The Most Frequently Used Materials for Compensation of Hard Dental Tissue

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Summary

The continual progress in development of new dental materials for tooth fillings and the presence of those materials on the market confuse the dentist when choosing the most appropriate material. The purpose of this research was to carry aut a survey in order to find out what are the most frequently used materials for permanent tooth fillings, dentine adhesives and polymerization units in clinical practice. The survey covered 304 subjects (doctors/dentists) with experience ranging from 1 to 40 years of practice. The results show that Tetric Ceram (Vivadent, Schaan, Liechtenstein) is the most used composite material, Syntac (Vivadent, Schaan, Liechtenstein) the most used dentine adhesive and Heliolux (Vivadent, Schaan, Liechtenstein) the most used curing unit for photopolymerisation of composite materials in clinical practice.

Key words: *composite resin, dentine adhesives, glass ionomer cements, polymerization units.*

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Introduction

The oldest material for posterior area teeth filling is amalgam, which has been used for that purpose for as long as 150 years (1). Since its usage demands extensive preparation of the cavity and since the material lacks aesthetic aspects, its alternative today are composite materials (CM) and more recently "smart restorative" (Ariston pHc (Vivadent, Schaan, Liechtenstein). Although the use of composite materials is more demanding than amalgam because of the particular cavity preparation necessary, CM are increasingly used for posterior area teeth filling, not only because of their aesthetic characteristics but also because of their improved physical and mechanical characteristics (higher percentage of inorganic filling). Hybrid CM aim at uniting the surface glow and smoothness of microfilled CM, with the hardness and wear resistance of classic microfilled resins. Weight percentage of fillings fluctuates between 87% to 85%, which ensures better physical and mechanical characteristics than composite materials with microfilling, lower coefficient of heat expansion, lower polymerization shrinkage, higher rate of conversion and resistance to water absorption (2). When using CM it is recommended that the material should be applied in layers up to 2 mm against the cavity walls, which ensures sufficient polymerization and lessens polymerization contraction. The lower layer of CM is less liable to change of dimensions. The preparation of cavities for composite fillings includes etching with 37% orthophos-

foric acid. Etching procedure of the enamel surface using orthophosforic acid is a physical and chemical procedure that enlarges the active surface for CM anchoring (2).

Higher dentine sensitivity as vital tissue to orthophosforic acid, different structure and lower surface energy proportional to the level of mineralization are the causes of the weaker connection with CM (2). It has been suggested that dentine tubules can cause irreparable damage of pulp on the one hand, and significant weakening of inorganic structure on the other because of the specific form and structure of dentine matter. Recent research has shown that treatment of dentine with orthophosforic acid removes the residue layer, which increases dentine permeability (20 times). This decalcifies intertubulus and peritubulus dentine and creates conditions for co-polymerization with bonding material (3). The depth of decalcification is caused by different factors that include pH concentration, viscosity and acid application time (4).

Preparation of dentine in a wider sense includes every conversion of dentine surface covered in residue layer, and the purpose is to create an appropriate surface for micromechanical bonding with dentine adhesives.

Mediating materials that enable connection of CM with enamel and dentine have the mutual name of dentine adhesives (DA). DA have been developing through five generations with the tendency of constant improvement of marginal seal and bonding. Bond strength with dentine amounts to 27-29 MPa, and with enamel 30-32 MPa (5,6).

With major reconstruction and I and V class cavities, glass ionomer cements (GIC) are recommended as replacements for dentine. They have the following qualities; biocompatibility, protection from caries effect (releasing of fluoride), better physical and mechanical characteristics than ordinary cements, easy usage and treatment, toothlike coefficient of thermal expansion, low level dimensional changes and chemical to the tooth and CM.

Ariston pHc has only recently appeared as an alternative to CM and amalgams. Because of its colour and characteristics it is recommended for smaller and medium cavities of back teeth. The use of Ariston pHc is simpler than CM because it does not require etching. However, it is still more complex to use than amalgam. It is similar to CM because of the particular level of micromechanical with dental tissue. It is also similar to amalgam because of the same requirements in forming retention cavities.

Commercial device for photopolymerization of CM in clinical conditions is a blue light of halogen bulbs that transmit rays from ultraviolet to the green part of the spectrum. The drawbacks of such bulbs are weakened intensity of light time and distance from the surface, resulting in a relatively low percentage of conversion and close to surface depth of hardening of darker shades and corners in particular.

Materials and methods

To acquire insight into the most frequently used materials in clinical practice in Croatia, a survey was carried out consisting of 15 questions (Figure 1). The survey included 304 interviewees, (doctors/dentists), with different periods of work experience, from Zagreb, Osijek, Rijeka, Split, Sisak, Zadar and Dubrovnik. The survey was carried out during professional lectures in the above mention cities, in order to determine the most used composite materials, dentine adhesives and curing units in clinical practice, and also to acquire an insight into the frequency of attending lectures.

Results

The results of the survey are given in the form of tables and graphs. Graph 1 shows that the frequency of attending lectures was the highest for dentists of 1-5 years of experience (28.6%), and the lowest for dentists of 30-40 years of experience (7.5%). For posterior teeth filling the most frequently used material is amalgam (41.7%) (Graph 2), while the most frequently used composite material is Tetric Ceram (30.3%) (Table 1). Graph 3 illustrates the types of material used for posterior teeth filling and the frequency of their usage with regard to years of experience. 79.3% of the dentists like to try out new materials, and the most frequent reason why they decide to use a particular material is its clinical characteristics (49.5%). 33.6% of the dentists use Ariston pHc in their work, and 61.5%

of the interviewees use liquid CM. Table 2 shows the most frequently used DA. Under composite fillings the most frequently used IS GIC base (46.5%) (Graph 4). Postoperative hypersensitivity appears in 22.3% of the cases (Graph 5), and is the least frequent when applying GIC under the composite and the most frequent when applying DA (46.7%) (Graph 6). Phosphate cement base (FCP) is most frequently used by dentists with 25-30 years of experience (27.1%) (Graph 7).

The most frequently used polymerization units are given in Table 3. 63.8% of the dentists consider it necessary to have a lamp with multiple programms, while only36.8% have heard of a plasma lamp.

Discussion

The ideal material for hard dental tissue compensation should be biocompatible, easy to apply and should enable final shaping without destroying the rest of the dental matter, be dimensionally stable and resistant to chewing pressure, X-ray contrasting, it be of appropriate colour and transparency (7,8,9). None of the permanent filling materials on the market today satisfy all of these requirements.

The survey showed that amalgam is the most frequently used material for posterior area teeth filling (41.7%), followed by composite material (39.2%). Ariston pHc is the least frequently used material for this purpose. A possible reason could be that this material has only recently appeared on the market. The results of the survey show that its greatest advantage is simple and easy usage (40.4%), mechanical characteristics (17.3%) and fluorid ions release (10.6%) and the greatest disadvantage its colour (56.7%).

The most frequently used CM in clinical practice is Tetric Ceram (30.3%), followed by Prodigy (KERR, Romulus, MI, USA) (15.6%) and Heliomolar (Vivadent, Schaan, Liechtenstein) (14.5%). 1.1% of the interviewees use compomers (Compoglass (Vivadent, Schaan, Liechtenstein), Hytac (ESPE, Seefeld Germany). Twenty year old materials such as Heliosit (Vivadent, Schaan, Liechtenstein) (0.3%), Isopast (Vivadent, Schaan, Liechtenstein) (0.3%) and Dentosit A+B (Vivadent, Schaan, Liechtenstein) (0.5%) (a two component chemically polymerizing CM) are still used in clinical practice.

The most request reason for using the above mentioned CMs are the clinical characteristics of the material (hardness, handling, time of usage (49.5%)), followed by the wide range of colours (15.8%), reasonable price (13.6%) and recommendation of colleagues (12.7%). 3.3% of the interviewees uses the mentioned materials because they have them in the clinics, not because they choose them themselves.

Graph 1 illustrates the population of dentists covered by the survey. Analysis of Graph 3 can lead to the conclusion that younger colleagues (1-5 years experience) prefer to use composites for posterior teeth cavity fillings (33.6%) and Ariston pHc (34.4%). It would be probable to expect more frequent amalgam usage by dentists with more years of work experience However Graph 3 shows that amalgam is more frequently used by the group of dentists with 1-5 years experience (27.8%). Another reason could be the fact that the highest number of interviewees belonged to the group with 1-5 years experience (28.6%). As many as 79.3% of the interviewees like to try out new materials.

Because of their improved characteristics and easy usage more and more dentists use liquid composite materials (61.5%). Liquid composite materials appeared for the first time on the market at the end of 1996 (12). So far they have not been indicated for I and II class fillings, only for stress area teeth fillings (10,11). They can be used for correction of existing composite fillings and as a base under CM. Since they have less inorganic filling (they are more viscous), they are more liable to polymerization contraction during hardening (12). The advantages of liquid composite materials according to the opinion of the interviewed dentists are their easy usage (49.5%) and suitability suitable for cervical lesions (11.1%). Major drawbacks are their high price (26.3%), spilling and more complex usage of hand devices (10.5%).

Since CMs do not have the ability of adhesion to hard dental tissue, it is necessary to convert the surface of the tooth and to use adhesive materials as a mediating layer. DA are indicated when the thickness of the remaining dentine is more than 0.5 mm. When treating deeper cavities a GIC base is recom-

mended is to put (13). The most frequently used adhesive according to the collected data is Syntac (19.3%). GIC base is the most frequently used under composite filling (46.5%), while 18.2% of dentists use phosphate cement base under the composite.

The prevention of edge fissure, micropermeation and postoperative hypersensitivity depends on the degree of integrity between composite resin and the tooth. 65.5% of dentists emphasise the largest number of complaints of postoperative hypersensitivity on the part of patients after putting composite fillings. Graph 6 shows that the least postoperative hypersensitivity appears after putting a GIC base under the composite filling (47.5%), while the greatest appears when adhesives alone are applied (46.7%). These facts emphasize the precision and sensitivity of the technique when using DA and CM, when it is necessary to pay close attention to the condition of the dentine which should not be too moist or too dry.

The characteristics of the material, source of light (intensity, exposition time, width of spectrum) and usage (orientation and distance of the source of light) together influence the depth and degree of polymerization, as well as the final result that influences the physical and mechanical characteristics of the composite filling (14,15). The polymerization device is of great importance for good clinical results and longevity of light polymerized CM. The survey has shown that the most frequently used polymerization unit is Heliolux (22.4%), followed by the oldest unit Heliomat (Vivadent, Schaan, Liechtenstein) (20.2%). This coincides with previously carried out research on the power of polymerization devices in dental clinics in the area of Zagreb where Heliomat appears to be the most frequently used. Most of these lamps are not for clinical usage, or in other words their power is considerably lower than 233 mW/cm^2 (16).

63.8% of dentists consider it necessary to have a multi program polymerization unit. Only 5.1% use Elipar Highlight (Vivadent, Schaan, Liechtenstein) units of a "soft-start" type (gradual polymerization). 36.8% of dentists have heard of a Plasma lamp, which has a great advantage, considering the shorter time of polymerization (1,2,3 and 5 seconds (gradual polymerization)), with an almost identical degree of conversion as a standard halogen bulb. The influence of a plasma polymerization device on polymerization shrinkage of CM remains to be investigated, since it is considered to be the major drawback of this kind of permanent filling material.

Conclusion

The results of the survey have shown that although the majority of dentists like to try out new materials, most of them decide to use amalgam fillings for posterior teeth. Most of the interviewees use GIC as a base under composite fillings (the so-called "sandwich technique"). Although the majority consider if necessary to have a multiprogramme polymerization device, a very small number (5.1%) use "soft-start" lamp type, probably due to financial reasons.