



SENSITIZING POTENTIAL OF TEMPORARY FILLING MATERIALS

Miglena Balcheva, Boris Valkov

Department of Conservative Dentistry and Oral Pathology, Faculty of Dental Medicine, Medical University - Varna, Bulgaria.

ABSTRACT

Introduction: When treatment requires multiple visits, temporary filling materials are needed in order to seal the cavity between the appointments. Some of their substances can be contact allergens. Although the risk is very low, it should not be ignored.

The aim of the study is to establish the sensitizing potential of temporary filling materials.

Materials and methods: In order to confirm allergy to temporary filling materials, we used a patch test with a panel of 9 allergens – components of temporary filling materials with established strong sensitizing properties.

Results: The results showed that sensitization and polysensitization to the examined dental materials are registered more often in women than men and zinc (Zn) is the most common sensitizer among the ingredients of temporary filling materials. Cross-sensitization between acrylates is also found.

Conclusion: There is an extremely small risk for the ingredients of the temporary filling materials to cause oral symptoms.

Keywords: temporary filling materials, dental allergens, patch testing,

INTRODUCTION

Treatment of dental caries and its complications sometimes requires a multi-stage approach, which can be a result of a number of reasons, such as persistent infection or lack of time on the part of the patient or the dental practitioner. For optimal results, the cavity should be sealed between visits, and this is achieved with temporary filling materials.

Like other dental materials, the substances found in temporary fillings are contact allergens that usually cause sensitization through a cell-mediated immunological mechanism; IgE-mediated reactions are uncommon. This means that it takes time for sensitization to occur. The short stay of temporary obturations almost excludes this possibility. However, due to their similar composition and longer stay in the mouth, other dental materials can sensitize the body and temporary fillings will cause allergic symptoms later. As a result, this issue shouldn't be ignored [1].

The ingredients of temporary filling materials that have an allergenic potential are:

- In sulfate-based materials – zinc (Zn);
- In Eugenol-based materials – Zn, eugenol, rosin, MMA, TEGDMA, EGDMA;
- In Zinc phosphate cements, zinc polycarboxylate cements and polyacrylic acid-based materials – Zn;
- In Glass ionomer cements – 2-HEMA, epoxy resin;
- Light-curing materials – MMA, BisGMA, UDMA, 2-HEMA, epoxy resin [2].

The aim of the study is to establish the sensitizing potential of temporary filling materials.

MATERIALS AND METHODS

Participants in the study were patients referred by their dentists for testing prior to dental treatment or because of registered oral symptoms – mucosal manifestations or burning mouth syndrome (BMS). In order to confirm allergy to dental materials, we used standard allergens from dental materials produced by Chemotechnique Diagnostics (Vellinge, Sweden). Hypoallergenic patches with polyethylene chambers IQ Ultra Chambers® and IQ Ultimate Chambers®, as well as the skin marker we purchased from the same company.

Table 1. A panel of standard dental allergens for patch testing

No.	Dental allergen	Concentration
1	Methyl methacrylate (MMA)	2,0% petrolatum
2	Triethylene glycol dimethacrylate (TEGDMA)	2,0% petrolatum
3	Ethylene glycol dimethacrylate (EGDMA)	2,0% petrolatum
4	Bisphenol A glycerolate dimethacrylate (BIS-GMA)	2,0% petrolatum
5	2-Hydroxyethyl methacrylate (2-HEMA)	2,0% petrolatum
6	Eugenol	2,0% petrolatum
7	Zinc (Zn)	2,5% petrolatum
8	Epoxy resin (Bisphenol A)	1,0% petrolatum
9	Urethane dimethacrylate (UDMA)	2,0% petrolatum

We selected a panel of 9 allergens – components of temporary filling materials with established strong sensitizing properties (Table 1) and applied them by patch test to confirm contact hypersensitivity. We placed the allergens according to the requirements of the test on the skin of the back (healthy, hairless and without tan) in the area between the first thoracic vertebra, crista iliaca and the spine and removed them after the 48th or 72nd hour. Results were reported according to the requirements of the International Contact Dermatitis Research Group (ICDRG) on the scale indicated in Table 2. The additional condition for the patients was to take no antihistamines during the testing and 7 days beforehand and no corticosteroids for at least 14 days before [3].

Table 2. A scale for reporting the results of patch testing

Code	Reaction
-	Negative reaction
+?	Doubtful reaction
+	Weak positive reaction (non-vesicular)
++	Strong positive reaction (edematous or vesicular)
+++	Extreme positive reaction (ulcerative or bullous)
IR	Irritant reaction

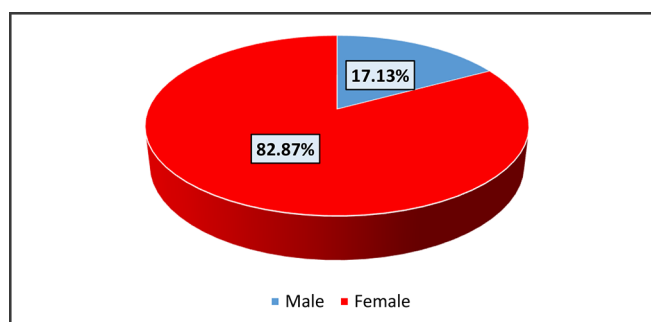
For the analysis of the data, a specialized statistical package IBM SPSS Statistics 20 was used. The significance level was chosen to be a p-value that was less than the predefined α -level. For the purposes of the study, the following statistical methods were applied – descriptive analysis, correlation analysis, non-parametric methods.

RESULTS

Among the patients who visited the Dental Allergy office, 724 underwent skin allergy testing (patch tests) to confirm sensitization to dental materials. About 82.9% (600) of them were women, and 17.1% (124) were men (Fig. 1). The average age of the participants was 56.25 ± 17.61 years, as the average age of women was significantly higher than that of men.

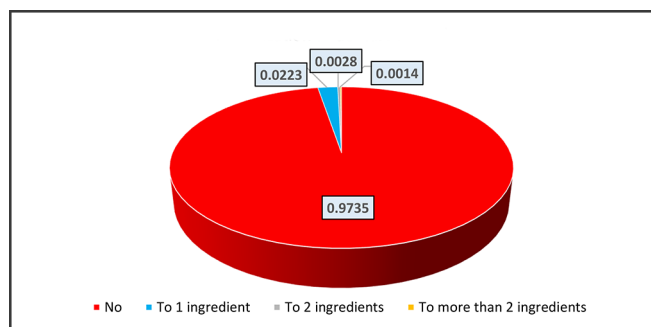
We registered previous or concomitant allergic disease (drug, pollen or food allergy mainly) in 79 of the patients (10.9%). Despite the fact that the relative proportion of women with concomitant allergies was higher than that of men, gender was not a determinant of this. Only 29 of the patients (4.0%) also mentioned a previously diagnosed allergy to dental materials. Women were again more often sensitized.

Fig. 1. Distribution of participants by gender



Patch tests were performed on patients to demonstrate sensitization to selected components of the temporary filling materials. At least one positive reaction was found in 19 (2.65%) of them – 16 patients were sensitized to one ingredient, two patients to 2 ingredients and one patient to more than 2 ingredients (Fig. 2).

Fig. 2. Distribution of sensitization by number of positive reactions



We also investigated the gender distribution of the reported results, looking for relation (Table 3). It turned out that for all of the allergens tested, except for 2-HEMA, women were more often sensitized and reacted positively on tests. However, the frequency was low, and the results did not have statistical significance – gender was not a determining factor in this case.

Table 3. Gender distribution of patch test results

Allergen	Gender	Result			
		-	+	++	+++
MMA	m	86 (98,9%)	1 (1,1%)		
	w	443 (98,7%)	4(0,9%)	1 (0,2%)	1 (0,2%)
TEGDMA	m	41 (100,0%)			
	w	180 (98,4%)	2 (1,1%)		1 (0,5%)
EGDMA	m	14 (100,0%)			
	w	41 (100,0%)			
BisGMA	m	38 (100,0%)			
	w	150 (97,4%)	4 (2,6%)		
2-HEMA	m	10 (90,9%)	1 (9,1%)		
	w	19 (100,0%)			
UDMA	m	1 (100,0%)			
	w	3 (75,0%)		1 (25,0%)	
Eugenol	m	34 (97,1%)	1 (2,9%)		
	w	128 (99,2%)	1 (0,8%)		
Zn	m	4 (100,0%)			
	w	27 (87,1%)	3 (9,7%)		1 (3,2%)
Epoxy resin	m	9 (100,0%)			
	w	40 (97,6%)	1 (2,4%)		

MMA was the only allergen tested, for which we reported positive results from all degrees of manifestation (Fig. 3). For TEGDMA, we reported weak positive and strong positive reactions (Fig. 4), and for EGDMA, there were no positive results. Among the results for BisGMA, we recorded weak positive reactions (Fig.5). Among the acrylates, we recorded the most frequent positive reactions to 2-HEMA (Fig. 6). A surprise for us was the moderately positive reaction to UDMA, which was considered a weak allergen (Fig. 7).

Fig. 3. MMA patch test results

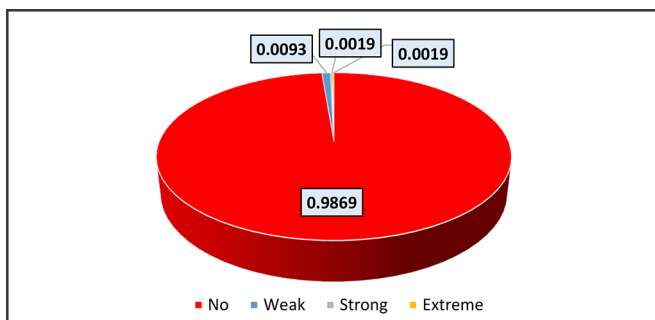


Fig. 4. TEGDMA patch test results

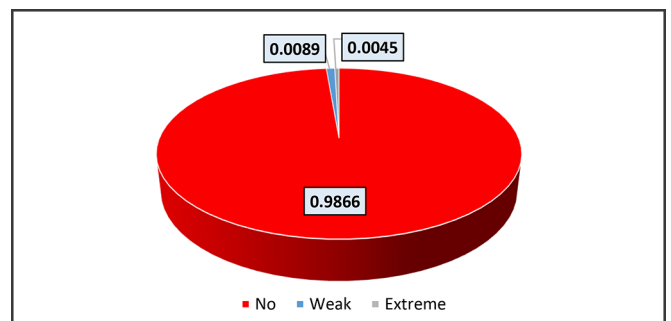


Fig. 5. BisGMA patch test results

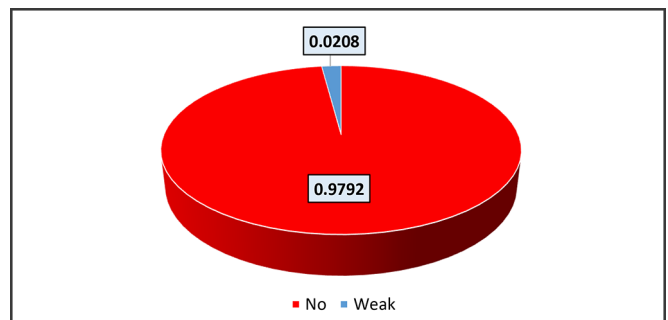


Fig. 6. 2-HEMA patch test results

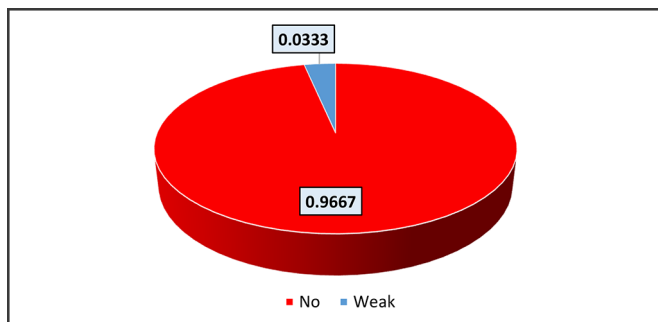


Fig. 9. Eugenol patch test results

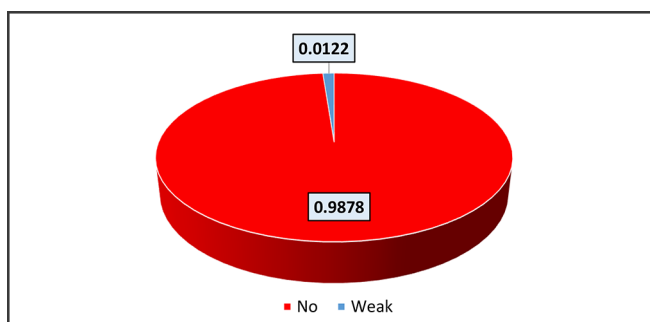


Fig. 7. UDMA patch test results

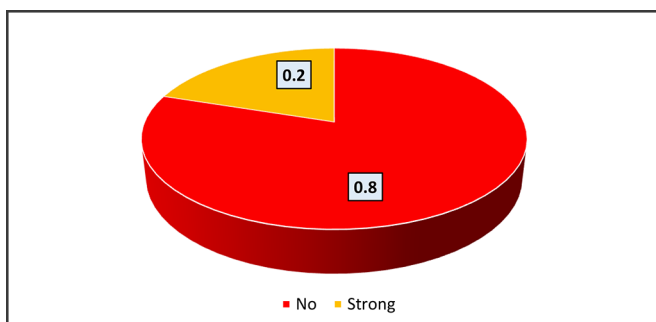
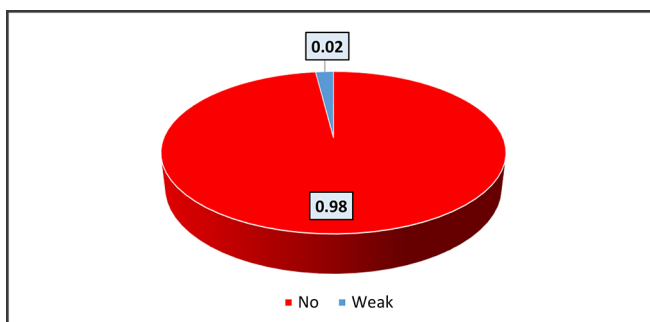


Fig. 10. Epoxy resin patch test results

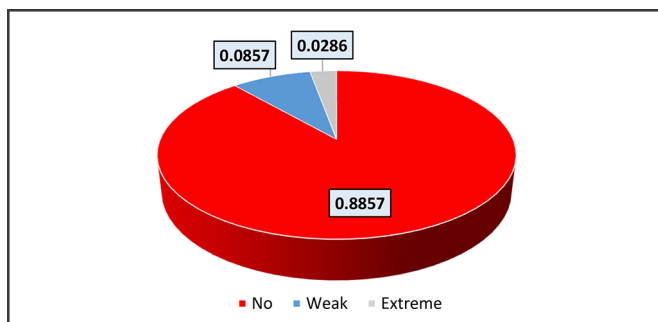


We reported one case of cross-sensitization to three acrylate allergens – MMA, TEGDMA and UDMA. Considering the report of only 14 cases with positive results, this explained the calculated correlation in sensitization between these allergens – statistically significant was the correlation between MMA and TEGDMA ($\tau=0.273$, $p=0.000$), and that between TEGDMA and UDMA ($\tau=1$, $p=0.01$).

We investigated the relationship between the history of oral symptoms and sensitization to individual acrylate allergens. We found an extremely weak negative correlation, the data being without statistical significance in all cases.

The results of our research showed that the share of those sensitized to zinc was the highest – 11.5% of those tested had weak positive or extreme positive reactions (Fig. 8). This share was higher with UDMA, but the number of those tested was very small, and the result could be ignored.

Fig. 8. Zinc patch test results



Only weak positive results were recorded for eugenol (Fig. 9) and for epoxy resin (Fig. 10).

Two cases of simultaneous sensitization had been registered, and the calculated strong positive correlation confirmed these facts – to MMA and eugenol ($\tau=0.566$, $p=0.000$), as well as to BisGMA and zinc ($\tau=0.685$, $p=0.006$).

We also investigated the relationship between the history of oral symptoms and sensitization to the last three allergens included in the series. We found a weak positive correlation with statistical significance only with the epoxy resin ($\tau=0.289$, $p=0.039$).

DISCUSSION

The studied group was dominated by women– the fact was not surprising since the group was composed of patients who had successively passed through the Dental Allergology office, and women were more likely to search for, confirm and treat their various diseases.

Almost 11% of study participants reported a concomitant allergy – this was in line with other studies showing even higher levels of sensitization in the population [4]. Regarding dental materials – about 4% of our patients shared that they had confirmed such sensitization. Other researchers analyzed the literature and results from epidemiological studies and skin samples, presenting similar data [5, 6, 7].

Women with sensitization to dental materials predominated over men – our result was also confirmed by other researchers. The difference in our study was the proportion of tested patients with oral manifestations – only about 27% versus more than 52% in other studies [8]. This led to the conclusion that it was likely that in our country, many cases of allergy remained undiagnosed and untreated, or patients neglected their condition. Only 4% of

the available oral symptoms were associated with the already confirmed concomitant allergy.

The acrylate allergens MMA and TEGDMA were defined as strong allergens – in our study they were the only ones with registered strong positive reactions. On the other hand, BisGMA and UDMA were considered allergens with low sensitizing potential [9], but we reported a high share of positive results. We believe that the result for UDMA was not significant due to the small number of cases.

Similarly, Lyapina et al. found in their study the most pronounced sensitization to BisGMA and 2-HEMA in the patient group. They attributed it to multiple contacts with acrylate materials and suspected/confirmed allergy to other dental materials as well [10].

The calculated correlation between some acrylate allergens – especially between MMA and TEGDMA – was also expected. It was also confirmed by the results of other authors [11]. Some works also commented on the possibility of cross-sensitization between acrylates and other materials, such as epoxy resin [12], but this was not confirmed in our case, most likely due to the small number of recorded positive reactions to the resin.

Regarding the other allergens, the share of positive reactions to zinc was the largest, and extreme positive reaction was also recorded. Our results were in sync with what other authors had commented, namely that most of-

ten people were sensitized to the metals used in dental work [13, 14, 15, 16].

Our study data showed a significant correlation only between oral symptoms and sensitization to epoxy resin.

It is difficult to compare our results regarding sensitization to the ingredients of temporary filling materials with those of other authors because the subject is rarely exploited. Acrylates, metals and others are usually studied individually, not in the combination we offer.

CONCLUSION

Along with all other requirements, temporary filling materials should have low-sensitizing potential. We prove in our study, that there is an extremely small risk for the components of the temporary filling materials to cause oral symptoms.

Abbreviations:

BisGMA – bisphenol A-glycidyl methacrylate

EGDMA – ethylene glycol dimethacrylate

2-HEMA – 2-hydroxyethyl methacrylate

MMA – methyl methacrylate

TEGDMA – triethylene glycol dimethacrylate

UDMA – urethane dimethacrylate

Zn – zinc

REFERENCES:

1. Valkov B. [Study of the properties of temporary filling materials] [dissertation]. Varna (Bulgaria): Medical University of Varna; 2024. 165 p. [in Bulgarian]
2. Bardot L. [The coronary temporary filling materials in conservative dentistry.] [in French] Sciences du Vivant [q-bio]. 2017. hal-01931955. [Internet]
3. Balcheva M. [Oral allergy syndrome as a manifestation of food allergy] [dissertation]. Varna (Bulgaria): Medical University of Varna; 2015. 178 p. [in Bulgarian].
4. Poncet P, Sénéchal H, Charpin D. Update on pollen-food allergy syndrome. *Expert Rev Clin Immunol*. 2020 Jun;16(6):561-78. [PubMed]
5. Khamaysi Z, Bergman R, Weltfriend S. Positive patch test reactions to allergens of the dental series and the relation to the clinical presentations. *Contact Dermatitis*. 2006 Oct;55(4):216-8. [PubMed]
6. Raap U, Stiesch M, Reh H, Kapp A, Werfel T. Investigation of contact allergy to dental metals in 206 patients. *Contact Dermatitis*. 2009 Jun;60(6):339-43. [PubMed]
7. Raap U, Stiesch M, Reh H, Kapp A. Contact allergy to dental materials. *J Dtsch Dermatol Ges*. 2012 Jun;10(6):391-6; quiz 397. [PubMed]
8. Olms C, Yahiaoui-Doktor M, Remmerbach TW. Contact allergies to dental materials. *Swiss Dent J*. 2019 Jul 22;129(7-8):571-9. [PubMed]
9. Kisselova-Yaneva A, Petrunov B. (Editors) [Practical guide of Dental clinical allergology] [in Bulgarian]. Medical University-Plovdiv, Plovdiv, 2011:40-42.
10. Lyapina M, Krasteva A, Dencheva M, Tsekova M, Kisselova-Yaneva A. Methacrylate and acrylate allergy in dental students. *J of IMAB*. 2013 Jul-Dec;19(4):363-370. [Crossref]
11. Rustemeyer T, de Groot J, von Blomberg BM, Frosch PJ, Scheper RJ. *Toxicol Appl Pharmacol*. 1998 Jan;148(1):83-90. [PubMed]
12. Carmichael AJ, Gibson JJ, Walls AW. Allergic contact dermatitis to bisphenol-A-glycidyl dimethacrylate (BIS-GMA) dental resin associated with sensitivity to epoxy resin. *Br Dent J*. 1997 Oct 25;183(8):297-8. [PubMed]
13. Forkel S, Schubert S, Corvin L, Heine G, Lang CCV, Opper E, et al. Contact allergies to dental materials in patients. *Br J Dermatol*. 2024 May 17;190(6):895-903. [PubMed]
14. Rai R, Dinakar D, Kurian SS, Bindoo YA. Investigation of contact allergy to dental materials by patch testing. *Indian Dermatol Online J*. 2014 Jul;5(3):282-6. [PubMed]
15. Al-Gawahiri M, Rustemeyer T, Franken SM, van Zuuren EJ, Ipenburg NA. Frequency and clinical relevance of contact allergy in dental patients. *Contact Dermatitis*. 2024 Jan;90(1):66-73. [PubMed]
16. Can A, Karabacak DE, Yalcin BK, Demir S, Buyukozturk S, Colakoglu B, et al. How important is patch testing with dental materials in real-life clinical practice? *Allergy Asthma Proc*. 2023 Mar 1;44(2):136-144. [PubMed]

Please cite this article as: Balcheva M, Valkov B. Sensitizing potential of temporary filling materials. *J of IMAB*. 2024 Oct-Dec;30(4):5882-5887. [Crossref - <https://doi.org/10.5272/jimab.2024304.5882>]

Received: 05/08/2024; Published online: 29/11/2024



Address for correspondence:

Assoc. Prof. Miglena Balcheva, DMD, PhD
Faculty of Dental Medicine, Medical University of Varna;
84, Tzar Osvoboditel Blvd., 9002 Varna, Bulgaria.
E-mail: drmitzy@gmail.com