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The application of restorative material packed in blisters in cross infection control in restorative dentistry

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KEYWORDS

cross-infection, restorative dentistry, restorative materials

SUMMARY

Introduction. Dental procedures bear risk of pathogens transmission leading to cross-infection. Means of protection aim at preventing direct contact with patient's infected tissues. Less attention is paid to indirect threats, such as the restorative material's infection during treatment. Restorative materials portioned and packed in disposable blisters may effectively eliminate the risk of material's contamination.

Aim. The aim of the study was to assess the knowledge and attitude of Polish dental students on infection of dental restorative materials during treatment.

Material and methods. A survey was conducted among students of the Faculty of Dentistry at the Medical University of Warsaw, who were given disposable packages of the restorative material for cavity reconstruction during practical classes.

Results. All students gained theoretical knowledge on cross-infection control. Less than half declared need for more classes in this field. Almost all of them (96%) admitted that pathogens transmission may occur during restorative treatment where one spatula is used for both picking the material from the syringe and placing it in the cavity. Only 68% of them actually use separate instruments during restorative treatment. All of them think that packing of the material in separate blisters may increase safety during treatment through minimizing risk of the material contamination.

Conclusions. Polish dental students need more classes concerning cross-infection control in restorative dentistry. Restorative materials packed in disposable blisters may increase patients safety during restorative treatment.

INTRODUCTION

Dental procedures bear high risk regarding transmission of pathogens, such as bacteria, viruses and fungi, as both the dental staff and the patients may have contact with blood, saliva and respiratory secretions (1). The human hepatitis B/C virus (HBV/HCV), human immunodeficiency virus (HIV) and herpes simplex virus (HSV) may be listed among the most dangerous microorganisms, which can be transferred in a dental office. All patients should therefore be treated as potential bearers of infectious diseases, which would help to implement safety standards. Dental procedures involve direct and/or indirect contact with blood and other tissue

fluids of the human organism. As a result, a transmission of contagious biological material from one patient to another, patient to the dental staff and vice versa and between members of the dental staff may occur (2). Such incidence is called cross-infection. Most practitioners pay attention to preventing cross-infection caused by direct contact with patient's secretions, particularly blood and saliva. In restorative dentistry, the direct exposure may take place when using non-sterile instruments, not changing of burs, handpieces, endodontic files or other instruments, and/or injuries caused by non-sterile instruments during and after dental procedure, ex. used needles, scalpel blades, tip of endodontic file. The indirect

contact with the infected material takes place through water spray created during the procedure and may be even more risky for both the patients and the dental staff than the direct exposure. The aerosol containing the patient's secretions and pathogens scatters around the dental office and its closest environment, while water droplets settle on dental instruments and all surfaces bearing risk of cross-infection. To prevent both the direct and indirect risk factors of cross-infection, means of surface disinfection, disposable materials (needles, blades, syringes and other), means of personal protection (disposable rubber gloves, eyewear and masks) and other (protective sheets for the dental unit and hand-pieces) are used. Moreover, disinfection and sterilization of the non-disposable instruments, dental unit and working surfaces are applied after each procedure. Implementing knowledge among the dental staff on ways of transmission of the pathogens and their elimination is indispensable (3). Such training should be a part of an undergraduate dental course, as students' understanding of the paths of transmission of infectious diseases would establish a well-protected environment in the future. Unfortunately, the knowledge and attitude towards cross-infection control vary between dental schools and countries, which is illustrated in table 1. A study conducted in Saudi Arabia (4) showed satisfactory knowledge and positive attitude of the students of dentistry regarding cross-infection. They were able to recognize risks of percutaneous injuries with infected needles and could identify means of self-protection, such as gloves, masks and eyewear (4). In the restorative dentistry, the operating area should be well protected from the scatter by means of a rubber dam, which significantly reduces the level of the spread microorganisms (1). It also protects dental instruments from touching other parts of the oral cavity than the lesion. Although there is a high degree of acceptance of the rubber dam, it's not used on a routine basis in restorative dentistry (5). A study proceeded by Kumar et al (1). showed that only 29.8% of the students in India routinely used rubber dam during restorative procedures. Likewise, as much as 49.6% of students in Malaysia do not use a rubber dam during treatment (6). Although the students of dental schools are well aware of the risk caused by transmission of the pathogens, there is a risk for abandoning of the taught procedures after graduation. A study conducted in British dental offices showed that more than 50% of the British post-graduates stops using rubber dam after leaving school (7). The majority of the Irish and the Welsh dentist (63%) do not use a rubber dam for any restoration (7). Similar situation has developed in Turkey, where rubber dam isolation is used in 23.7% of cases (8). Therefore, mandatory training on cross-infection control should be implemented during undergraduate training, with an impact on post-graduate regular updates.

The reconstruction of tooth's tissues involves using resin-based materials, built of a matrix, containing an organic blend of monomers, and an inorganic filler. Their setting is based on a reaction of polymerization, which is initiated by light of a specific wave length. Due to the fact that the restorative material may spontaneously set by a visible light, they are packed in a syringe containing 2-5 g of the material, which provide good isolation from the outer environment. During restorative treatment blood, saliva and other tissue fluids can get transmitted to a syringe containing the restorative material, especially when the same spatula is used for collecting and placing the material it in the patient's mouth. This seems to be a forgotten factor of cross-infection, as there is no research conducted on it. The literature shows a method of the instruments' tips decontamination during the restorative treatment. The disinfection of the instruments should be performed with disinfection agents, such as 70% ethanol or 2% glutaraldehyde. This method's concept establishes that the tip of the instrument is disinfected each time before picking of a new material's portion from the syringe (9). However, the immersion time seems to be too long for the clinical conditions. Also, the effectiveness of the disinfection solutions proved not to be satisfactory. Both mentioned factors suggest this technique is time consuming and unreliable (9). Using two separate spatulas, each for collecting and placing of the material in the cavity, is still recommended for preventing of the restorative material from infection. It requires a presence of an active dental assistant and more attention from the dental staff, so as not to swap the instruments. It may also increase the treatment cost, as additional instruments need to be disinfected and sterilized. The materials science provides new solutions to eliminate problems concerning potential infection of the restorative materials. Recently introduced light-cured resin-based restorative material Next (DENTAL LIFE SCIENCES (mfg Ltd., Wigan, UK), can be used for all cavity classes reconstruction. The material is portioned and packed into disposable small packages called blisters (fig. 1). The composition of the material is made of a mixture of dimethacrylates (*bis*-GMA, TEGDMA, UDMA, *bis*-EMA), aluminum-barium-silicon glass, pyrogenic silica, photo initiators, stabilizers and pigments. The amount of the added filler is 78 wt.%. Its uniqueness is expressed in its sterile, disposable packaging. The material is accessible in portions of 0.07 and 0.2 g, and is dedicated for a single patient only.

AIM

The aim of the study was to evaluate the knowledge and attitude of the Polish students of the Faculty of Dentistry and Medicine, Medical University of Warsaw regarding methods of preventing cross-infections of the restorative materials during treatment.

Tab. 1. Percentage share of used and not used means of protection against cross infection in restorative dentistry in the opinion of respondents

Author, year of publication	Means of protection against cross-infection	Percentage share of positive responses (use means of protection)	Percentage share of negative responses (do not use means of protection)
Kumar et al., 2009 (1)	Wearing disposable rubber gloves	99.3%	0.7%
	Wearing face mask	96.5%	3.5%
	Changing hand pieces after every patient	16.3%	83.7%
	Changing saliva ejector after every patient	69.5%	30.5%
	Changing burs after every patient	20.6%	79.4%
	Rubber dam isolation	29.8%	70.2%
Shah et al., 2009 (3)	Wearing disposable rubber gloves	100%	0
	Wearing face mask	65%	35%
	Single-use burs	59%	41%
	Disposable coverings for suction cables, light curing lamps and light handles	79%	21%
Al-Essa and AlMutairi, 2017 (4)	Wearing disposable rubber gloves	98.1-100%	0-1.9%
	Wearing face mask	98.1-100%	0-1.9%
Wan Noorina et al., 2016 (6)	Wearing disposable rubber gloves	99.6%	0.4%
	Wearing face mask	97.1%	2.9%
	Rubber dam isolation	50.4%	49.6%

MATERIAL AND METHODS

A total of 56 students (third year, n = 28; fourth year, n = 21; fifth year, n = 7) of the undergraduate dental course of the Faculty of Dentistry at the Medical University of Warsaw participated in the study. The distribution of the students is presented in table 2. Each student was given a 0.07 g blister of the restorative material Next ((DENTAL LIFE SCIENCES (mfg Ltd., Wigan, UK; shade A2) and was asked to use it for restoration of a chosen cavity. Afterwards, the students were invited to anonymously and individually fill in a questionnaire consisting of 25 questions related to their attitude to transmitting infections during restorative treatment. The examples of the questions are illustrated in figure 2. Completion of the questionnaire took approximately 15 min. All returned data was analyzed and interfered with chi-quadrat test, using SPSS 10.0 for Windows (SPSS Inc., Chicago, USA) at a significance level of p < 0.05.

RESULTS

A total of 25 students (15 females (60%) and 10 males (40%)) have returned the questionnaires. The response rates were 35.7% (third year), 38.1% (fourth year) and 100% (fifth year). The overall response rate was 44.6% (tab. 2). The study results are presented in figure 3. During clinical classes, all students had means of self-protection, such as gloves, masks, eyewear and means of the patient’s protection (eyewear, rubber dam). Despite the accessibility of the rubber dam, none of the reconstructions was proceeded with the isolation. All respondents confirmed that they were provided with sufficient knowledge concerning cross-infection in the restorative dentistry. No more than 40% of them expressed interest in additional seminars or lectures concerning transmission of pathogens in a dental practice, with no relevance of this result (confidence interval 21.1-61.1% at α = 0.05; p = 0.424). No more than 24% of the interviewees of all



Fig. 1. Resin-based restorative material Next packed in disposable blisters, both sides view

years believed that the additional lectures should be held in each academic year of the undergraduate course (confidence interval 9.4-45.1% at $\alpha = 0.05$; $p = 0.998$). As much as 96% of the students agreed that the transmission of the pathogens may occur during cavity restoration proceeded with one spatula for both taking the material from the syringe and placing it in the cavity. The remaining 4%, who did not agree with this statement, were students of the third year. Only 68% of the students admitted to using separate spatulas during cavity restoration, which proved not to be statistically relevant (confidence

interval 46.5-85.1% at $\alpha = 0.05$; $p = 0.108$). The rest, who denied using separate spatulas, were the students of the fourth year. All respondents believed that packing of the restorative material in blisters may prevent cross-infection during cavity restoration by minimizing of the risk of the material's contamination. No more than 40% of the respondents stated that using portioned materials may increase the overall treatment cost (confidence interval 21.1-61.3% at $\alpha = 0.05$; $p = 0.424$), while only 4% of them believed that the treatment would be cheaper (confidence interval 0.1-20.4% at $\alpha = 0.05$; $p = 1.000$). In the opinion of 60% of the students, using material Next may be ineffective for the dental practice as the opened material may not be kept for future procedures (confidence interval 38.7-78.9% at $\alpha = 0.05$; $p = 0.424$). None of the students has ever encountered a restorative material other than Next packed in blisters, while 96% of them have never seen any dental material packed in disposable packages. The remaining 4% of the students have identified a polishing paste as the example of a dental material packed in disposable packages.

DISCUSSION

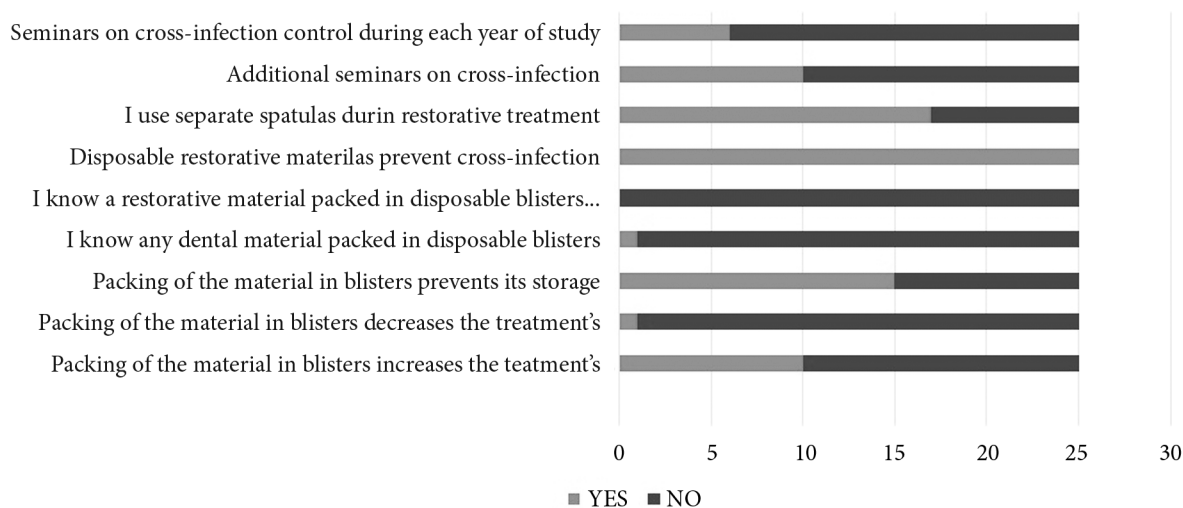
Dental procedures should be performed with maintenance of a maximum level of protection regarding cross-infections. The patients' trust in their dentist requires a minimization of the procedural mistakes and maximization of safety during treatment in return. According to the American guidelines for infection control released by the Centers for Disease Control and Prevention, a partner of the International Association of National Public Health Institutes, dentists have legal duties

Tab. 2. Distribution of the students according to academic year and gender and responsive rate

Academic year	Gender	n (%)	Amount of handed surveys according to academic year	Amount of responses (%) to survey according to academic year
3rd year	female	3 (30)	28	10 (35.7)
	male	7 (70)		
4th year	female	5 (62.5)	21	8 (38.1)
	male	3 (37.5)		
4th year	female	7 (100)	7	7 (100)
	male	0		
Total count			Total amount of handed surveys	Total amount of responses (%) to survey
females		15 (60)	56	25 (44.6)
males		10 (40)		

1. Choose whether you agree with the statement: „Dental restoratives packed in blisters may prevent cross-infection in a dental practice.”
 - Yes, I agree with the statement
 - No, I do not agree with the statement
2. Choose whether you agree with the statement: „Packing of the dental restoratives in blisters does not influence cross-infection occurrence in a dental practice.”
 - Yes, I agree with the statement
 - No, I do not agree with the statement
3. On a routine basis do you use a separate spatula for taking a restorative material from the syringe and placing it in the cavity?
 - Yes, I do
 - No, I do not
4. Do you think that transmission of the pathogens from one patient to another can be facilitated by using the same spatula for taking a restorative material from the syringe and placing it in the cavity?
 - Yes
 - No
5. Have you been provided with a knowledge on cross-infection occurrence and prevention in the dental practice during your undergraduate dental course?
 - Yes
 - No
6. Do you think that providing additional seminars/lectures concerning cross-infection occurrence and prevention in a dental practice is needed?
 - Yes (please fill in which year you would like these classes to be provided)
 - a. III year
 - b. IV year
 - c. V year
 - d. III, IV and V years
 - No

Fig. 2. Examples of the questions of the survey conducted among dental students



Ryc. 3. Wyniki przeprowadzonej ankiety w formie diagramu

to take all necessary steps to prevent the transmission of infections in their practices (2). Disposable materials and instruments are dedicated for one patient only and must not be kept for further usage. Antibacterial mouth rinses, used by patients before a dental procedure, are recommended to reduce the amount of bacteria, which could be released in the form of the air-born aerosols during treatment (2). In restorative dentistry, there is no standard protocol for disinfection of the resin-based materials used for restorations (10). During treatment, portions of the material are repeatedly collected from the syringe and placed in the cavity in a layering technique. The contaminated spatula, which had direct contact with the patient's tissues, is then put back in the block of the material in the syringe, creating a risk of contamination (9, 11). It may get contaminated with the patient's blood and saliva, especially if the treatment is done without a rubber dam isolation (5). The infected material will be used during subsequent procedure, creating risk of unintended pathogens transmission. This requires re-thinking of the problem of the cross-infection during restorative treatment and finding adequate means of protection. The application of a disposable packages containing selected portion of the restorative material could be a good alternative to increase comfort and safety during treatment. This solution may be accepted by both the dentists who are inert as far as cross-infection problem is concerned, and those who take all necessary precautions during treatment.

The students of dentistry should be taught of all factors that would put their own or their patients' health at risk. Despite very low response rate of the conducted survey, which prevents vast analysis of the obtained data, the results are alarming. Moreover, there are no similar studies proceeded among the polish students of dentistry, thus it's impossible to compare the study results. The lectures and seminars on cross-infection control are held during the first, second and fourth year of the undergraduate course. Although all students claimed that their knowledge on pathogens' transmission during dental called upon the need for more lectures. The need for spreading knowledge is also justified by a mere 68% of the students, who complied with the standard of

using separate spatulas during cavity restoration. It may be interesting that the group of those, who denied using separate instruments, was made up of the students of the fourth year. It may result from the fact that the students of the third and fifth years pay more attention during clinical classes, the first ones (third year) due to lack of experience and thus relying on theoretical knowledge, the latter (fifth year) as preparation to the diploma exam. The students also did not comply to the need for the isolation of the operating area with the rubber dam, even though it was accessible to them. Although the market of the dental materials is rapidly spreading, it is surprising that the Polish students did not recognize any disposable dental material. Their belief in a higher cost of the treatment proceeded with them was also astonishing. More than half of the students admitted to the statement that using disposable restorative materials was unfavorable for a dental office, as they could not be kept opened for the next procedures. During clinical classes, the Polish students use syringed restorative materials, which may decide upon their lack of experience in clinical work with the disposable ones. The blister containing material must be used at a shortest time and must not be kept open till the next procedure, due to aging of the material opened to the outer environment. This prevents re-use of the material and minimizes the risk of cross-infection. As the studies indicate, young post-graduate dentists are likely to abandon the taught precautions regarding cross-infection. Therefore, the utilization of the newest strategies from dental materials' science may contribute to the increase of the safety of the restorative procedures, even without their attention. The results of the conducted survey study suggest that the university assistants should intensify their control over students during clinical classes and sustain their theoretical knowledge.

CONCLUSIONS

Polish undergraduate students need more theoretical knowledge on cross-infection control during restorative treatment. Portioned restorative materials packed in blisters may increase patient's safety during restorative treatment.

CONFLICT OF INTEREST

None

REFERENCES

1. Kumar S, Sharma J, Duraiswamy P, Kulkarni S: Infection control practices among undergraduate students from a private dental school in India. *Rev Odonto Ciênc* 2009; 24(2): 124-128.
2. Centers for Disease Control and Prevention: Guidelines for Infection Control in Dental Health-Care Settings 2003. *MMWR* 2003; 52(No. RR-17): 1-76.
3. Shah R, Collins JM, Hodge TM, Laing ER: A national study of cross infection control: "Are we clean enough?". *Brit Dent J* 2009; 207(6): 267-274.

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4. Al-Essa NA, AlMutairi MA: To what extent do dental students comply with infection control practices? *Saudi J Dent Res* 2017; 8: 67-72.
5. Feierabend SA, Matt J, Klaiber B: A comparison of conventional and new rubber Dam systems in dental practice. *Oper Dent* 2011; 36(3): 243-250.
6. Wan Noorina WA, Abdullah D, Goo CL, Rahman MM: Practice of infection control amongst clinical dental students of three public universities in Malaysia. *Eur J Dent Med* 2016; 8(1-3): 6-11.
7. Mala S, Lynch CD, Burke FM, Dummer PMH: Attitudes of final year dental students to the use of rubber dam. *Int. Endodontic J* 2009; 42: 632-638.
8. Yüzbaşıoğlu E, Saraç D, Canbaz S et al.: A survey of cross-infection control procedures: knowledge and attitudes of Turkish dentists. *J Appl O Sci* 2009; 17(6): 565-569.
9. Lopes LG, Máximo AA, Taveira CT et al.: How to avoid cross contamination during handling resin composites with spatulas. *Rev Odontol Bras Central* 2016; 25(72): 94-97.
10. Werle SB, Santos RCV, Dotto PP: Contamination of composite resins in dental clinics of a teaching institution. *Pesqui Bras Odontopediatria Clin Integr* 2012; 12: 473-476.
11. Ferreira RO, Caires NCM: Assessment of contamination of composite resins tubes in Dental School Clinics in a private university at Manaus-AM. *J Health Sci Inst* 2012; 30: 206-210.