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Possibilities of polyepoxy composites (highly and low-filled) for treatment, closure, and restoration of deep carious and traumatic lesions of teeth

BY

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Abstract

The theoretical assumptions (on the biocompatibility of epoxy with the ecosystem of the tooth and oral cavity; on the ability to use carious masses as a hardener; on the water resistance of semi-cured epoxy composites) - are presented. Based on these hypotheses, the views on the possibility of creating self-installing epoxy dental fillings and self-restoration of affected teeth – were proposed. These assumptions are good confirmed in practice, using the example of an original, cheap, and generally available epoxy material of cold curing with polyamines such as PEPA and DETA. Examples of successful self-restorations are shown and assumptions are made about the possibility of solving up to 75% of dental problems of patients of all categories in this way.

Introduction

At first glance, it seems pointless to even undertake the study of such a topic. It is traditionally believed that even a small carious cavity has no chance not only of self-healing but also of self-sealing outside a dental office and qualified supervision. Regarding medium-sized lesions, risks and skepticism increase, and for deep lesions such self-medication simply seems to be a crime against the health of humanity.

In fact, everything is not so scary and hopeless. On the contrary, today's dental polymers (mostly acrylic in nature, with bio-impact synthetic hardeners) cannot be considered an ideal final option for the development of dental science. For example, their degree of curing (especially for photopolymers) does not always exceed 80%. The main barrier to their future is the need to thoroughly clean the tooth surface, dry the surface, use primers, and... high hardness (something that is an advantage for them).

Indeed, when treating deep carious or traumatic lesions, the restored tooth faces additional problems that are not noticeable when treating small and even medium-sized cavities. These are different coefficients of thermal expansion and different reactions to pressure changes during chewing and rinsing processes. The stability of polyacrylate dentures and fillings is very high, and their guaranteed service life is usually comparable to the patient's lifespan. During operation in the mouth, polyacrylate materials practically do not elasticize and do not swell. But this inflexibility of polyacrylates sometimes does bad service to the tooth. Thus, along the contact line, the adhesive interphase gradually separates and liquids penetrate there. This gradually increases the sensitivity of the tooth to the loads. Microdisplacements in the contact area lead to gradual pushing of the adhesive area by the filling, microtraumas along the dentin/enamel, and finally to cracks in the contact area. At the same time, the filling itself often remains quite strong (although not always).

Epoxy fillings, dentures, and inserts still significantly swell and elasticize (and accordingly lose their initial strength) during operation in the oral cavity. Therefore, their service life is an order of magnitude lower than new acrylic dental materials. But the loss of their properties only leads to their loss and does not destroy the tooth tissues themselves (even if they are weakened). It has also been revealed that secondary carious processes rarely occur under epoxy fillings, even if the adhesive contact is broken. This may be a consequence of the inclusion of carious masses on the surface of the damaged tooth in the epoxy curing process - which is not found in any non-epoxy filling system (acrylic, amalgam, polymer-cement). Moreover, a fallen epoxy insert can be easily replaced at any time (even on the day it falls out)

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independently. First experiments show that epoxy materials have a cleaning effect on the bottom of a damaged cavity - even if no surface cleaning has been carried out.

Our Composite laboratory in Chuiko Institute of Surface Chemistry have a more than 30-year experience in investigation, development, and implementation of polymer dental materials [1-3, 6]. Our first works on epoxy filling suggested the possibility of treating minor damage; at best, the potential for treating moderate damage was assumed [6-9]. The effect of a simple epoxy restoration of deep lesions (especially without preliminary cleaning of the surface, removal of nerves, pins, etc.) seemed doubtful due to the aggressiveness of the moist oral environment, the excess of carious masses in deep cavities, and the lack of pin holders. The first experiments show wide (maybe - unlimited) possibilities for such use [6-9]. But in dental periodics [4,5,10] this term does not relate to the concept of restoration, but only to the chemistry of curing of traditional clinically used (acrylic, etc) compositions.

Some experimental estimates

Due to the laboratory scale of the work (as well as the mobility of the patient carriers of the experiment), it is still difficult to make a complete statistically reliable coverage of the experimental results on deep filling and tracking the dynamics of the tooth-polymer system. But Table 1 informatively highlights the first results.

Table 1. Test results for deep self-sealing, observed for 6 months.

Toital	More 3 monts	Less 3 monts	Less 7 days
6	4	1	1

Table 2. Estimated mechanical and resistance parameters of epoxy dental seals

	Normal conditions	In wet\aqua
Compression, MPa	100	40
Adhesion to steel, kgf	400+-200	100+-50
Adhesion to dental enamel, kgf	200+-100	50+-20
Water-absorption, %\month	3+-1	10+-5
		
1	2	3

Fig. 1. View of the self-restoration site - tooth 6 on the right (installed 4.2024 - has not fallen out yet): 1 - before installation; 2 - after; 3 - view in combination with adjacent (5 and 4) teeth. The area of epoxy composite flowing onto adjacent tooth 5 is visible.

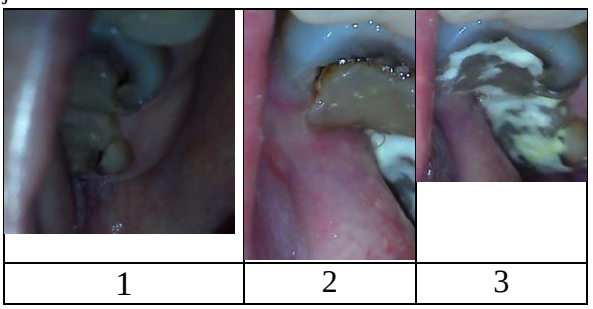

Fig. 2. View of the self-restoration site - teeth 7 and 8 are half-destroyed (installed 4.2023 - fell out 6.2024): 1 - before installation; 2 - after epoxidation of tooth 8; 3 - after additional epoxidation of the adjacent tooth 7.

Fig.3. Fig. 2. View of the self-restoration site in 5 right molar – before (left) and after epoxy-filling. Epoxy-composite worked during 1 year after that fell out without destruction of molar.

Assessing prospects

It is obvious that the adhesion and mechanical parameters of self-installed fillings will be noticeably lower than those installed normally, under the right conditions, by a qualified doctor. There is no need to even look for scientific explanations here, but we will indicate some obvious reasons.

1. Lack of serious cleaning or preparation of the contact surface. This immediately reduces adhesion and increases the risk of loss. However, this drawback in this case is not fatal, since the replacement filling can be reinstalled immediately, in the coming days, and independently.
2. Incompleteness of the compositions for self-installation. This drawback will be solved if this scientific direction is actively studied by specialized scientists and dental practitioners.
3. Comparative softness of polyepoxides and their ability to gradually swell in warm aqueous solutions.
4. Inertia of world medicine, disinterest of dentistry business, and increased sensitivity of medical practic to the problems of sepsis, insensitivity, and isolated negative cases. This will slow down the implementation of new technologies in much the same way as the complete transition of gasoline vehicles to electric power has been slowed down in the last 50 years.

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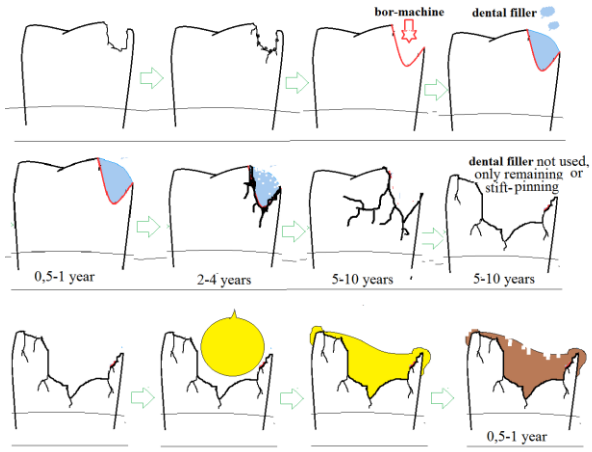

Fig.4. Visualization of the process of development of a deep carious cavity (including due to medical interventions with a drill machine). The first and middle rows are traditional medicine, the third row is self-restoration of the resulting cavity.

From Fig.4. it is clear how destructive even a small intervention of a drill can be in an attempt to restore the eco-balance of a tooth. When two unfavorable factors combine – chipping of part of the tooth before filling and secondary processes – a serious cavity develops. Repeated treatment may result in the loss of most of the outer body of the tooth. After which, doctors usually either send for removal of the nerve with the installation of crowns or removal of the entire tooth.

This is not at all what a patient dreams of when he comes to the dentist and leaves there his time, money (sometimes considerable), and peace of mind for the next few days (and sometimes the next months and years). It's good if the dentist is a person with a conscience and does not seek to enrich himself or assert himself (for example, by transferring him to his student for treatment) on the patient's problem. But even the best and most error-free doctor is unlikely to go beyond the diagrams shown in Fig. 2. Medical immunity (more precisely, impunity), the lack of doctors and their solidarity (if the patient sues one of them) will allow him to avoid any problems in the event of an unsuccessful operation.

In our situation, the patient simply stirs the epoxy compound, waits several hours until it half-hardens, and presses it into the cavity. The degree of preliminary surface cleaning is up to the patient himself. You don't have to clean it at all - but then the likelihood of unsuccessful installation and rapid loss is greater (since food debris can interfere with epoxy-tooth contact). You can brush and rinse the area being installed with a toothbrush during the day and do not eat anything else before installation. Everyone can develop for themselves rules for self-installation and reinstallation of such seals.

Conclusions

1. Based on theoretical assumptions (about the biocompatibility of epoxy with the ecosystem of the tooth and oral cavity; about the ability to use carious masses as a hardener; about the water resistance of semi-cured epoxy compositions), views on the possibility of creating self-installing epoxy dental fillings and self-restoration of affected teeth are presented.
2. These assumptions have been well confirmed in practice, using the example of an ordinary, cheap, and widely available cold-curing epoxy material using polyamines such as PEPA and DEET.
3. Examples of successful self-restorations are shown and assumptions are made about the possibility of eliminating up to 75% of the dental problems of patients of all categories in this way.

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