Aspects on Structure of Materials Used for Different Types of Occlusal Splints

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Occlusal splint therapy can be defined as the art and science of reestablishing the neuromuscular balance of stomatognatic system and creation of a mechanical disadvantage for parafunctional forces with the help of removable appliances. The aim of the study was to identify the structure, the role and the types of occlusal splints that are efficient in the treatment of different forms of dysfunctional syndrome of stomatognatic system. The study sample comprised 49 subjects, 17 males and 32 females, aged between 12 and 73 years; the patients benefited by specific treatment of stomatognatic system dysfunctions in the last three years in Clinic of Gnatho-prosthetics, Dental General Hospital No. 1 of Iasi. We have used occlusal splints manufactured from transparent material (acrylic resin) that can be flexible or rigid. The rigid resin was the first material of choice, and the occlusal splints can be made with occlusal cover: partial or total. These can be applied on mandible or maxilla. From the sample taking under study, we have searched the efficiency of both types of appliances made-up from hard acrylic resin, and respectively, soft thermoforming occlusal splints. Also, we appreciated the importance of chemical structure of material used in elaborating the appliances. The results had the following distribution: only 19% of subjects observed a real improvement of their status, the percentage being relatively small. The response to treatment applied was swifter and with better results in the patients which obeyed to the given indications, and wear a type or another of the occlusal splints. Thus, from the entire batch, a percentage of 42% totally followed the indications, 30%, only partially, and 28% have not obeyed; the results appear proportional with the consideration conferred. The occlusal splints, hard or soft, used in treatment of dysfunctional syndrome are an ideal method, because only in the conditions we could talk about quality dental therapy. In most of the cases, therapy should be associated with drug and symptomatic therapy.

Keywords: occlusal splint, acrylic resin, chemical structure, soft resin appliance by thermoforming procedure.

For many years, for the diagnosis and treatment of various disorders of the masticatory system there has been used occlusal splint therapy. In the literature there are described many designs for occlusal splints, and the different types of splint are used to treat different conditions. A proper examination and differential diagnosis is necessary to lead to a decision regarding the appropriate role of splint therapy for each problem.

We should consider both the physical and chemical properties of materials used to manufacture occlusal splints and the material behaviour in the oral cavity.

An occlusal splint is a removable appliance covering some or all of the occlusal surfaces of the teeth in either the maxillary or mandibular arches. The ideal occlusal splint is made from laboratory-processed acrylic resin, which should cover the occlusal surfaces of all the teeth in one arch. It should provide even simultaneous contacts on closure on the retruded axis with all opposing teeth and anterior guidance causing immediate disclusion of the posterior teeth and splint surface outside intercuspal position [1].

Basically, there are two different materials, based upon consistency, which are used in the fabrication of occlusal splints. Hard acrylic resin that are either chemically cured or heat/pressure processed, resulting in hard and rigid tooth-borne and occlusal surfaces. Alternatively, there are soft or resilient appliances manufactured from plastics or polymers, producing an appliance which has a somewhat flexible and pliable tooth-borne and occlusal surface. There is a third variation of material known as dual laminated, because it consists of hard acrylic resin on the occlusal surface and a soft material on the inner aspect (tooth-borne surface). This produces an appliance with the positive qualities of a soft material (fitting well and providing comfort for the supporting teeth), with the versatility of a hard acrylic resin adjustable occlusal surface. Hard acrylic resin appear to have several advantages over their soft counterparts. The fit of a hard acrylic resin, be it a hard or a hard-soft tooth-borne interface, is generally more stable and more retentive owing to the material(s) used and to the more accurate, consistent, and reliable method of fabrication [2].

Acrylic resins are known as polymethyl methacrylate or PMMA, which are synthetically obtained and can be modelled, packed or injected into molds during an initial plastic phase which solidify through a chemical reaction-polymerisation [3-6].

The essential characteristics of these material are: important resistance to fracture, do not require heat treatment to achieve polymerization; allow polish easy, allowing regain its luster; and, using the ratio of polymer
and monomer indicated, avoiding contractions vertical and linear shrinkage that may occur acrylic structure.

However, the disadvantages of thermopolymerisable acrylic resins connected to increased porosity, high water retention, volume variations and irritating effect of the residual monomer (organic solvent, hepatotoxic), awkward wrapping system, difficult processing, together with the polymer development, have led to alternative materials such as polyamides (nylon), acetal resins, epoxy resins, polystyrene, polycarbonate resins etc. [7].

Nowadays, thermoplastic appliances are in high demand both from patients and clinicians, dictating that search for scientific proof is essential since it may reinforce or discourage the clinicians decision for their use as an approach to orthodontic retention.

Transparent retention appliances are presented in the literature with various names such as ‘invisible retention appliances’ [8, 9], “Essix” retention appliances [10-12], “vacuum-formed retainers” [13], “transparent overlay retainers” [14] and/or “thermoplastic retainers” [15, 16].

There can be found multiple variations in thickness and shape of the material. Thermoplastic appliances are usually manufactured from 2 kinds of material: (a) Essix type A co-polyester (Raintree Essix, Inc., Metairie, LA, USA) and type Endure (Great Lakes Orthodontics, Tonawanda, NY, USA) and (b) polypropylene co-polymer or ethylene Essix type C’+ (Raintree Essix, Inc., Metairie, LA, USA) and, resilience of 3 thermoplastic materials, namely Raintree Essix C+, Invisacryl C and TR revealed that thermoplastic materials Raintree Essix C+ and Invisacryl C based on propylene with Rockwell hardness between 85 and 102, are less resilient in comparison to TR material which is based on co-polyester and exhibits Rockwell hardness between 105 and 115.

Thermoplastic acetal is a polyoxy-methylene-based material, which as a homopolymer has good short-term mechanical properties, but as a copolymer has better long-term stability [17].

Acetal resin, a product of formaldehyde polymerization, is a thermoplastic polymer with a crystalline structure without a residual monomer, and according to the manufacturers, acetal resin is neither toxic nor allergic.

Acetal resin is very strong, resists wear and fracturing, and it’s flexible, which makes it an ideal material for occlusal splints and orthodontic appliances. Acetal does not have the natural translucency and esthetic appearance of thermoplastic acrylic and polycarbonate [18].

For occlusal splints there can be used different types of thermoplastic material:
- hard elastic foils: BIOCRYL® “C” and BIOCRYL® - acrylic plates without monomer - in clear-transparent or coloured for orthodontic plates; well bonding to acrylic.

DURAN® is a high transparent and abrasion-resistant material for all indications in the splint therapy. IMPRELON® “S” - extremely unbreakable, high transparent and abrasion-resistant for high quality prosthetic splints and orthodontic appliances with excellent long-term earing qualities;
- hard/soft compound foils: DURASOFT® is a transparent sandwich material for splints with a soft inner side for extremely convenient wearing, especially comfortable for snoring devices;
- soft elastic foils: BIOPLAST® is such a foil - clear transparent, coloured or multi-coloured for soft remaining splints, mouth-guards and positioners.

IMPRELON® S and DURASOFT® are containing polycarbonate, which is storing air moisture. Therefore it is necessary to predry these foils in order to avoid air bubbles during the pressure moulding process.

Most splints are now made using heat-cured acrylic. Splints can also be made in soft acrylic or using light cured composite. Soft acrylic splints are usually made for the lower jaw, can be made quickly by the dentist and are indicated for short time use in patients with acute pain and/or dysfunction symptoms caused by muscular hyperactivity or acute trauma. This type is also indicated in children with deciduous teeth if they have signs and symptoms of severe bruxism. Gnashing the teeth may serve the purpose to adjust the occlusion of the deciduous teeth while the jaws are growing. However, a splint may be indicated if the children develop pain symptoms, if the gnashing sounds are disturbing or if the permanent teeth are affected, showing signs of nonfunctional wear.
habit during daytime. A soft splint can be used during daytime to help in breaking the parafunctional habit, either alone or used in one jaw with a conventional hard splint in the other.

**Experimental part**

Our clinical experimental study was carried out on 49 patients, ages between 12-73 years old, with a recommendation for applying occlusal splints, after the diagnostic of dysfunctional syndrome of stomatognatic system. From the lot of study a total of 81 subjects initially included into our study and investigated by electromyography between October 1st 2009 and March 1st 2012, the evaluation of our patients was performed during the dental treatment, and also during the hospitalization (fig. 4).

From the sample taken into study, there were children (22 patients) – 5 boys and 18 girls, and adults (26 patients) – 12 were men and 14 women (fig. 5).

**Results and discussions**

The study evaluated the possibilities of treating dysfunctional syndrome of stomatognatic system with two types of appliances: occlusal splints made-up from hard acrylic resin, included in orthodontic appliances following to treat also, the correction of occlusal relations between dental arches: 8 children and 12 adults, and the soft occlusal splints, applied for a number of 36 patients. Distribution of patients with combined occlusal splint and orthodontic appliance had an improvement for occlusal relation between dental arches.

The results of the study were focused to determine the degree of improvement of symptoms in dysfunctional syndrome of stomatognatic system: good amelioration of symptoms, only few symptoms are ameliorated, and some patients observed no changes in their symptomatology. The graphic representation illustrated in figure 7, show that very good results were obtained in patients with soft-appliances, and it was reported only 1 case with no amelioration of the symptoms. Also, for the subjects treated with occlusal splints made-up from hard acrylic resin, the proportion of the cases with a good improvement of symptoms and only few amelioration of the symptoms is reduced, comparative with the soft-splints sample of study; we had observed that there were 2 cases with no amelioration of the symptoms for the patients treated with hard-splints.

We had to be informed also about the urban or rural area of the patients taken into study, as a social criteria: there were 32 adults (7 patients from rural and 25 patients from urban area) and 17 children subjects (7 from rural and 10 from urban area). It can be observed that the number of urban patients is higher than the number of patients coming from rural area.

We recommended an individualized treatment for each patient, but applying those two types of occlusal splints: hard-splint appliance and soft-splint appliance. So, after gender criteria, there were 3 patients (masculine gender) with hard acrylic resin occlusal splint and 14 patients (also, masculine gender) with soft occlusal splints. For feminine gender, there were 10 patients with hard-splint appliances and 22 patients with a soft appliance therapy (fig. 6).
Ekberg et al. [19] found that there was an improvement of overall subjective symptoms in both the splint treatment groups. Also, in the study, no statistical significant difference was found between the two splint groups after treatment in reducing the major symptom: pain.

Kuttila et al. [20] involved a specific group of patients with different symptoms, that decreased significantly for those using acrylic splints, although there was no significant difference between the groups.

A recent study [21], reported no statistical difference between the hard splint treatment group and other splint appliance in all of the pain parameters they used, except for “emotional and physical functioning”. There was actually a significantly higher improvement in this parameter.

Based upon much research, and despite the many disagreements regarding its efficacy, the hard splint is a customary application which has the most successful outcome in patients who suffer from functional disorders of the masticatory system. This splint has an important benefit for being a non-penetrating and reversible appliance [22].

The use of soft occlusal splints is more convenient and acceptable to the patients, and showed a little superiority more than hard ones [23].

**Conclusions**

Occlusal splints represent the most frequent applied therapy and efficient treatment for patients with dysfunctional syndrome of stomatognatic system proved by many studies, with a successful rate of 70-90%.

The hard-occlusal splints has a numerous number of recommendations to be applied and are the most successful outcome in patients who suffer from functional disorders of the masticatory system.

Occlusal splint therapy using soft-splints has better longterm results in reducing the symptoms of dysfunctional syndrome and improves the patients status.

In most of the cases, therapy by muscle relaxation mouthguards must be associated with drug therapy and symptomatic treatment.

**References**