prosthesis. However, this prosthesis may worsen the conditions for subsequent implantation.

The optimal option for removable prosthetics with medium defects in the dentition for decades are clasp dentures. Being semi-physiological and having a relatively small volume compared to plate prostheses, they help to reduce the time of adaptation to them. An important advantage for patients is the possibility of using aesthetic methods of fixation (attachments and telescopic crowns). Depending on the clinical case, many designs of clasp prostheses are possible, allowing to take into account the structural features of the hard and soft tissues of the prosthetic bed.

The development and implementation of modern highly efficient structural materials and technologies has made it possible to improve clasp prostheses with fixation on clasps. An example of this is the thermo-injection system for monomer-free molding of plastic - white thermoplastic plastic "Dental D" for the manufacture of the frame of clasp prostheses, presented by the Italian company "QuattroTi".

Dental D is a technological polymer based on the semi-crystalline structure of polyoxymethylene, which has an aesthetic appearance and is produced in a spectrum of 10 colors close to the VITA scale [16].

Its properties are: biocompatibility (corresponding to international standards ISO 10993), high strength, which is 15 times higher than that of acrylic plastic (3200 units against 200 units); exceptional traction and toughness; optimal combination of stiffness and tackiness, flexibility, creep resistance, and low coefficient of static and dynamic friction. Optimum dimensional stability, elasticity and damping capacity, and especially high wear resistance are also important advantages.

However, the material is not without drawbacks: high cost and the inability to perceive excessive chewing pressure. It should also be noted that it is recommended to store and care for prostheses using special solutions, which will help extend their service life [4].

Recently, clasp prostheses made of acetate plastic (polyformaldehyde, polyacetal, polyoxymethylene) have become widespread [14]. It is characterized by increased resistance to various mechanical damage, to high-intensity loads (including shock), to abrasion; it practically does not concede to metal in durability. In addition, the material is not affected by solvents and oils of organic origin, and is also easy to

process [28]. Acetal is now produced in a wide range of color shades (seventeen white shades on the standardized Vita tooth shade scale, as well as three pink shades for the base of a removable denture) [20], which makes it possible to completely fabricate a clasp denture from acetal. Not unimportant is that it does not cause allergic reactions and irritation in patients, and the absolute non-hygroscopicity of thermoplastic prevents bacteria and food particles from penetrating into the thickness of the prosthesis, making it much more hygienic than acrylic. It also has flexibility, which allows the prosthesis to adhere more closely to the gums and palate.

Speaking about the shortcomings, first of all, low elasticity should be attributed. Too small thickness in some cases can lead to a decrease in the stabilization properties of the prosthesis. In addition, in this context, it would be appropriate to say about the high cost. Relocation of the structure is too complicated, its implementation can in some cases be equal in cost to a new one. [thirty].

The above analysis undoubtedly indicates the advantages of a clasp prosthesis over lamellar ones, however, the indications for the former are limited: it is necessary to have at least 6 healthy teeth in the dentition with a clinical crown of sufficient size.

In the absence of these conditions, the patient is offered various designs of plate prostheses.

The most common type of laminar prosthesis for almost a century (since 1938) are acrylic plastics with holding clasps. They took the position of an almost ideal material in the field of restoration of medium and large defects in the dentition: the base of this material looked natural, was strong, had dimensional stability and, importantly, high technological properties, was easy to polish, and there was always the possibility of repairing or rebasing the prosthesis. A significant disadvantage of acrylic plastic prostheses is the microporosity of the bases, which inevitably arises for technological reasons, due to shrinkage that occurs during the polymerization process. They do not have a protein nature and therefore cannot cause allergies by themselves. The main etiological factor in the development of allergy to acrylate is considered to be the residual monomer [24,25], which is contained in plastic in an amount of 0.2%, which increases to 8% if the polymerization mode is violated [8, 9.26]. It is a low molecular weight compound, the monomer - ester of methacrylic acid - combines with body tissue proteins, turns into an antigen. It has been established that the monomer reduces the titer of lysozyme in saliva. In addition, its direct toxic effect on the cells of the oral mucosa, including mast cells and basophils, leads to a nonspecific release of histamine, which is able to modulate the allergic response to exposure to causally significant allergens, thereby causing allergic contact dermatitis [5, 30].

Thus, the residual monomer leached out of prostheses, even in small amounts, affects the functional state of oral cavity neutrophils and suppresses their activity. According to a number of authors, the monomer is a protoplasmic poison, is extremely active upon contact with tissues, and can have an irritating and toxic effect on the entire body [7,8,15,17]. These shortcomings of acrylic prostheses stimulated the search for new types of base materials.

Along with the elimination of allergic effects on body tissues, when developing basic materials, attention was paid to a number of important characteristics:

plasticity and impact resistance, which mainly determine the functional qualities and durability of the prosthesis [14,16];

- water absorption (swelling), since the base materials are mostly in the aquatic environment;

- heat resistance (determining the maximum operating temperature of the material), thermal expansion and thermal conductivity.

In addition, they must meet the following requirements:

-do not have an unpleasant taste and smell;

- have an attractive appearance that mimics the natural color of the gums / tooth enamel;

- be biologically inert and harmless to the oral cavity and the whole human body;

- Possess strength and resistance to abrasion;

- reliably interact with other elements of the prosthesis;

- be heat-conducting, technological and elastic, as well as resistant to various loads.

One of these materials was thermoplastics - a type of plastic that can reversibly change into a highly elastic state when heated. In 1956, members of the Society for Artificial Organs isolated biologically neutral from the group of thermoplastics, the so-called "medical grade thermoplastics", which later began to be used to create artificial organs and structures, in particular in orthopedic dentistry.

The general characteristic of thermoplastics is determined by the wording "material that is plastic when heated", i.e. materials are packed in a heated state without the use of monomers [27]. After heating at a temperature of 160 to 200°C, thermoplastics acquire a viscous-flow state and are introduced into a pre-closed mold through an injection channel under a pressure of up to 50 atm [29].

At the moment, there are 3 types of materials used for the manufacture of removable dentures that have the property of rebound elasticity: nylons, acrylic polymers - polymethyl methacrylates and acetals - polyformaldehydes. These substances have different structures, but have some common properties [13,14]:

1. They have high precision, stability and uniformity due to hot injection under 12 atm pressure;

2. devoid of residual monomer;

3. contain a stable dye that gives the prosthesis an aesthetic appearance for a long time;

4. very light.

In 2018-2019, the staff of the Institute of the National Research University "BelSU" studied and compared the terms of adaptation to the two groups of materials most commonly used as bases for partial dentures: thermoplastics and acrylics. For this purpose, the sociological method of questioning was chosen, as it is the most accessible and convenient clinical method for statistical data analysis. Patients were asked questions to assess the timing of adaptation, the main complaints when using removable dentures, the quality of workmanship and the hygienic state of dentures, taste preferences and satisfaction with the design. The criteria for including patients in the study were:

1) partial absence of teeth,

2) indications for removable prosthetics,

3) informed voluntary consent of the patient,

4) making a partial removable denture for the first time,

5) time after prosthetics is at least 2-4 months.

The results of the study showed statistically significant evidence that thermoplastics are easy to use, they also have less porosity, better color stability and aesthetics, the process of rehabilitation and getting used to them takes less time than acrylic prostheses. In addition, thermoplastics are distinguished by greater elasticity and shock-absorbing properties, which corresponded to the literature data (Tregubov I.D., 2007). However, they are quite sensitive to abrasive pastes, so special products or ordinary soap should be used for daily care. They should be professionally cleaned every 5-6 months. It should be noted that in practice, the excessive elasticity of such prostheses showed a negative effect on the mucosa: nylon prostheses deform during use under the load of chewing, which leads to an uneven distribution of pressure on the mucosa. This phenomenon causes its rapid atrophy. Accordingly, a practical prosthesis should be more rigid. Another disadvantage of nylon prostheses is that they are repaired by additional pressing, which is a rather complicated and expensive process.[2,3,9,10,11,12]

The average time for adaptation to acrylic plastic prostheses is 19-30 days. In turn, they have a more pronounced smoothness compared to thermoplastics, as they are more amenable to technical processing. Acrylic plastics in many clinics are still the only material for the manufacture of bases for removable dentures, since they are

inexpensive, have a simple manufacturing technology, do not require expensive equipment and, compared with thermoplastics, have a less negative effect on the tissues of the prosthetic bed [6].

The search for methods of removable prosthetics, which allows using the advantages of various groups of materials, has led researchers to develop the so-called "Sandwich prostheses".

Sandwich system is a removable prosthesis, the frame of which is made of white thermoplastic. The basis of the prosthesis consists of acrylic plastic and artificial teeth. Due to the combination of different layers of materials, the prosthesis got its name - "Sandwich".

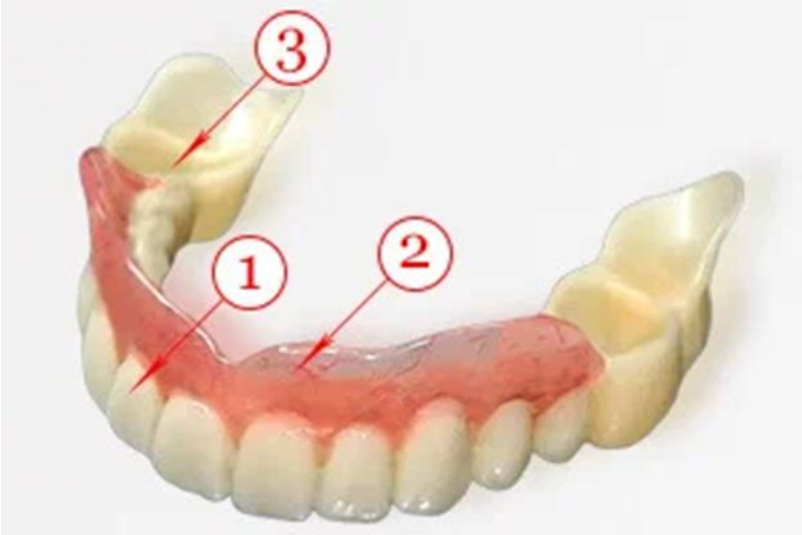

Figure 1. Sandwich prosthesis: 1 - artificial teeth, 2 - acrylic base with artificial teeth, 3 - hollow thermoplastic crowns.

The main advantages of the prosthesis are the possibility of not grinding the remaining natural teeth and a significant reduction in the volume of the base, which reduces the time for adaptation to the prosthesis.

However, this prosthesis is not without drawbacks:

- due to the small volume of the framework, an increased load is placed on the tissue of the prosthetic bed, as a result of which, when chewing, patients may experience pain.
- risk of destruction of abutment teeth;
- more expensive than classic removable structures.

A mandatory requirement is the presence of a bilateral end location of the abutment teeth. Sandwich prostheses are not installed on the front teeth.

Indications for "Sandwich-prostheses":

1. large included defects in the dentition;
2. intolerance to classic SNPP (pronounced gag reflex);
3. anomalies in the structure of the palate;

4. increased dryness of the oral cavity;

5. the inability to carry out implantation.

Conclusions. The study of the features of modern dental prosthetics, taking into account the physicochemical properties of the structural materials used, allows the orthopedist to correctly approach and consider from all aspects the issue of choosing an orthopedic treatment plan, based on the individual characteristics of the patient.

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