DENTAL MATERIALS FOR CORONARY OBSTRUCTION UTILIZED IN PEDODONTICS

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Abstract

Dental caries is one of the most frequent diseases which affects, to quite a high extent, both temporary and mixed dentition. Restoration of the loss of hard dental substance caused by simple or complicated caries of the temporary teeth and of the young permanent teeth can re-establish tooth morphology and, implicitly, the mastication, phonation, physiognomic functions, as well as that of space maintenance in the dental arch. The rapid and continuous development of dental materials offers numerous therapeutic possibilities for the management of dental caries. The characteristics of the material employed for the realization of coronary restorations in paediatric dentistry influence the final result of the treatment. When the result is not the one expected by the specialist, one should re-examine the therapeutic plan, the conditions of its application, starting from the diagnosis, continuing with the proprieties of the material and with the clinical steps involved by the technique had in view. Considering the diversity of the materials now available in paediatric dentistry, the practitioner should possess sound knowledge about their (mechanical, aesthetic, biological) properties, and also about the advantages and disadvantages of their utilization in specific clinical situations, for realizing an optimum and long-time restoration.

Keywords: paediatric dentistry, dental materials, children.

In temporary dentition and mixed dentition, the dental caries usually affects multiple tooth surfaces, so that restoration of the carious lesion appears as a real challenge for the pedodontist. Odontal restoration is a technique involving both theoretical and practical (manuality) knowledge, being performed on an organ with special biological characteristics [1].

The procedures applied upon hard dental hard tissues belong to restorative odontology, involving either a minimum invasive treatment method or more complex restorations, required by a considerable loss of hard dental substance; they may be realized through either indirect (with the participation of the dental laboratory) or direct techniques (in the dental office) [2].

The main objective of paedriatic restorative dentistry is reconstruction of tooth morphology, thus assuring the space necessary for the eruption of the permanent teeth on the dental arch, a good functionality, control of dental eruption, its aesthetics and a normal growth (organization of the inter-arch relations) [3].

Whichever the technique applied, a good coronary restoration is the one capable of preserving its initial characteristics for a long period of time, an especially important aspect mainly for young patients, with the purpose of postponing the moment of a new treatment as long as possible [4]. Frequent re-interventions increases the probability of tooth loss, sometimes requiring its prosthetic substitution.

To achieve an optimum coronary reconstruction, a dental material should possess certain qualities, such as: anatomical shape (correct functionality), optical harmony.
(especially for restorations in the frontal zone), a good marginal closure and the capacity to protect the remaining dental rest, an adequate working time, easy manipulation and a relatively simple application technique (to assure an as short as possible intervention).

In paedriatic dentistry, selection of the most adequate material for coronary obturation in temporary dentation and mixed dentition should consider the following factors [3]:
- Age of the child
- The extent of his/her cooperation
- The carious risk (the status of oro-dental hygiene and the nutritional hygiene)
- The size and extension of the lesion (as both surface and depth)
- Localization of the lesion
- The period of time up to the exfoliation of the temporary tooth
- Pulp status, etc.

1. Silver amalgam is the standard material for coronary obturation, utilized in dentistry, due to its bacteriostatic properties, for more than 160 years [1]. The properties of the new materials available on the market are compared with those of this alloy. Mention should be made of the fact that the technology of amalgam manufacturing evolved considerably, and that the amalgam alloys now at hand have, probably, a quite different composition than the old ones. As a material of coronary restoration, silver amalgam is nowadays recommended for use by several reputed organizations in the field, such as WHO, ADA, NIH, FDA.

Among the properties of amalgam, worth mentioning are:
- good mechanical resistance
- simple management
- long durability
- relatively low cost
- good marginal integrity, with a low ratio of secondary caries in the teeth from the lateral area
- less sensitive application technique, comparatively with that of other restoration dental materials.

Nevertheless, the control of humidity remains important, as the excess of water produces a delayed dilatation, especially in alloys containing zinc, so that the recommendation made in paedriatic dentistry is the application – as much as this is possible – of an obturation of amalgam by means of a rubber dam. This will also reduce the failure ratio of the amalgam obturation in temporary teeth, Kilpatrick and Neuman (2007) reporting general values of this ratio of 0-58%, while the ratio recorded in a controlled clinical millieu is of 0-22% [5].

The mechanical behaviour of amalgam is characterized by rigidity and resistance to high compression. Resistance to traction and flexion is not very high, so that, when preparing the cavity, an adequate volume of material should be assured, especially in cases of occluso-proximal cavities, which is quite difficult for temporary teeth, due to the proximity of the pulp horns. That is why, frequent fractures may occur in this type of restorations, which justifies the choice of other therapeutical options.

As to the longevity granted by restorations with amalgam, they assure the longest duration, comparatively with other dental materials. The most frequent reason for the substitution of amalgam obtrurations is the occurrence of dental caries [6].

In spite of such valuable properties, this material has two important shortcomings: it is not aesthetic and it contains mercury. From an aesthetic perspective, no improvements can be made; the simple finishing of the obturation may improve its characteristics to a certain extent, its aspect included, an issue which may significantly reduce the substitution of amalgam obtrurations.

The literature makes mention of the possible adverse effects of amalgam (such as disorders of the renal function, reduced immunity, neuronal toxicity, allergies, etc.), caused by:
- inhalation of mercury vapours or of the amalgam powder;
- ingestion of amalgam;
- environmental considerations.

Free mercury is toxic, being absorbed through the respiratory tract and in contact with the skin. Inhalation of amalgam powder appears, most frequently, during the removal of an old obturation. Such an effect is transitory, its consequences being reduced as much as possible
if the dentist uses a rubber dam and a high speed aspirator. The studies devoted to such aspects showed that the values of mercury in the plasma and urine of patients with amalgam obturations are approximately the same with those of the patients who have never had such restorations [7].

Exposure to the mercury contained in amalgam has no adverse effects upon the neurological condition of children [8]. Equally, no measurable modifications were registered in relation with the resistance to amalgam or to antibiotics of children with amalgam restorations [9], and no statistically significant differences were found as to the neuro-behavioural evaluation or velocity of the nervous conduction, along 7 years, in children with amalgam vs composite obturations [10].

The alergy to amalgam is rare, only 50 cases being reported along 100 years, the main symptom being the occurrence of some lichen-type lesions on the mucosa and eritem of the skin, present nevertheless only on the mucosa adjacent to the tooth/teeth with amalgam obturations, with no visible effects upon the organism [1].

For environmental considerations, several countries are reducing the industrial utilization of mercury – the medical domain included [11]. The possible toxicity of amalgam is still under debate, especially due to the probable elimination of mercury, which prohibited its utilization, in some European countries, in pregnant women and in children with ages below 6 years [3].

In the case of temporary teeth, silver amalgam may be utilized in the following clinical situations:
- deep class I or II cavities
- temporary teeth to be exfoliated within 1 year
- increased individual carious risk
- non-cooperating children
- cases in which isolation is difficult to attain
- cases which cannot be monitored in time.

2. The glass ionomer cement (CGI) has been introduced in the’70. This group of materials has a more fragile resistance, compared with that of composite materials, yet showing the advantage of a good adherence to enamel and dentin without acid etching, which explains their utilization in the Atraumatic Restorative Treatment (ART) technique applied in paediatric dentistry, as well. The expansion coefficient of glass ionomer cements is highly similar to that of dentin. When bonding is accomplished, these materials remain dimensionally stable, in spite of the modified levels of humidity and temperature, thus stimulating percolation.

The most important advantage, comparatively with composite materials, is that glass ionomers are capable of releasing fluoride over a longer period of time, fluoride having the capacity of being incorporated after local fluorisations, as well, thus contributing to remineralization and manifesting a cario-preventive activity [12]. This property recommends them especially for children with high carious risk [13]. However, their low resistance restricts their utilization in permanent dentation, even if they can be successfully applied in temporary dentation and as temporary restorations in children with high cariogenic risk. Application of a protection laquer (for example, G-Coat Plus, GC) is recommended for improving their mechanical and aesthetic properties [14].

Due to the presence of water in their composition, they do not need very strict isolation, as in the case of composite materials, an especially useful property for their use in pedodontics [15], once known that no suitable isolation may be attained in all clinical situations. However, even in the case of CGI application, contamination with saliva should not be very high, as such a situation reduces the sealing capacity and the ratio of retention, as well [16-18].

Due to their cario-prophilactic effect, these materials may appear as the optimum choice for the cementation of pedodontic crowns, of orthodontic rings or even of brackets.

The literature of the field makes no mention of a possible difference between the cario-preventive effect of CGI-based sealants and of those based on resins [19], yet sealing with CGI cement might have the advantage of its application with minimum instrumentation and also when control of humidity is problematic.

Glass-ionomer cements are among the most indicated dental materials in paedriatic stomatology, their utilization starting from the simple sealing of the pits and fissures up to temporization in the application of a long-lasting obturation. Anyway, similarly with other
materials of dental restoration, CGI utilization should be adapted to each clinical case [14].

In paediatric dentistry, glass ionomer cements are largely utilized for:
- young, less cooperative children,
- in all cases in which a good isolation of the oral cavity fails
- protection of the pulp tissue in cases of a very profound caries of the temporary or young permanent teeth
- in the treatment of the Molar Incisor Hypomineralization Syndrome
- Early Childhood Caries (ECC)
- for protecting the prime permanent molars through sealing (in children with partially erupted teeth or with special needs) or in cases of incipient carious lesions at these levels
- children with high carious risk
- cervical caries
- Atraumatic Restorative Treatment
- sandwich technique

Studies devoted to such topics have also shown that CGI-based sealants assure protection of the tooth from the immediate proximity of a molar with a white-spot type lesion on the proximal side on which sealing is performed (following a possible dental separation, for assuring direct access) [20]. Thus, Cagetti et al. (2014) reported that the distal sides of the second temporary molars from the vicinity of a prime permanent molar sealed with CGI has a considerably lower risk of developing a carious lesion, comparatively with the one situated in the vicinity of a prime permanent molar sealed with resin-based materials.

3. Glass cements modified with metal (CERMET) appeared on the market for improving certain mechanical properties of glass ionomers. Most of them are obtained through sinterization of the glass particles with metal ones. It is still debatable whether enrichment of their structure with a metal has really brought about clinical benefits from the view point of resistance, remaining however undoubtful whether the optical properties were modified, Cermet losing their capacity of imitating the dental structure.

4. Resin-Modified Glass Ionomers = RMGI (80% CGI and 20% composite resins) show the advantage of rapid bonding, requiring acid etching prior to their application. They are also known as ionomeric glass photopolymerizable cements, benefiting from a shorter bonding time and lower solubility, compared with that of CGI, in the oral cavity, in the first hours after their application, yet with a rate of fluoride release equal/ slightly lower than that of CGI (initially high, it decreases rapidly, than it may be “recharged”).

As to the modification of the mechanical properties, the assertion may be made that resistance to fracture and to abrasion is improved, while biocompatibility and the hydrodynamics of fluoride ions are maintained. The most important aspect is that the resin-modified glass cements preserve their physico-chemical adherence to the tooth structure[15, 21, 22].

The indications for the utilization of resin-modified glass cements in odontal restorations of the temporary teeth are the following:
- proximal and occlusal restorations in the absence of occlusal stress, when the time period to tooth exfoliation on the arch is ≤ 3 years
- restorations in the anterior section (more aesthetic than those realized with classical CGI).

5. Compomers (low fluoride release with water uptake) (20% CGI) - these materials, representing a combination between a composite and a glass ionomer, have better aesthetics than glass ionomers and also the advantage of fluoride release (even if reduced), requiring however acid etching. Nevertheless, it appears that retention is deficitary, so that microspaces may occur between the dental structure and obturation. In spite of such limitations, the success rate is relatively high, similar to that of the amalgam, CGI, RMGI and of composite resins; however, additional investigations on such aspects are still necessary [13].

6. Composite resins
Numerous dentists support the utilization of composites as restoration materials in the restaurative treatment of children dental caries.
Composite resins are extremely sensitive to any technical intervention, so they should be used – especially in paedriatic dentistry – only when a good isolation may be obtained. In spite of this, composite resins preserve the principle of economy of hard dental substances - suitable for the requirements of (minimum invasive) microdentistry.

For their successful utilization in the odontal treatment of children, certain factors should be considered, such as: the possibility of cavity isolation, the size of the carious lesion, patients compliance during the therapeutic procedure, along with his/her and his/her parents conviction that regular check-ups are necessary.

Nowadays, several forms of presentation which meet specific requirements exist, either for fissure sealing (for which a low-viscosity material is needed, for assuring a deep penetration and also an optimum marginal sealing), or for the restoration of odontal lesions.

According to particles’ size and their chemical composition, several types of materials may be utilized for restorations in the anterior or posterior region: microhybrid composites, condensable composites and fluid (flowable resin) composites [3]. Microhybrid high-density composites are indicated both for restorations of frontal teeth, due to their physiognomic qualities, and for posterior teeth, due to their mechanical qualities. Fluid composites are largely used in incipient occlusal caries, in cervical lesions, as well as in the sandwich technique (once they are situated at the basis of the cavity).

According to Ch. Naulin-Ifi (2011), the type of composite material will be selected depending on the nature of carious lesion and age of the child, as follows:

- 2-8 year-old child
- superficial caries → solid/flow composite
- average caries → solid composite
- 9-11 year-old child
- superficial caries → solid/flow composite
- average caries → solid composite
- deep caries → the sandwich technique (CGI + composite)

**CONCLUSIONS**

The permanent developement of practitioners as to the new restoration materials and techniques for specific clinical situations, and as to their advantages, comparatively with the classical materials, along with a correct interpretation of the assertions made by producers vs the results of the studies performed in the field, represent indispensable qualities for a reputed dentist and, more so, for a good pedodontic specialist.

**References**

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