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Application of rubber dam in restorative and endodontic procedures – the experience of the therapist and the patient

Jovana N. Stašić, Jugoslav Ilić, Tatjana Savić-Stanković

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SUMMARY

Introduction/Objective Challenges in the application of the rubber dam, inexperience, and discomfort of the patient are reasons for its undesirability. That is why education and training of young dentists is important, as well as bringing this phase of work closer to patients in order to reduce discomfort.

The objective was to examine the attitudes about knowledge and skills of young dentists in our community and the impression of patients during the application of the rubber dam in the performance of restorative and endodontics procedures.

Methods The research was conducted on the basis of epidemiological questionnaires filled out by 30 dentists (specialist studies and internship at the Clinic for Dental Diseases) and 30 patients immediately after working with the rubber dam. The questionnaires had three categories: general information about the dentist's knowledge and experience, information on clinical work with the rubber dam, and patient impressions.

Results A total of 37% of dentists had the experience of using rubber dam during endodontic procedures, while 23% of dentists used them during restorative procedures. Lack of experience (2–4 years) did not significantly affect the ability to place rubber dam in simple clinical procedures ($p = 0.321$) while it had a significant impact in more difficult situations ($p = 0.027$). During clinical work, the indication for the placement of the rubber dam did not significantly influence the choice of the jaw on which the dental procedure will be performed ($p = 0.659$). The average time for placing the rubber dam in both procedures was five minutes. After clinical work, 57% of patients felt no pain, and 93% would agree to reapply the rubber dam during future procedures.

Conclusion Young dentists have knowledge but insufficient experience when working with the rubber dam, which can be explained by their caution with the analysis of the clinical situation. Additional education and training during work with the rubber dam is necessary, in order to increase the independence of young dentists. Patients easily tolerate working with rubber dam and have a positive opinion.

Keywords: rubber dam; clinical experience; restorative procedures; endodontic procedures; attitude of patient

INTRODUCTION

During restorative and endodontic procedures, the soft tissues of the lips, cheeks, and tongue, as well as the presence of saliva and gingival fluid, limit the working field and lead to the possibility of contamination. Ensuring a relatively dry working field is possible by using cotton rolls and aspiration by saliva ejector. However, to establish an absolutely dry working field, the use of the rubber dam is necessary.

In addition to limited working field during clinical work, using various irrigants and acids can easily lead to chemical damage to soft tissues, as well as to the possibility of aspiration and swallowing of small rotating instruments used during work.

To overcome all the mentioned difficulties, the rubber dam should be an essential part of restorative and endodontic procedures. The application of rubber dam provides several benefits. In addition to isolating the operating field from saliva, gingival fluid, and blood [1], the absolutely dry working field improves adhesive procedures

when applying restorative materials and contributes to the durability of adhesive restoration [2]. Furthermore, by preventing various irrigants, medications, and other chemical agents from coming into contact with the surrounding oral mucosa and damaging it, the use of a rubber dam ensures the patient's safety from swallowing/aspiration of small instruments [3, 4], as well as the protection of the dentist from infectious diseases and aerosol contamination during dental interventions [5, 6].

However, despite the well-known advantages of the rubber dam, dentists often do not decide to use it in their clinical work, based on the opinion that the implementation of this procedure is complicated and is more time consuming during clinical work. Also, additional reasons for not using rubber dam include the high cost of rubber dam sets and patients' non-acceptance [7].

In restorative dentistry, working with a rubber dam depends on the severity of the clinical situation and the possibility of placing the rubber dam. The European Association of Endodontists recommends using the rubber dam as mandatory during endodontic therapy and

vital pulp therapy [8, 9]. Data from the literature show that regardless of the development of modern dentistry and new materials, the use of rubber dam in different parts of Europe is not increasing. A study by Marshall and Page [10] in 1990 showed that of 1008 surveyed general dentists in the United Kingdom, only 1% applied rubber dam during restorative procedures and 11% during endodontic therapy. In New Zealand and the United States, the routine use of the rubber dam in endodontics was recorded by 57% and 59% of general dentists, respectively [11, 12]. Irish general dentists have reported a higher percentage of restorative and endodontic procedures without rubber dams [7]. Also, clinical experience has an influence on the incidence of rubber dam application. Çağa et al. [13] found in their work that dentists with more years of experience show a lower incidence of using the rubber dam when performing various dental procedures. In the same study, 110 dentists (27% of the respondents) stated that placing the rubber dam is complicated, and 143 (36%) patients do not accept working with rubber dam [13]. A study from New Zealand showed that, compared to more experienced dentists, significantly more dentists with less than 10 years of clinical experience use rubber dam. A greater trend of additional education in the application of the rubber dam was also noted, as well as a greater use of the rubber dam during endodontic procedures by dentists working in a team compared to independent ones in private practices [11]. A similar situation was observed in the study by Mala et al. [14], who examined the attitudes of final-year students on the use of rubber dam. Although the rubber dam was used in adult patients by 98% of students in their final year of study during endodontic procedures, 62% of them believed that rubber dam would decrease after graduation due to the difficulty of its placement and the lack of its acceptance by patients [14].

Therefore, the aim of this study was to examine the attitudes of young dentists in our community towards the knowledge and skills related to the rubber dam placement, as well as the patients' impressions during the application of the rubber dam during restorative and endodontic procedures.

METHODS

The research was conducted at the Department of Restorative Odontology and Endodontics of the School of Dental Medicine, University of Belgrade, based on the filling out of epidemiological questionnaires. Thirty dentists, both specialization residents and on internships, and 30 patients completed questionnaires before and after placing the rubber dam during restorative and endodontic procedures. The dentists filled out two questionnaires, while the third questionnaire was filled out by the patients. Consent to fill out the questionnaire was completely voluntary.

The first questionnaire consisted of 11 questions related to general information about dentists and their previous knowledge about the rubber dam. In this questionnaire, the data was obtained from the dentist's previous experience working with rubber dam. For the purpose of data

analysis, young dentists were grouped based on years of experience into three groups: dentists having less than two years of clinical experience (on an internship or specialization residents), dentists with 2–4 years of experience (specialization residents), and those with more than five years of clinical experience. The questionnaire also contained a self-assessment of the degree of independence when placing rubber dam in simple and more difficult clinical situations. Clinical situations that were considered simple included the following: those where more than 50% of the crown was preserved, supragingival approximal cavities, the absence of interproximal contacts, normal interproximal contacts, and isolation of less than three teeth. More severe clinical situations included the following: destruction of more than 50% of the crown, subgingival proximal cavities, anxious patient and isolation of more than three teeth. Filling out of the first questionnaire was done immediately before the intervention.

The second questionnaire, also designed for dentists, consisted of questions related to the management of the rubber dam during restorative or endodontic procedures. This questionnaire was filled out after the clinical work. It consisted of 10 questions, and these were related to the indications for the placement of the rubber dam, the selection of clamps, and teeth that are isolated. Also, the time needed for rubber dam placement was noted, as well as the occurrence of difficulties during the procedure.

The third questionnaire was designed for patients, who gave answers after the intervention in which the rubber dam was applied. It consisted of nine questions, and the questions were formulated to obtain information about the presence of pain when placing and working with the rubber dam. The patient's overall impression and the willingness to use rubber dams again during future restorative and endodontic interventions were examined.

To carry out this research, a basic rubber dam set was used, comprising an elastic rubber sheet, a frame, metal clamps with and without the wings, a template for marking the perforations on the rubber, punch pliers (Ainsworth type), rubber dam forceps for holding and placing the clamp on the tooth and dental floss for fixing the rubber sheet circumferentially.

All data were statistically analyzed in IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA), via descriptive statistical methods, using the Mann–Whitney and χ^2 test.

RESULTS

a) Results based on the data obtained from the first questionnaire

1. Age distribution of young dentists and clinical experience

The study includes dentists in specialist studies and internship with minimal clinical experience and experience of up to seven years. Of the total number of dentists who participated in the research, 17 were 25–29 years old,

Table 1. Distribution of dentists' age and clinical experience expressed in months**Tabela 1.** Distribucija starosti stomatologa i kliničkog iskustva iskazanog u mesecima

Age of the dentist	25	26	27	28	29	30	31	32	35	39
Number of dentists of the specified age	2	3	2	6	4	6	1	3	2	1
Clinical experience expressed in months	5.5	4	15	6.5	48	36	48	60	84	36

while one dentist was 39. By comparing years of age and clinical experience, the greatest clinical experience (84 months / seven years) was observed in dentists aged 35, while the least experience (4 months) was recorded in young dentists aged 26 (Table 1). By grouping the data according to the methodological plan, it was obtained that of the total number of dentists ($n = 30$), 13 dentists had up to two years of clinical experience, 12 dentists 2–4 years, and five dentists 5–7 years of clinical experience.

2. Additional sources of learning about rubber dams in relation to clinical experience

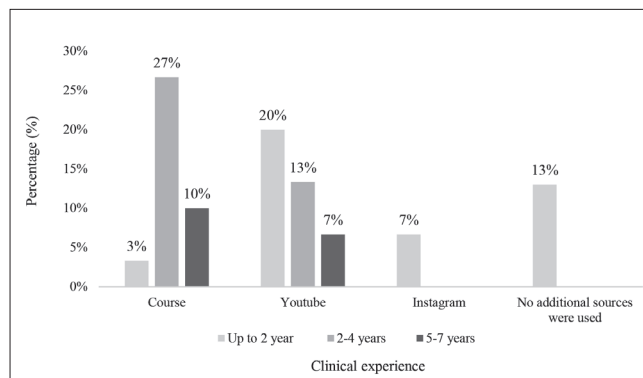
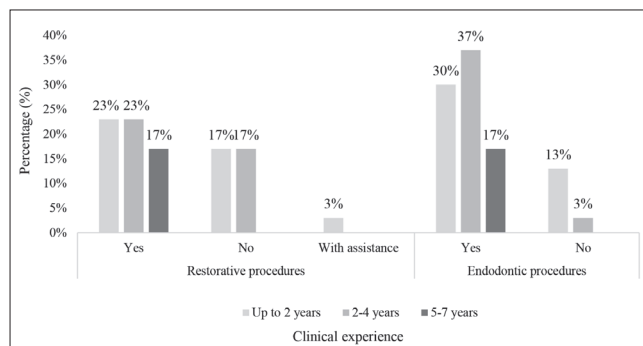
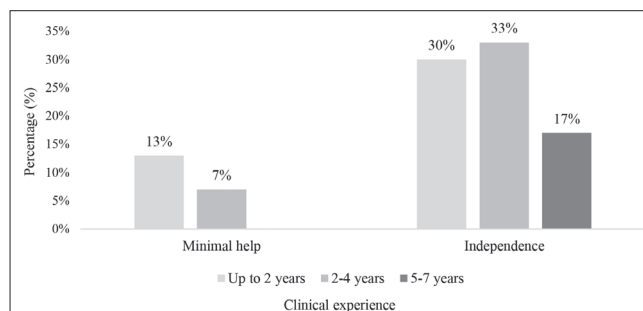
Dentists with 2–4 years of clinical experience attended courses (27%) and used internet sources – YouTube (13%) – as additional learning sources. A similar trend was observed among dentists with 5–7 years of experience (courses 10%; YouTube 7%). Among dentists with the least number of years of experience, a diverse application of additional learning sources was observed. It was also noted that 13% of dentists with the least years of experience did not use additional sources of learning. Years of clinical experience significantly influenced the need for additional learning resources ($p = 0.028$) (Figure 1).

3. Previous application of the rubber dam during restorative and endodontic procedures by all dentists based on years of clinical experience

Based on previous knowledge and experience among dentists with up to two years of clinical experience and among dentists with 2–4 years of clinical experience, the independent use of rubber dam was reported in 23% of clinical situations during restorative procedures. Among dentists with the most years of clinical experience, independence in placing rubber dam during restorative procedures was recorded in 17% of the cases.

A somewhat higher frequency of working with a rubber dam during endodontic procedures was recorded among dentists with up to two years of clinical experience (30%), as well as among dentists with 2–4 years of clinical experience (37%). Dentists with the most clinical experience showed an equal representation of rubber dam during restorative and endodontic procedures.

In terms of clinical work without the use of the rubber dam, among dentists with the least years of clinical experience, it was observed that it was equally represented in both clinical procedures, while among dentists with clinical experience of 2–4 years, a higher percentage of not using the rubber dam was recorded when performing restoratives compared to endodontic procedures (Figure 2).

**Figure 1.** Additional sources of learning about rubber dam in relation to clinical experience**Slika 1.** Dodatni izvori učenja o koferdamu u odnosu na kliničko iskustvo**Figure 2.** Previous application of the rubber dam during the implementation of restorative and endodontic procedures by all dentists based on years of clinical experience**Slika 2.** Prethodna primena koferdama tokom sprovođenja restaurativnih i endodontskih procedura kod svih stomatologa na osnovu godina kliničkog iskustva**Figure 3.** The level of independence in applying the rubber dam in simple clinical situations in relation to clinical experience**Slika 3.** Nivo samostalnosti u primeni koferdama u jednostavnim kliničkim situacijama u odnosu na kliničko iskustvo

4. The level of independence in applying rubber dam in simple clinical situations in relation to clinical experience

Dentists with the least years of experience, as well as dentists with experience of up to four years, needed minimal help in 13% and 7% of the cases, respectively. Years of experience did not significantly affect the level of independence in placing the rubber dam in simple clinical situations ($p = 0.321$) (Figure 3).

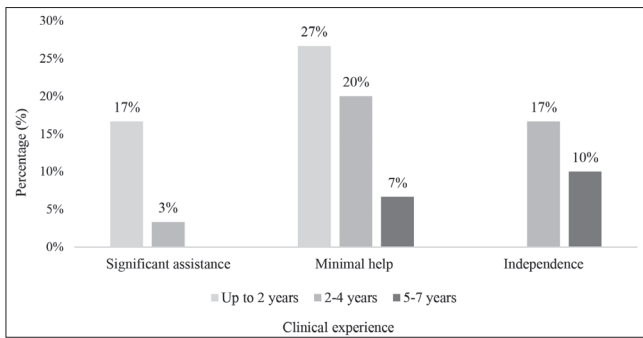


Figure 4. The level of independence in applying the rubber dam in more difficult clinical situations in relation to clinical experience
Slika 4. Nivo samostalnosti u primeni koferdama u težim kliničkim situacijama u odnosu na kliničko iskustvo

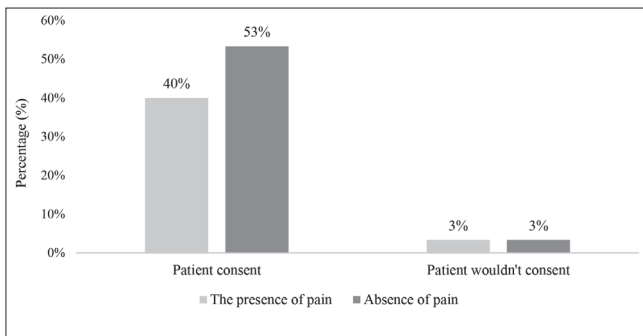


Figure 5. The patient consent to the re-placement of the rubber dam in relation to the presence of pain
Slika 5. Pristanak pacijenta na ponovno postavljanje koferdama u odnosu na prisustvo bola

Table 2. Distribution of the sex and age of patients
Tabela 2. Distribucija pola i godina starosti pacijenta

Sex		Age (years)		
Female	Male	20–39	40–60	61–80
20	10	18	8	4

5. The level of independence in applying rubber dam in more difficult clinical situations in relation to clinical experience

In all three groups of dentists, minimal assistance was needed in placing the rubber dam in more difficult clinical situations, with the fact that the least independence was shown by the group of dentists with up to two years of work experience and the greatest by dentists with the most years of work experience. Complete independence in placing the rubber dam was recorded in 17% of cases among dentists with 2–4 years of work experience and dentists with the longest work experience (10%). In more difficult clinical situations, years of experience are significant characteristics at the level of independence ($p = 0.027$) (Figure 4).

a) Results based on the data obtained from the second questionnaire

1. Indications for placement of the rubber dam during clinical work in relation to experience

During clinical work, young dentists with up to two years of clinical experience installed rubber dam in 33%

of cases during endodontic treatments and in 10% of restorative procedures. Dentists with 2–4 years of clinical experience, as well as dentists with the most experience, used rubber dam when performing endodontic procedures in 33% and 17% of situations. Clinical experience did not significantly influence the choice of indications for placing rubber dam ($p = 0.128$).

2. Choice of the jaw, isolated teeth, and teeth with a clamp placed on them

Among all dentists, regardless of clinical experience, a higher prevalence of the rubber dam use was noted for the lower jaw in both clinical procedures. During restorative procedures, 7% of the dentists placed the rubber dam in the lower jaw, and 67% of endodontic treatments with the rubber dam were performed in the lower jaw. During clinical work, the indication for the placement of the rubber dam did not significantly influence the choice of the jaw on which the dental procedure will be performed ($p = 0.659$). In most clinical situations, the lower lateral teeth are isolated with a rubber dam.

3. Average time of placement of the rubber dam during restorative and endodontic procedures

For restorative procedures, three (10%) dentists placed the rubber dam in five minutes, while one dentist needed 5–10 minutes. For placing rubber dam during endodontic procedures, 24 (80%) dentists recorded a time of five minutes. In both procedures, the average time for the rubber dam placement was five minutes ($p = 0.137$).

c) Results based on the data obtained from the third questionnaire

1. Distribution of sex and age of patients

In the study, 20 female and 10 male patients participated. The patients were aged 20–80 years (Table 2).

2. The presence of pain during the rubber dam placement and the patient's consent to re-placing the rubber dam in relation to the presence of pain

During restorative and endodontic procedures, 43% of patients felt pain, while 57% had no painful sensations. After completing the clinical work, based on the subjective feeling of pain, 12 (40%) patients would agree to have the rubber dam re-placed, while one (3%) patient would not agree to the reinsertion of the rubber dam. The patient's consent to reapply the rubber dam in relation to pain was not statistically significantly related ($p = 1.000$) (Figure 5).

DISCUSSION

Although the use of rubber dam dates to 1864, data from the literature indicate that rubber dam haven't yet been introduced as an integral part of the clinical procedure among dentists during restorative and endodontic procedures [15–18].

Licensing boards in the United States require the use of the rubber dam as a mandatory and integral part of clinical practice [19]. Also, the European Association of Endodontists' recommendation is the necessary use of the rubber dam during endodontic therapy and vital pulp therapy [8, 9].

In addition to these mandatory requirements, the practice of dentists has shown a certain level of aversion to rubber dam. Therefore, young dentists were included in this research in order to examine their attitudes based on the fact that they have little or no clinical experience. In addition to dentists, patients were also examined in terms of comfort while working with the rubber dam and the presence/absence of pain.

Although rubber dam application is a mandatory part of the curriculum in all dental schools, data from the study by Ryan and O'Connell [20] indicate that students graduate with the opinion that rubber dam application will have no benefit in their future clinical work except during endodontic treatment. As reasons for this, they cite difficulties and a long-time during placement, as well as the opinion that patients don't accept working with rubber dam [14].

Further educational activities are necessary to overcome the discrepancy between the knowledge acquired during studies and the low frequency of rubber dam use after graduation [21]. In their study, Mala et al. [14] concluded that due to the development of modern dentistry, there may be a different trend in the use of rubber dam after graduation among today's students compared to dentists who graduated decades ago.

The study of Milanovic et al. examined the attitudes, knowledge, and skills in working with rubber dam among students in their final year at the School of Dental Medicine, University of Belgrade. In this study 88% of 130 included students didn't feel confident enough to place a rubber dam on their own [22]. The findings of the study of Milanovic et al.'s can be linked to our results regarding independence in placing rubber dam in simple and more difficult clinical situations. In our study, the selection of simple and more difficult clinical situations was made based on clinical experience while working with rubber dam, as well as on the basis of the degree of difficulty of placing rubber dam. In simple clinical situations, young dentists with up to 2 years of experience and 2–4 years of clinical experience needed minimal help. In more difficult clinical situations, the need for minimal assistance was noted by all dentists regardless of years of experience. A higher rate of independence was observed in simple versus more difficult clinical situations.

In the second part of the research, dentists, after performing endodontic and restorative procedures, filled out a second questionnaire. The questions from the second questionnaire related to skills during work with rubber dam. The indications for the placement of rubber dam depended on clinical experience. The use of rubber dam was more prevalent during endodontic procedures in the lower jaw among all dentists. This can be explained by the fact that for endodontic interventions, it is usually necessary to isolate only one, treating tooth. Isolation of one tooth with a rubber dam is a simpler procedure and doesn't require much

time. For restorative procedures, such as the reconstruction of approximal cavities, it is necessary to isolate more teeth, both for the placement of the matrix and for providing more space for manipulation. Data from the literature give clear recommendations that during restorative procedures, it is necessary to isolate one tooth distally and two teeth mesially from the tooth being reconstructed [23], making placing rubber dam in these situations a more complex procedure. Dentists with up to 2 years of clinical experience placed a rubber dam in 33% of all restorative procedures. This can be explained by the increased motivation of young dentists with the least experience and desire to practice and implement techniques that are more complicated in order to acquire new knowledge.

The most frequently isolated teeth in both dental procedures were the lower lateral teeth, which can be explained by the difficult work in the lower jaw due to increased salivation and the presence of a massive tongue and surrounding soft tissues. In a study by Ryan and O'Connell [20], over 90% of students applied a rubber dam for the restoration of the lateral teeth, which is consistent with our study.

Data from the literature indicate that one of the reasons for not using the rubber dam is a time-consuming procedure [7, 24, 25]. In our study, the average time for placing the rubber dam in both restorative and endodontic procedures was five minutes. The data on the average time are in accordance with the data from the literature [26].

Although patients' first experience with the rubber dam procedure can be frightening, data from the literature show that they tolerate it well [13, 26, 27]. During restorative procedures without the use of local anesthesia, patients may experience pain and discomfort. The use of local anesthesia and careful work can reduce patient discomfort. Thus, out of 30 patients, 12 who felt pain would still repeat the dental procedure with the rubber dam. Adequate approach, explanation of the importance of placing the rubber dam, and the experience of the dentist greatly contribute to obtaining the patient's consent for the placement of the rubber dam in subsequent visits.

CONCLUSION

Considering the limited sample size, we can conclude that young dentists have knowledge but insufficient experience when working with the rubber dam, which is related to the existence of less frequent use in more complex situations. Patients tolerate well the placement of the rubber dam and have a positive opinion about this procedure. Additional education and practical training in working with the rubber dam are necessary to increase the independence of young dentists when performing this phase of work.

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Primena koferdama tokom izvođenja restaurativnih i endodontskih procedura – iskustva terapeuta i pacijenata

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KRATAK SADRŽAJ

Uvod/Cilj Izazovi pri aplikaciji koferdama, neiskustvo u radu i nelagodnost pacijenata uzroci su nepoželjnosti njegove upotrebe. Zbog toga su edukacija i obuka stomatologa veoma važne, kao i približavanje ove faze rada pacijentima radi smanjivanja diskomforta. Cilj rada je ispitati stavove o znanju i veštinama mladih stomatologa u našoj sredini i utisak pacijenata tokom primene koferdama pri izvođenju restaurativnih i endodontskih procedura.

Metode Istraživanje je sprovedeno na osnovu popunjavanja epidemioloških upitnika od strane 30 stomatologa (specijalističke studije i pripravnički staž Klinike za bolesti zuba) i 30 pacijenata neposredno nakon rada sa koferdamom. Upitnici su podeljeni u tri kategorije: opšte informacije o znanju i iskustvu stomatologa, informacije tokom kliničkog rada sa koferdamom i utisak pacijenata.

Rezultati Iskustvo korišćenja koferdama tokom endodontskih procedura imalo je 37% stomatologa, dok je 23% stomatologa koristilo koferdam tokom restaurativnih procedura. Mali broj godina iskustva (2–4) nije značajno uticao na sposobnost postavljanja koferdama u jednostavnim kliničkim procedurama ($p = 0,321$), dok su na sposobnost postavljanja koferdama u težim situacijama godine iskustva imale značajan uticaj ($p = 0,027$). Tokom kliničkog rada, indikacija za postavljanje koferdama nije značajno uticala na odabir vilice na kojoj će biti sprovedena stomatološka procedura ($p = 0,659$). Prosečno vreme za postavljanje koferdama kod obe procedure iznosilo je pet minuta. Nakon kliničkog rada, 57% pacijenata nije osetilo bol, a 93% bi pristalo na ponovno postavljanje koferdama tokom budućih procedura.

Zaključak Mladi stomatolozi imaju znanje ali nedovoljno iskustva tokom rada sa koferdamom, što se može objasniti oprežnošću u analizi kliničke situacije. Neophodne su dodatne edukacije i obuka tokom rada sa koferdamom kako bi se povećala njihova samostalnost. Pacijenti lako podnose rad sa koferdamom i imaju pozitivno mišljenje o njemu.

Ključne reči: koferdam; kliničko iskustvo; restaurativne procedure; endodontske procedure; stav pacijenta

UVOD

Tokom izvođenja restaurativnih i endodontskih procedura, meka tkiva usana, obraza i jezika, kao i prisustvo pljuvačke i gingivalne tečnosti, ograničavaju radno polje i dovode do njegove kontaminacije. Obezbeđivanje relativno suvog polja rada moguće je primenom vaterolni i aspiracijom. Međutim, za uspostavljanje apsolutno suvog polja rada neophodna je upotreba koferdama.

Pored sužavanja radnog polja tokom kliničkog rada, izazov predstavlja i upotreba različitih iriganasa i kiselina koje lako mogu dovesti do hemijskih oštećenja mekih tkiva, kao i mogućnost aspiracije i gutanja sitnih rotirajućih instrumenata koji se koriste pri radu.

U cilju premošćavanja svih navedenih poteškoća, koferdam bi trebalo da predstavlja neizostavni deo sprovođenja restaurativnih i endodontskih procedura. Njegova primena obezbeđuje niz pogodnosti. Pored izolacije operativnog polja od pljuvačke, gingivalne tečnosti i krvi [1], apsolutno suvo polje rada unapređuje sprovođenje adhezivnih procedura tokom primene restaurativnih materijala i doprinosi dugotrajnosti adhezivnih ispuna [2]. Istovremeno, sprečavajući različite iriganse, medikamentate i druga hemijska sredstva da dođu u kontakt sa okolnom oralnom mukozom, primena koferdama obezbeđuje zaštitu pacijenta od gutanja i aspiracije sitnih instrumenata [3, 4], kao i zaštitu stomatologa od infektivnih bolesti i kontaminacije aerosolima tokom stomatoloških intervencija [5, 6].

Ipak, i pored dobro poznatih prednosti koferdama, stomatolozi se u svom kliničkom radu često ne odlučuju za njegovu upotrebu vodeći se mišljenjem da je sprovođenje ove procedure komplikovano i da iziskuje veći utrošak vremena tokom kliničkog rada. Takođe, kao dodatni razlozi za nekorišćenje koferdama navode se visoka cena koferdam seta i neprihvatnje

od strane pacijenata [7]. U restaurativnoj stomatologiji rad sa koferdamom zavisi od težine kliničke situacije, kao i od mogućnosti za njegovo postavljanje. Preporuka Evropskog udruženja endodontologa definiše upotrebu koferdama kao obaveznu tokom endodontske terapije i terapije vitalne pulpe [8, 9]. Podaci iz literature pokazuju da bez obzira na razvoj savremene stomatologije i novih materijala, upotreba koferdama u različitim delovima Evrope nije u porastu. Studija koju su sprovedli Marshall i saradnici [10] 1990. godine pokazala je da je od 1008 ispitivanih opštih stomatologa u zemljama Ujedinjenog Kraljevstva samo 1% primenjivao koferdam tokom restaurativnih procedura, a 11% pri endodontskoj terapiji. Na Novom Zelandu i u Sjedinjenim Američkim Državama rutinska primena koferdama u endodonciji zabeležena je kod 57% i 59% opštih stomatologa [11, 12]. Među irskim stomatolozima opšte prakse zabeleženo je sprovođenje restaurativnih i endodontskih procedura bez upotrebe koferdama u većem procentu [7]. Takođe, kliničko iskustvo ima uticaja na incidencu primene koferdama. Čađa i saradnici [13] u svom radu nalaze da stomatolozi sa većim brojem godina radnog staža ređe koriste koferdam pri sprovođenju različitih stomatoloških procedura. U istoj studiji, 110 stomatologa (27% ispitivanih) navelo je da je postavljanje koferdama komplikovano, a 143 (36%) da pacijenti ne prihvataju rad sa koferdamom [13]. U studiji sa Novog Zelanda pokazano je da, u odnosu na iskusnije stomatologe, znatno više stomatologa sa manje od deset godina kliničkog iskustva koristi koferdam. Zabeležen je i veći trend dodatnih edukacija u primeni koferdama, kao i veća primena koferdama tokom sprovođenja endodontskih procedura kod stomatologa koji rade u kolektivu u u poređenju sa onima koji rade samostalno u privatnim ordinacijama [11]. Slična situacija je uočena i u studiji koju su sprovedli Mala i saradnici [14], koji su ispitivali stavove studenata završne godine o primeni koferdama. Iako

je koferdam kod odraslih pacijenata koristilo 98% studenata završne godine studija tokom endodontskih procedura, njih 62% smatra da će se upotreba koferdama smanjiti nakon diplomiranja zbog teškoće postavljanja i neprihvatanja od strane pacijenata [14].

Stoga je cilj ove studije bio da se ispituju stavovi mladih stomatologa u našoj sredini o znanju i veštinama u vezi sa koferdamom, kao i utisci pacijenata tokom primene koferdama pri izvođenju restaurativnih i endodontskih procedura.

METODE

Istraživanje je sprovedeno na Klinici za bolesti zuba Stomatološkog fakulteta Univerziteta u Beogradu na osnovu popunjavanja epidemioloških upitnika. Trideset stomatologa na specijalističkim studijama i pripravničkom stažu i 30 pacijenata popunili su upitnike pre i posle rada sa koferdamom tokom sprovođenja restaurativnih i endodontskih procedura. Stomatolozi su popunjavali dva upitnika, dok su treći upitnik popunjavali pacijenti.

Prvi upitnik se sastojao od 11 pitanja koja su se odnosila na opšte informacije o stomatolozima i njihovom prethodnom znanju o koferdamu. U ovom upitniku dobijeni su podaci o prethodnom iskustvu stomatologa u radu sa koferdamom. Radi statističke analize podataka, mladi stomatolozi su grupisani na osnovu godina iskustva u tri grupe: stomatolozi koji su na pripravničkom stažu i stomatolozi na specijalističkim studijama koji imaju do dve godine kliničkog iskustva, stomatolozi na specijalističkim studijama sa 2–4 godine iskustva i oni sa više od pet godina kliničkog iskustva. Upitnik je sadržao i ličnu procenu stepena samostalnosti pri postavljanju koferdama u jednostavnim i težim kliničkim situacijama. Pod jednostavnim kliničkim situacijama smatrane su: očuvanost više od ½ krunice, supragingivalni aproksimalni kaviteti, odsustvo interproksimalnih kontakata, normalni interproksimalni kontakti i izolacija manje od tri zuba. Pod težim kliničkim situacijama navedene su: destrukcija više od ½ krunice, subgingivalni aproksimalni kavitet, teskoba i izolacija više od tri zuba. Popunjavanje prvog upitnika vršeno je neposredno pre intervencije.

Drugi upitnik, koji je takođe bio namenjen stomatolozima, sadržao je pitanja koja su se odnosila na rad sa koferdamom tokom restaurativnih ili endodontskih procedura. Popunjavanje ovog upitnika vršeno je nakon sprovedenog kliničkog rada. Sastojao se od 10 pitanja, koja su bila vezana za indikacije za postavljanje koferdama, odabir kvačica i zuba koji su izolovani koferdamom. Takođe, notirano je i vreme za koje je postavljen koferdam, kao i postojanje poteškoća tokom rada.

Treći upitnik bio je namenjen pacijentima, koji su odgovore davali nakon završene intervencije u kojoj je primenjen koferdam. Upitnik je sadržao devet pitanja, a pitanja su formulisana u cilju dobijanja informacija o prisustvu bola pri postavljanju i radu sa koferdamom. Ispitivani su opšti utisak pacijenata i pristanak na ponovno postavljanje koferdama prilikom budućih restaurativnih i endodontskih intervencija.

Za sprovođenje ovog istraživanja korišćen je osnovni koferdam set, koji se sastojao od elastične gume, rama, metalnih kvačica sa krilcima i bez njih za fiksaciju gume za zub, šablona za obeležavanje otvora na gumi, klešta za pravljenje otvora, klešta

za držanje i postavljanje kvačice na zub i dentalnog konca za fiksiranje gume oko zuba.

Svi podaci su statistički analizirani u SPSS programu (SPSS v22.0, SPSS Inc, Chicago, IL, USA), deskriptivnim statističkim metodama upotrebom testova Men–Vitni i χ^2 .

REZULTATI

a) Rezultati na osnovu podataka dobijenih iz I upitnika

1. Distribucija godina starosti mladih stomatologa i kliničkog iskustva

Studija obuhvata stomatologe koji su na specijalističkim studijama i pripravničkom stažu sa minimalnim kliničkim iskustvom i iskustvom do sedam godina. Od ukupnog broja stomatologa koji su učestvovali u istraživanju, njih 17 je bilo starosti 25–29 godina, dok je jedan stomatolog imao 39 godina. Poređenjem godina starosti i kliničkog iskustva uočeno je najveće kliničko iskustvo (84 meseca / sedam godina) kod stomatologa sa 35 godina starosti, dok je najmanje iskustvo (četiri meseca) zabeleženo kod mladih stomatologa starosti 26 godina (Tabela 1). Grupisanjem podataka prema metodološkom planu, dobijeno je da je od ukupnog broja stomatologa ($n = 30$), 13 stomatologa imalo do dve godine kliničkog iskustva, 12 stomatologa između 2–4 godine, a pet stomatologa 5–7 godina kliničkog iskustva.

2. Dodatni izvori učenja o koferdamu u odnosu na kliničko iskustvo

Stomatolozi sa 2–4 godine kliničkog iskustva pohađali su kurseve (27%) i koristili internet izvore – YouTube (13%) – kao dodatne izvore učenja. Sličan trend je zabeležen i kod stomatologa sa 5–7 godina iskustva (kursevi 10%, YouTube 7%). Kod stomatologa sa najmanjim brojem godina iskustva uočena je raznovrsna primena dodatnih izvora učenja. Zabeleženo je i da 13% stomatologa sa najmanje godina iskustva nije koristilo dodatne izvore učenja. Godine kliničkog iskustva značajno su uticale na potrebu za dodatnim izvorima učenja ($p = 0,028$) (Slika 1).

3. Prethodna primena koferdama tokom sprovođenja restaurativnih i endodontskih procedura kod svih stomatologa na osnovu godina kliničkog iskustva

Na osnovu prethodno stečenog znanja i iskustva, kod stomatologa sa kliničkim iskustvom do dve godine, kao i kod stomatologa sa 2–4 godine kliničkog iskustva, samostalna upotreba koferdama je prijavljena u 23% kliničkih situacija tokom sprovođenja restaurativnih procedura. Kod stomatologa sa najviše godina kliničkog iskustva zabeležena je samostalnost u postavljanju koferdama tokom sprovođenja restaurativnih procedura u 17% slučajeva.

Nešto veća učestalost rada sa koferdamom tokom sprovođenja endodontskih procedura zabeležena je kod stomatologa sa do dve godine kliničkog iskustva (30%), kao i kod stomatologa sa 2–4 godine kliničkog iskustva (37%). Stomatolozi sa najvećim kliničkim iskustvom pokazali su podjednaku upotrebu koferdama tokom sprovođenja kako restaurativnih tako i endodontskih procedura.

U pogledu kliničkog rada bez primene koferdama, kod stomatologa sa najmanjim brojem godina kliničkog iskustva uočeno je da je podjednako zastupljen kod obe kliničke procedure, dok je kod stomatologa sa kliničkim iskustvom 2–4 godine zabeležen veći procenat nekorišćenja koferdama prilikom izvođenja restaurativnih u odnosu na endodontske procedure (Slika 2).

4. Nivo samostalnosti u primeni koferdama u jednostavnim kliničkim situacijama u odnosu na kliničko iskustvo

Kod stomatologa sa najmanjim brojem godina iskustva i stomatologa sa iskustvom do četiri godine bila je neophodna minimalna pomoć u 13% i 7% slučajeva, redom. Godine iskustva nisu značajno uticale na nivo samostalnosti u postavljanju koferdama u jednostavnim kliničkim situacijama ($p = 0,321$) (Slika 3).

5. Nivo samostalnosti u primeni koferdama u težim kliničkim situacijama u odnosu na kliničko iskustvo

Minimalna pomoć u postavljanju koferdama u težim kliničkim situacijama bila je potrebna kod sve tri grupe stomatologa, s tim što je najmanju samostalnost pokazala grupa stomatologa do dve godine radnog iskustva, a najveću stomatolozi sa najvećim brojem godina radnog iskustva. Potpuna samostalnost u postavljanju koferdama zabeležena je u 17% slučajeva kod stomatologa sa 2–4 godine radnog iskustva i kod stomatologa sa najdužim radnim iskustvom (10%). Pri težim kliničkim situacijama godine iskustva su značajno uticale na nivo samostalnosti ($p = 0,027$) (Slika 4).

b) Rezultati na osnovu podataka dobijenih iz II upitnika

1. Indikacije za postavljanje koferdama tokom kliničkog rada u odnosu na iskustvo

Tokom kliničkog rada, mladi stomatolozi sa do dve godine kliničkog iskustva koristili su koferdam u 33% slučajeva tokom sprovođenja endodontskih tretmana i u 10% restaurativnih procedura. Stomatolozi sa 2–4 godine kliničkog iskustva i stomatolozi sa najvećim iskustvom koristili su koferdam pri sprovođenju endodontskih procedura u 33% i 17% situacija. Kliničko iskustvo nije značajno uticalo na izbor indikacija za postavljanje koferdama ($p = 0,128$).

2. Izbor vilice, zuba koji su izolovani i zuba na koje je postavljena kvačica

Kod svih stomatologa, bez obzira na kliničko iskustvo, primena je veća zastupljenost primene koferdama u donjoj vilici kod obe kliničke procedure. Tokom restaurativnih zahvata, 7% stomatologa je postavilo koferdam u donjoj vilici, dok je 67% endodontskih tretmana sa koferdamom sprovedeno u donjoj vilici. Tokom kliničkog rada, indikacija za postavljanje koferdama nije značajno uticala na odabir vilice na kojoj će biti sprovedena stomatološka procedura ($p = 0,659$). U najvećem broju kliničkih situacija koferdamom su bili izolovani donji bočni zubi.

3. Prosečno vreme postavljanja koferdama tokom restaurativnih i endodontskih procedura

Kod restaurativnih procedura tri (10%) stomatologa su postavila koferdam za pet minuta, dok je jednom stomatologu

bilo potrebno 5–10 minuta. Za postavljanje koferdama tokom sprovođenja endodontskih procedura kod 24 (80%) stomatologa zabeleženo je vreme od pet minuta. Kod obe procedure, prosečno vreme za postavljanje koferdama iznosilo je pet minuta ($p = 0,137$).

c) Rezultati na osnovu podataka dobijenih iz III upitnika

1. Distribucija pola i godina starosti pacijenata

U istraživanju je učestvovalo 20 pacijenata ženskog i 10 pacijenata muškog pola. Pacijenti su bili starosti 20–80 godina (Tabela 2).

2. Prisustvo bola tokom postavljanja koferdama i pristanak pacijenta na ponovno postavljanje koferdama u odnosu na prisustvo bola

Tokom sprovođenja restaurativnih i endodontskih procedura, 43% pacijenata je osetilo bol, dok 57% pacijenata nije imalo nikakve bolne senzacije. Nakon završenog kliničkog rada, na osnovu subjektivnog osećaja bola, 12 (40%) pacijenata bi pristalo da im se ponovo postavi koferdam, dok jedan (3%) pacijent ne bi pristao na ponovno postavljanje koferdama. Pristanak pacijenta na ponovno postavljanje koferdama u odnosu na prisustvo bola nije bilo statistički značajno povezano ($p = 1,000$) (Slika 5).

DISKUSIJA

Iako primena koferdama datira još iz davne 1864. godine, podaci iz literature ukazuju na to da među stomatolozima koferdam još uvek nije uveden kao sastavni deo kliničke procedure tokom sprovođenja restaurativnih i endodontskih zahvata [15–18].

Odbori za izdavanje licenci za rad u Sjedinjenim Američkim Državama zahtevaju upotrebu koferdama kao obavezni i sastavni deo kliničkog rada [19]. Takođe, preporuka Evropskog udruženja endodontologa je obavezna upotreba koferdama tokom endodontske terapije i terapije vitalne pulpe [8, 9].

I pored ovih obaveznih zahteva, praksa stomatologa je pokazala određenu stopu odbojnosti prema koferdamu. Stoga su u ovo istraživanje uključeni mladi stomatolozi kako bi se ispitali njihovi stavovi, polazeći od činjenice da nemaju ili imaju malo kliničkog iskustva. Pored stomatologa, ispitivani su i pacijenti u pogledu komfora tokom rada sa koferdamom i prisustva/odsustva bola.

Iako je na svim stomatološkim fakultetima primena koferdama obavezni deo nastavnog plana, podaci iz studije koju su sprovedli Ryan i O'Connel [20] ukazuju na to da studenti diplomiraju sa mišljenjem da primena koferdama neće imati nikakvu korist u njihovom budućem kliničkom radu, osim tokom endodontskog lečenja. Kao razloge za to navode teškoće i dugo vreme tokom postavljanja, ali i mišljenje da pacijenti ne prihvataju rad sa koferdamom [14].

Očigledno, neophodne su dalje edukativne aktivnosti kako bi se prevazišao nesklad između znanja stečenog tokom studiranja i niske učestalosti upotrebe koferdama nakon diplomiranja [21]. Mala i saradnici [14] u svojoj studiji su zaključili da usled razvoja savremene stomatologije može postojati drugačiji trend

upotrebe koferdama nakon diplomiranja današnjih studenata u poređenju sa stomatolozima koji su diplomirali pre nekoliko decenija.

Milanović i saradnici su u svojoj studiji ispitivali stavove, znanje i veštine u radu sa koferdamom kod studenata završne godine Stomatološkog fakulteta Univerziteta u Beogradu. U ovoj studiji od 130 studenata završne godine studija, 88% studenata se nije osećalo dovoljno sposobnim da samostalno postavi koferdam [22]. Nalazi studije Milanović i saradnika mogu se povezati sa našim rezultatima po pitanju samostalnosti u postavljanju koferdama u jednostavnim i težim kliničkim situacijama. U našoj studiji, odabir jednostavnih i težih kliničkih situacija izvršen je na osnovu kliničkog iskustva tokom rada sa koferdamom, kao i na osnovu stepena otežanosti postavljanja koferdama. Pri jednostavnim kliničkim situacijama, kod mladih stomatologa do dve godine i 2–4 godine kliničkog iskustva bila je neophodna minimalna pomoć. U težim kliničkim situacijama, potreba za minimalnom pomoći je zabeležena kod svih stomatologa bez obzira na godine iskustva. Veća stopa samostalnosti je uočena pri jednostavnim u odnosu na teže kliničke situacije.

U drugom delu istraživanja, stomatolozi su nakon sprovedenih endodontskih i restaurativnih procedura popunjavali drugi upitnik, u kome su se pitanja odnosila na veštine tokom rada sa koferdamom. Izbor indikacija za postavljanje koferdama zavisio je od kliničkog iskustva. Kod svih stomatologa, upotreba koferdama je bila češća tokom izvođenja endodontskih procedura i to u donjoj vilici. To se može objasniti činjenicom da je za endodontske intervencije najčešće neophodno izolovati samo jedan zub, onaj na kome se sprovodi endodontska terapija. Izolacija jednog zuba koferdamom je jednostavnija procedura i ne iziskuje mnogo vremena. Za restaurativne procedure, kao što je rekonstrukcija aproksimalnih kaviteta, neophodno je izolovati više zuba, kako zbog postavljanja matrice, tako i zbog obezbeđivanja više prostora za manipulaciju. Podaci iz literature daju jasne preporuke da se tokom restaurativnih zahvata izoluje jedan zub distalno i dva zuba mezijalno od zuba koji se rekonstruiše [23], što postavljanje koferdama u ovim situacijama čini kompleksnijim zahvatom. Stomatolozi sa do dve godine kliničkog iskustva su u 33% situacija postavili koferdam tokom izvođenja

restaurativnih procedura. To se može objasniti povećanom motivisanošću mladih stomatologa sa najmanje iskustva i željom da uvežbaju i implementiraju tehnike koje su komplikovanije kako bi stekli nova znanja.

Najčešće izolovani zubi kod obe stomatološke procedure bili su donji bočni zubi, što se može objasniti otežanim radom u donjoj vilici zbog povećane salivacije, prisustva masivnog jezika i okolnih mekih tkiva. U studiji koju su sprovedli Ryan i O'Connell [20], preko 90% studenata je primenilo koferdam za restauraciju bočnih zuba, što je u skladu sa našom studijom.

Podaci iz literature ukazuju da je jedan od razloga za nekorisćenje koferdama veliki utrošak vremena [7, 24, 25]. U našoj studiji, prosečno vreme za postavljanje koferdama i kod restaurativnih i kod endodontskih procedura iznosilo je pet minuta. Podaci o prosečnom vremenu su u skladu sa podacima iz literature [26].

Iako pacijentovo prvo iskustvo sa procedurom postavljanja koferdama može biti zastrašujuće, podaci iz literature pokazuju da je pacijenti dobro podnose [13, 26, 27]. Tokom sprovođenja restaurativnih procedura bez upotrebe lokalne anestezije moguća je pojava bola i nelagodnosti kod pacijenata. Upotreba lokalne anestezije i pažljiv rad mogu smanjiti nelagodnost kod pacijenata. Tako, od 30 pacijenata, njih 12 koji su osetili bol bi ipak ponovili rad sa koferdamom. Adekvatan pristup pacijentu, objašnjenje važnosti primene koferdama i iskustvo stomatologa umnogome doprinose dobijanju saglasnosti pacijenata za postavljanje koferdama pri narednim posetama.

ZAKLJUČAK

Uzimajući u obzir ograničenu veličinu uzorka, možemo zaključiti da mladi stomatolozi imaju znanje, ali nedovoljno iskustva u radu sa koferdamom, što je u vezi sa ređom upotrebom u složenijim situacijama. Pacijenti dobro podnose rad sa koferdamom i imaju pozitivno mišljenje o ovoj proceduri. Dodatne edukacije i praktična obuka u radu sa koferdamom neophodne su kako bi se povećala samostalnost mladih stomatologa prilikom izvođenja ove faze rada.

Three case reports of different clinical applications of mineral trioxide aggregate

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SUMMARY

Introduction Calcium silicate dental cements have a wide range of applications in clinical dentistry. Many formulations were developed in the last decade and successfully employed for dental healing. In this paper, several clinical applications of mineral trioxide aggregate (MTA+, Cerkamed, Stalowa Wola, Poland) were presented.

Outlines of cases The first case report reflects the application of the MTA+ for the healing of the root perforation of the upper premolar. The second case report was the usage of MTA+ for indirect pulp capping in patient who came with pain of the tooth previously restored with composite filling. The third case report was a patient with periapical cystic lesion that was removed surgically and root canal filled retrogradely with MTA+.

Conclusion Altogether, current calcium silicate based dental cements bear a great potential for solving numerous issues in the dental practice regarding huge or problematic defects of dentine or alveolar bone.

Keywords: calcium silicate cement; mineral trioxide aggregate; root perforation; indirect pulp capping; retrograde root canal filling

INTRODUCTION

Calcium silicate- (CS) based cements are used in many clinical applications such as direct/indirect pulp capping, pulp amputation, root-end canal obturation, perforation repair, apexogenesis/apexification, and other endodontic procedures [1]. The main advantages of CS cements are outstanding mechanical resistance, high pH, longer Ca ions release than in calcium hydroxide and their antibacterial properties, while the shortcomings include tooth discoloration, poor handling properties and long setting time [2]. Nevertheless, CS-based cements – mineral trioxide aggregate (MTA) clinically even exceeded long-time favored calcium hydroxide, especially in maintaining the tooth vitality during pulp capping due to less toxicity and bioactivity resulting in superior dentinogenesis and hard tissue barrier formation [3].

An important clinical application of CS cements is the healing of the root perforations. Root canal perforations may occur during preparation of access cavity, postspace preparation, or as a consequence of an internal resorption [4]. Intracanal/conservative and extracoronary/surgical repair of perforations have been described [5]. Usually, perforations occur unnoticed and therefore the dentist can rarely influence one of the most important criteria for the success of the treatment time [6].

Perhaps the main and widely investigated application of CS cements is a direct pulp capping [7]. Surprisingly, the use of CS cements for indirect pulp capping in permanent

teeth is not widely reported. In the rare clinical study on this topic, Selvendran et al. proved superior healing rate of both MTA (Angelus, Brazil) and Biodentine (Septodont, France), cements in comparison with Dycal (Dentsply, USA) [8]. In primary teeth, Saikia et al. demonstrated the highest amount of dentin deposition with light-cured CS (TheraCal, BiscoInc, USA) than in MTA (Angelus, Brazil) when they were used for indirect pulp capping [9].

Retrograde root canal filling is an important clinical indication for the use of CS cements [10]. The main drawback of the current formulations of CS cements for retrograde root canal filling is their long setting time [1]. A short setting time is necessary to prevent possible wash-out when CS is used as a root-end filling material. During the surgical intervention of periapical lesions, the surgeon has short time to adequately place a retrograde material in the root canal because CS cements are very sensitive to any additional liquid absorption. The fast setting CS formulation is recently introduced as a RetroMTA (BioMTA, South Korea) which manufacturer claims that material is capable to set in 5 minutes [11]. In addition, the control of operative bleeding is very important for the success of the surgical intervention. The main goal of retrograde filling is to fill the root canal, thus preventing the propagation of the infection in the periapical tissue [12]. The recommendations claim that only apical part of the canal should be filled. However, it remains the question if the excess material in the periapical tissue may hamper the postoperative healing and the outcome of the procedure.

In the present paper, the contribution to this important clinical field is given by presenting three clinical cases of the patients where commercially available form of CS cement – MTA+ (Cerkamed) was used for healing the root perforation, indirect pulp capping and retrograde root-end filling.

REPORTS OF CASES

Case 1

A 26-year-old patient came with a discomfort and pain of the upper left second maxillary premolar. The patient recorded the endodontic treatment two weeks ago. Radiographic examination has showed the presence of perforation on the distal part of the coronal third of the root. The tooth experienced slight percutory tenderness. The treatment was performed by an endodontist. Provisional filling was removed and cavity was rinsed with 5% NaOCl solution and thereafter with sterile normal saline solution for one minute. The MTA+ (Cerkamed) was mixed in accordance with manufacturer recommendation and used to seal the perforation. The tooth was restored with provisional cement and radiographed (Figure 1). At a control appointment, one week later, no pain and other symptoms were observed and thus the tooth was restored with composite filling (Tetric Evo Ceram, Ivoclar, Lichtenstein). The patient was recalled after 3 months when tooth was free of symptoms and tenderness to percussion within normal limits. Unfortunately, patient refused control radiography.

Case 2

A 35-year-old patient came with a pain of the upper second right molar. The pain was associated with physical stimulus lasted for ~2 minutes each time started. The tooth was previously restored with composite filling material 1.5 year ago. Pulp vitality was assessed with tooth sensibility test, thermal test and electrical stimuli. No history of spontaneous pulpal pain was recorded. Pulp sensitivity was compatible with reversible stage of inflammation. After removal of carious lesion with excavator and sterile ball round bar, the tooth was diagnosed with deep dental caries without pulpal exposure. Cavity was rinsed with 5% NaOCl and saline solution for one minute and thereafter MTA+ (Cerkamed) was mixed in accordance with manufacturer's instructions and placed in the floor of the cavity with a thickness of ~ 0.5 mm. Provisional restoration with glass ionomer cement (Fuji IX, GC, Japan) was completed over the capping material. The patient was presented for a recall appointment 1 month later. Control radiography showed the application of the MTA+ and temporary restoration (Figure 2). The tooth was subjected to pulp sensitivity test and responded within normal limits. Thereafter, the tooth was subjected to definitive composite restoration (Tetric Evo Ceram, Ivoclar, Lichtenstein).



Figure 1. The radiograph of the root canal perforation of the upper left second premolar sealed with mineral trioxide aggregate and temporary restored (one day after the treatment)

Slika 1. Radiogram perforacije zida kanala korena gornjeg levog drugog pretkutnjaka zaptivenog mineralnim trioksidnim agregatom i privremeno restauriranog (jedan dan posle tretmana)



Figure 2. The radiograph showing the indirect pulp capping of the upper right second molar sealed by mineral trioxide aggregate and temporary restoration (one month after the treatment).

Slika 2. Radiogram prikazuje indirektno prekrivenu pulpu gornjeg desnog drugog kutnjaka preparatom mineralnim trioksidnim agregatom i privremeni ispun (mesec dana posle tretmana).

Case 3

A 46-year-old patient with a non-symptomatic maxillary right first premolar was seen at dental practice. The patient reported that the tooth had been root treated 6 years previously and that the tooth was restored with ceramic crown. Extraoral examination showed normal soft tissue structures without tooth mobility and tenderness to percussion. Diagnostic radiographic examination revealed large periapical radiolucency associated with maxillary right first premolar. Following the radiographic criteria for the diagnosis of large periapical lesion, the findings were suggestive of a periapical cyst.

The patient was presented with several treatment options including tooth extraction and implant placement. However, patient decided to save the tooth and therefore root-end surgery was recommended.



Figure 3. The radiograph of the upper right first premolar retrogradely obturated with mineral trioxide aggregate after removal of the cystic lesion (one week after the treatment); arrows show the material placed in the cystic defect surrounding the apex of the root.

Slika 3. Radiogram gornjeg prvog desnog premolara retrogradno opturisanog mineralnim trioksidnim agregatnim posle uklanjanja cistične lezije (jedna nedelja posle treatmenta). Strelice pokazuju materijal aplikovan u cistični defekt oko vrha korena zuba.

The surgical procedure was performed by oral surgeon under local anesthesia (Lidocain 2%, Galenika, Serbia). Following the reflection of the flap, the curettage was performed and granulation tissue was completely removed. After root-end resection (~ 1 mm), the root-end canal was filled with MTA+ (Cerkamed) according to manufacturer's instruction. The interesting modification of the standard procedure is that excess material was placed purposely in the bone defect in order to circumvent the drawback of the current calcium silicate based formulation – solubility of the material related with long setting time. Thereafter, the flap was repositioned and radiographic examination was performed (Figure 3). Seven days later, the patient returned symptom free and sutures were removed. Patient returned for a recall appointment 3 months later, when clinical examination revealed no sensitivity to percussion or palpation.

DISCUSSION

This study showed numerous beneficial effects of CS based dental materials. Indeed, it is not wrong to state that these materials present one of the main breakthroughs in the fields of dentistry in the last several decades. They present great opportunities to solve some of the previously non-solving clinical problems. The reasons for their beneficial healing outcomes are numerous, but generally may be explained by slow, but long lasting release of Ca ions from the material together with their biocompatibility and superior physical resistance in comparison to calcium hydroxide [1, 5].

In this paper, different clinical applications of CS cement – MTA+ (Cerkamed) are presented.

Considering the application of MTA for healing the root perforation, the previous observations in the

scientific literature are confirmed – the crucial factor for the successful outcome is the time elapsed between the occurrence of the perforation and the treatment procedure [6]. In the case presented, the exact occurrence time of the perforation was exactly determined since the symptoms occurred soon after the canal obturation. Therefore it is to assume that the root canal was perforated during the endodontic instrumentation and that the wound site was not infected for a long period of time. That in turn may result in better prognosis of the treatment.

Observing the case of the use of MTA for healing the deep carious lesion, it was demonstrated that the cement was capable to eliminate the pain of the patient in the teeth that was previously restored with composite restoration. This presumably comes as a consequence of pulpal exudates absorption and subsequent decrease of the hydraulic pressure in the pulpal tissue. It is interesting to note that literature data comparing the clinical outcome of various commercially available CS cements in comparison with calcium hydroxide based liners in indirect pulp capping is scarce. In a rare and valuable study on this topic, Selvendran et al. [8] compared calcium hydroxide (Dycal, Dentsply Sirona, Charlotte, NC, USA), MTA (Angelus, Londrina, Paraná, Brazil) and Biodentine (Septodont, Saint-Maur-des-Fossés, France) for indirect pulp capping in permanent molars in 36 patients and they have found, after three months, the success rate of Dycal, MTA and Biodentine to be 75%, 92%, and 100%, respectively, while after six months the success rate was 77%, 91%, and 92%, respectively. To the best of our knowledge, long-term systematic outcomes are not documented in the literature. However, the tendency is clear – CS-based cements result in superior clinical outcome than calcium hydroxide-based materials when used for indirect pulp capping.

Regarding the root-end filling, several different approaches are reported in the literature. One point of view claims that CS-based cements may be extruded in the periapical space and result in positive periapical healing [13, 14], while the second group of authors state that it can result in a failure of root canal filling [15]. Consequently, resorption of unset MTA may occur and subsequently cause unsatisfactory obturation of the root canal and bacterial leakage. It is interesting to note that CS-based cements were at one point of time in the scientific literature taken as candidates in orthopedics as bone replacement materials. The researchers have given up on that application due to their non-resorptivity [16]. However, their biocompatibility is not a matter of discussion. These materials are claimed to be highly biocompatible [17]. Yet, there is a clinical issue of CS application for root-end filling. Namely, current CS formulations are still in huge percentage not satisfactory for this procedure due to their long setting time and poor handling properties. It is our assumption that a thin layer of CS placed on the floor of the periapical defect may be a barrier for “unsetting” of the cement in the root canal since it is well known that final setting time of CS cements is around 24 hours and that in clinical circumstances it is possible to provide conditions only for finishing the initial setting

time of the cement (~10 minutes) [18]. There are many techniques / hemostatic agents described in the literature to achieve these goals, including the application of bone wax, collagen membranes, aluminum chloride, ferric sulfate, epinephrine etc. Quick hemostatic effect, easy manipulation and biocompatibility of applied agents are the most important factors influencing the control of the operative bleeding during the endodontic surgery. It is also of great importance to avoid undermining natural bone healing and damage of the surrounding tissues [19, 20]. The authors of this paper believe that proven antimicrobial properties of MTA alongside with its high level of pH may have only a positive role in periapical healing. This assumption goes in line with novel state of the art approaches in the healing of the periapical cystic lesions that includes the non-surgical innovative techniques based on the combination of the mineral trioxide aggregate and injectable platelet rich fibrin [21]. Certainly, long-term clinical studies are needed to confirm this hypothesis.

Mineral trioxide aggregate is a suitable material for the treatment of root perforations, indirect pulp capping and retrograde root canal filling. In this study, it was demonstrated that MTA+ (Cerkamed) application resulted in clinically and radiographically and repaired dentine/bone lesions. More clinical studies with longer follow ups are recommended.

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Tri prikaza slučaja upotrebe mineralnog trioksidnog agregata u kliničkoj praksi

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KRATAK SADRŽAJ

Uvod Kalcijum-silikatni dentalni cementi imaju širok opseg primene u kliničkoj stomatologiji. Poslednjih nekoliko decenija razvijene su njihove različite formulacije, koje su sa uspehom primenjivane u stomatološkim tretmanima. U ovom radu predstavljeno je nekoliko slučajeva primene cementa na bazi mineralnog trioksidnog agregata (MTA+, CerKamed, Poljska).

Prikaz bolesnikâ Prvi klinički slučaj oslikava primenu preparata MTA+ u cilju zalečenja perforacije zida korena gornjeg pretkutnjaka. Drugi klinički slučaj prikazuje primenu MTA+ za indirektno prekrivanje pulpe pri terapiji dubokog karijesa kod pacijenta koji je došao sa simptomom povremenog kratkotrajnog provociranog bola zuba restauriranog kompozitnim ispunom. Treći klinički slučaj se odnosi na pacijenta sa periapexnom cističnom tvorevinom na gornjem levom pretkutnjaku. Lezija je uklonjena hirurški, a kanal korena napunjen retrogradno preparatom MTA+.

Zaključak Sveukupno, postojeći dentalni cementi na bazi kalcijum-silikata nose ogroman potencijal za rešavanje brojnih problema u kliničkoj praksi, a koji se odnose na velike ili problematične defekte dentina ili alveolarne kosti.

Ključne reči: kalcijum-silikatni cement; mineralni trioksidni agregat; perforacija korena; indirektno prekrivanje pulpe; retrogradno punjenje kanala korena

UVOD

Kalcijum-silikatni (KS) cementi se koriste u mnogim kliničkim slučajevima, kao što su direktno/indirektno prekrivanje i amputacija pulpe, opturacija kanala korena, zaceljenje perforacije, apeksogeneza/apeksifikacija i druge endodontske procedure [1]. Glavne prednosti KS cemenata su velika mehanička otpornost, visok pH, dugotrajnije otpuštanje Ca jona nego kod kalcijum-hidroksidnih preparata i antibakterijska svojstva, dok nedostaci uključuju prebojavanje zuba, teškoće pri manipulaciji i dugo vreme očvršćavanja [2]. Ipak, MTA cementi klinički zadovoljavaju, čak i prevazilaze, dugogodišnje favorizovani kalcijum-hidroksid, naročito u očuvanju vitaliteta pulpe nakon prekrivanja zbog manje toksičnosti i bioaktivnosti, koje pospešuju procese dentinogeneze i osteogeneze [3].

Vrlo važna klinička primena KS cemenata je kod slučajeva zaceljenja perforacija koje nastaju za vreme preparacije pristupnog kaviteta, prostora za kanalski kočić ili kao posledica internih resorpcija [4]. Intrakanalsko konzervativno i ekstrakoronarno tj. hirurško lečenje perforacija opisani su u literaturi [5]. Obično perforacija ostaje nezapažena, pa stoga praktičar retko može da utiče na jedan od najvažnijih kriterijuma za uspeh, a to je vreme koje protekne od njenog nastanka do trenutka započinjanja terapije [6].

Sasvim je sigurno da je glavna i najviše ispitivana primena KS cemenata za direktno prekrivanje pulpe [7]. Malo je iznenađujuće da slučajevi sa ovim cementima za indirektno prekrivanje pulpe stalnih zuba nisu često objavljeni. U jednoj od retkih studija u vezi sa ovom temom, Salvendran i sar. dokazuju superiornost kako cementa MTA (Angelus, Brazil) tako i Biodentina (Septodont, Francuska) u poređenju sa kalcijum-hidroksidnim preparatom Dycal (Dentsply, SAD) [8]. Kod mlečnih zuba, Saikia i sar. demonstriraju značajno veću depoziciju dentina primenom svetlosnopolimerizujućeg KS cementa (TheraCal, BiscoInc, SAD) u odnosu na MTA (Angelus, Brazil) preparat kod indirektnog prekrivanja pulpe [9].

Retrogradno punjenje kanala korena je vrlo važna klinička indikacija za primenu KS cemenata [10]. Ipak, glavni nedostatak trenutnih formulacija KS cemenata za retrogradno punjenje kanala je njegovo produženo očvršćavanje [1]. Za vreme hirurških intervencija periapexnih lezija operater ima kratko raspoloživo vreme da adekvatno retrogradno nanese materijal u kanal korena jer je KS cement veoma osetljiv na dodatnu apsorpciju tečnosti. Iz tog razloga je zahvalna brzoočvršćavajuća formulacija, nedavno uveden preparat RetroMTA (BioMTA, Južna Koreja), za koji proizvođač tvrdi da očvršćava za pet minuta [11]. Osim toga, kontrola intraoperativnog krvarenja je veoma važna za uspeh hirurške intervencije. Glavni cilj retrogradnog punjenja je da se hermetično ispuni kanal korena i tako spreči širenje zapaljenja i infekcija u periapexna tkiva [12]. Stoga je preporuka da se ispuni samo apeksni deo kanala. Ipak, ostaje pitanje u kojoj meri prebačen materijal u periapexna tkiva može ugroziti postoperativno zaceljenje, a time i ishod celokupne procedure.

U ovom radu, doprinos pomenutoj temi biće iskazan kroz prikaz tri klinička slučaja, pacijenata sa primenjenim KS cementom, preparatom MTA+ (CerKamed, Poljska), kroz tretman perforacije zida korena, indirektnog prekrivanja pulpe i retrogradnog punjenja vrha kanala korena zuba.

PRIKAZ SLUČAJA 1

Pacijent star 26 godina došao je u ordinaciju sa nelagodnošću i bolom na gornjem drugom levom premolaru. Potvrdio je istoriju endodontskog lečenja od pre dve godine. Radiografija je pokazala prisustvo perforacije u bifurkaciji u distalnoj partiji krunične trećine korena. Zub je pokazivao laganu perkutornu osetljivost. Nakon sprovedenog endodontskog tretmana od strane endodontiste privremeni ispun je uklonjen uz irigaciju kaviteta 5% NaOCl u trajanju od jednog minuta, a zatim sterilnim fiziološkim rastvorom. MTA+ (CerKamed, Poljska) zamešan je prema uputstvu i nanet na perforacionu površinu. Zub

je restauriran privremenim cementom i radiografisan nakon sedam dana (Slika 1). Pri kontroli koja je obavljena posle nedelju dana nije bilo bolnih senzacija ni drugih simptoma, pa je zub restauriran kompozitnim ispunom (Tetric Evo Ceram, Ivoclar, Lihtenštajn). Pacijent je pozvan na kontrolu tri meseca kasnije, kada je zub bio bez simptoma, a perkutorna osetljivost u granicama normale. Nažalost, pacijent je odbio kontrolnu radiografiju.

PRIKAZ SLUČAJA 2

Pacijent star 35 godina došao je u ambulantu sa bolom u gornjem desnom molaru. Bol izazvan fizičkim stimulusima je trajao oko dva minuta. Zub je po navodu pacijenta bio restauriran pre godinu i po dana kompozitnim ispunom. Test vitaliteta pulpe je potvrđen termalnim i elektrotetom. Nije zabeležena istorija spontanog bola, a osetljivost pulpe je bila kompatibilna sa reverzibilnim zapaljenskim stanjem. Nakon pažljivog uklanjanja karijesne mase ekskavatorom i sterilnim okruglim svrdlom, na zubu je klinički dijagnostikovana duboka karijesna lezija bez komunikacije sa pulpom. Nakon tretmana dentina sa 5% NaOCl u trajanju od jednog minuta i sledstvenog ispiranja sterilnim fiziološkim rastvorom, MTA+ (Cerkamed, Poljska) zamešan je i nanet na pod kaviteta u debljini od oko ~ 0,5 mm. Zub je na testu vitaliteta pokazao vrednosti u granicama normale, nakon čega je provizorno restauriran glas-jonomernim cementom (Fuji IX, GC, Japan) nanešenim preko medikamentozne podloge. Posle mesec dana pacijent je došao na kontrolu, pri čemu je radiografija pokazala senku aplikovanog MTA+ cementa i privremenu restauraciju (Slika 2). Nakon toga je usledila definitivna kompozitna restauracija (Tetric Evo Ceram, Ivoclar, Lihtenštajn).

PRIKAZ SLUČAJA 3

Pacijent starosti 46 godina sa asimptomatskim maksilarnim prvim desnim premolarom je došao u ambulantu. Izjavio je da je zub lečen pre šest godina a zatim restauriran keramičkom krunicom. Ekstraoralnim pregledom primećeno je normalno stanje meklotkivnih struktura, bez klaćenja zuba i perkutorne osetljivosti. Dijagnostičko radiografsko ispitivanje je pokazalo periapeksno rasvetljenje oko vrha korena zuba. Sledeći radiografske kriterijume za velike periapeksne lezije, nalaz je ukazivao na periapeksnu cistu.

Pacijentu je predočeno nekoliko terapijskih rešenja uključujući i ekstrakciju sa sledstvenom implantacijom. Ipak, pacijent se odlučio za spašavanje zuba i zbog toga je predložena hirurška intervencija apikotomije. Ona je sprovedena od strane oralnog hirurga pod lokalnom anestezijom (Lidocain 2%, Galenika, Srbija). Nakon odizanja režnja, izvršena je kiretaža, a granulaciono tkivo potpuno uklonjeno. Zatim je izvršena resekcija (~ 1 mm) od vrha korena i kanal ispunjen MTA+ (Cerkamed, Poljska) cementom prethodno zamešanim prema uputstvu proizvođača. Interesantna je bila primena modifikacije standardne procedure, pri čemu je višak ovog materijala namerno prebačen u kostni defekt u cilju prevencije ispoljavanja nedostatka trenutno postojećeg KS materijala – njegove rastvorljivosti koja je posledica dugog vremena vezivanja. Zatim je reponiran režanj, a zub radiografisan. Sedam dana kasnije pri kontroli, pacijentu

su skinuti šavovi i konstatovano je odsustvo simptoma. Pacijent je pregledan i posle dva meseca, pri čemu nije primećena osetljivost zuba na perkusiju i palpaciju.

DISKUSIJA

Prikazani klinički slučajevi pokazali su brojne koristi KS cementa. I zaista, nije pogrešno tvrditi da pronalazak KS cemenata predstavlja najznačajniji naučni prodor u oblasti stomatologije u poslednjih nekoliko decenija. Ovi materijali daju šansu onim diskutabilnim slučajevima koji su ranije bili osuđeni na radikalnu intervenciju. Razlozi za njihovo uspešno delovanje su brojni, a uopšteno se mogu sumirati kroz njihovo lagano otpuštanje Ca jona uz visoku biokompatibilnost sa unapređenim fizičkim karakteristikama u odnosu na kalcijum-hidroksidne preparate [1, 5].

U ovom radu su prikazane različite kliničke primene postojećeg KS cementa – MTA+ (Cerkamed, Poljska).

Razmatrajući primenu MTA za lečenje perforacije korena, može da se tvrdi da su prethodna zapažanja u naučnoj literaturi potvrđena – bitan faktor za uspešan ishod je vreme proteklo od nastanka perforacije do njenog tretmana [6]. U opisanom slučaju, vreme nastanka perforacije je bilo tačno utvrđeno pošto su se simptomi javili odmah nakon opturacije. Zbog toga se može tvrditi da je koren kanala perforiran za vreme endodontske instrumentacije i da mesto ozlede nije bilo inficirano dugo vremena. Ovo posledično daje bolju prognozu preduzetog tretmana.

Posmatrajući slučaj sa primenom MTA za lečenje dubokog karijesa, primećeno je da je cement sposoban da eliminiše bol kod pacijenta sa zubom prethodno restauriranim kompozitnim ispunom. Ovo se prevashodno dešava kao posledica apsorpcije pulpnog eksudata i sledstvenog smanjenja hidrodinamskog pritiska u pulpnom tkivu.

Interesantno je primetiti da u savremenoj literaturi nema mnogo radova o korelaciji ishoda tretmana sa različitim komercijalnim KS cementima, kao ni poređenja njihovih efekata sa kalcijum-hidroksidnim preparatima kod indirektnog prekrivanja pulpe. U jednoj od retkih i značajnih studija u vezi sa ovom važnom temom, Selvendran i sar. poredili su kalcijum-hidroksidni Dycal (Dentsply, SAD), MTA (Angelus, Brazil) i Biodentine (Septodont, Francuska) za indirektno prekrivanje stalnih molara kod 36 pacijenata. Nakon tri meseca je nađeno sledeće stanje uspeha terapije, redom: 75%, 92% i 100%, a nakon šest meseci uspeh je iznosio 77%, 91% i 92%, redom [8]. Koliko nam je do sada poznato, dugotrajne sistematske studije o uspehu terapije KS cementima još uvek nisu dokumentovane u literaturi. Ipak, tendencija je jasna: terapija KS cementima ishoduje značajno boljim kliničkim rezultatom nego sa materijalima na bazi kalcijum-hidroksida kod indirektnog prekrivanja pulpe.

Posmatrajući apeksno punjenje kanala korena, u literaturi je opisano nekoliko različitih pristupa. Jedan od njih tvrdi da se nakon prebacivanja KS cementa u periapeksni prostor očekuje pozitivan rezultat periapeksnog zalečenja [13, 14]. Drugi autori pak smatraju ovakav protokol kompromitujućim za ostvarivanje uspeha lečenja [15]. Naime, tvrdi se da može doći do resorpcije nevezanog i hemijski neizreagovanog, nehidratisanog MTA i mogućeg mikrobnog prodora u periapeksno tkivo. Interesantno je da je zabeležena primena KS cementa u ortopediji kao materijala za zamenu nedostajućeg kostnog tkiva. Međutim, ubrzo se

odustalo od toga zbog njegove osobine slabe resorptivnosti [16]. Sa druge strane, biokompatibilnost KS cemenata nije uopšte za diskusiju jer su ovi materijali mnogo puta dokazani po tom osnovu i to kao visoko kompatibilni [17]. Postoji jedno važno pitanje vezano za kliničku primenu KS cemenata za apeksnu opturaciju kanala. Naime, sadašnje formulacije KS materijala još uvek uglavnom nisu zadovoljavajuće za ovu proceduru zbog dugog vremena očvršćavanja i otežanog mešanja. Pretpostavka u ovoj studiji je da tanak sloj KS cementa na podu periapeksne lezije može predstavljati barijeru za „neizreagovan“ cement u kanalu korena zuba, s obzirom na to da je dobro poznato da je za krajnje očvršćavanje potrebno 24 časa, a u kliničkim uslovima je moguće obezbediti završetak jedino inicijalnog očvršćavanja cementa [18]. Postoje brojni protokoli opisani u literaturi za postizanje ovih ciljeva, uključujući upotrebu koštanih voskova, kolagenih membrana, aluminijum-hlorida, kalcijum-sulfata, epinefrina itd. Brz hemostatički efekat, lako mešanje i biokompatibilnost agenasa su najznačajniji faktori koji utiču na kontrolu krvarenja za vreme endodontske hirurgije. Takođe je od velike važnosti da se izbegne ometanje normalnog koštano-zarastanja i oštećenje okolnog tkiva [19, 20]. Autori ovog rada veruju da dokazano antimikrobno dejstvo MTA zajedno sa visokim pH samo može imati dodatnu pozitivnu ulogu u periapeksnom zalečenju. Ova pretpostavka u saglasnosti je sa

novim tehnologijama kod lečenja periapeksnih cističnih lezija koje uključuju nehirurške inovativne pristupe zasnovane na kombinaciji primene MTA i ubrizgavanja trombocita bogatih fibrinom [21]. Svakako da ovakav pristup mora biti podržan dugotrajnijim kliničkim ispitivanjima koja bi potvrdila ispravnost takvih protokola.

ZAKLJUČAK

Mineralni trioksidni agregat je materijal koji je pogodan za lečenje perforacija korena zuba, indirektno prekrivanje pulpe i retrogradno punjenje kanala korena. U ovoj studiji je pokazano da upotreba MTA+ (Cerkamed, Poljska) dovodi do uspešnog kliničkog i radiografskog izlečenja lezija dentina i kosti. Potrebno je sprovesti dodatne kliničke studije sa dužim periodima praćenja lečenja.

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Light-curing units for composite resin polymerization

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SUMMARY

Light-curing units for light polymerization of composite resins are important instruments of dental practice, and their proper use has a direct impact on the physical characteristics of the material being illuminated, its biocompatibility, as well as on the overall clinical success and durability of dental composites. Irradiance represents the power of radiation per unit of irradiated surface and should be distinguished from irradiance measured directly at the lamp head, which is called output irradiance or emittance. Also, different areas on the surface of the material can be exposed to different radiation powers, which sometimes significantly deviate from the given average value. The reason for this is the inhomogeneity of the radiation beam. The 3D profile of the light beam gives the most precise information about the quality of radiation to which the material will be exposed. Due to the existence of different photoinitiator systems, the use of devices with a wider emission spectrum that covers a larger range of light wavelengths is often recommended today. An important characteristic of the light-curing unit is its power, but the use of lamps of higher power does not mean a proportional reduction in polymerization time. The quality and maintenance of light sources are certainly one of the important factors that influence the success of restorations.

Keywords: polymerization lamps; irradiance; composite materials; light polymerization

INTRODUCTION

Light-curing units are an important and daily-used equipment part of every dental practice. The quality of the lamp, as well as its proper handling, have a direct impact on the physical characteristics of the curing material, its biocompatibility, and the overall clinical success and durability of dental photopolymer systems (composites, adhesive systems, luting agents, cements). However, numerous studies testify to dentists' lack of information on characteristics of the light-curing units to which they should pay attention when choosing, that is, buying a lamp, as well as to their inappropriate use and maintenance in practice [1, 2, 3]. This can be one of the reasons for the failure of dental restorations.

The goal during light curing is to deliver a sufficient amount of light energy, of a precisely determined wavelength, which is required by the photoinitiator system of the material being cured. In addition, during light curing, it is necessary that all parts of the restoration are irradiated, as well as that all points receive the same amount of energy [4]. The information that manufacturers point out, as well as the information that dentists pay attention to when choosing a lamp, are often not enough to get a realistic insight into the quality of polymerization that can be achieved with a particular lamp.

LIGHT-CURING UNITS – IMPORTANT PARAMETERS

The characteristic that is often put in the foreground is irradiance. Irradiance represents the power of radiation [Watt] per unit area [m^2], but for the requirements of dentistry, we are using mW/cm^2 . Therefore, irradiance is inversely proportional to the area on which it is measured. The larger the irradiated surface, the lower the irradiance and vice versa. In other words, irradiance depends on two parameters: the radiant power of the light source and the distance of the curing material. Laboratory data of clinical importance are irradiance values measured at real distances from the light source. This is done in order to simulate clinical conditions as closely as possible.

However, what is problematic is that manufacturers often emphasize a general irradiance value, measured directly next to the light source. Since in this case the measured surface is actually the surface of the lamp head, the irradiance value obtained in this way directly depends on the size of the lamp head and has nothing to do with the real irradiance to which the material will be exposed. If we assume that two lamps with two completely identical sources of radiation, of equal power [W], have heads of different dimensions, it is clear that the irradiance measured on their heads will not be the same. A lamp with a smaller head will have a dramatically higher output irradiance value. That is, a weaker lamp with a smaller head diameter can have the same irradiance value as a much higher power lamp with a larger head, which is needed to cover the entire restoration. In this way, by reducing

the diameter of the lamp head, the manufacturer can advertise a lamp with low radiation power as a lamp with high irradiance. In order to avoid confusion, another term should be used for irradiance measured directly at the lamp head – output irradiance or simply emittance. This value, considered in isolation, for the reasons mentioned, is not of clinical significance. It would be more useful to look for data such as radiant power [W], lamp head diameter, and irradiance values from clinically relevant distances per relevant unit area.

It is equally important to keep in mind that irradiance represents only the average value of radiation power per unit area. However, the light source and subsequently the light beam are never homogeneous [5]. Different areas on the surface of the material being cured can be exposed to different radiation power values, which sometimes deviate significantly from the displayed average value. Thus, it can happen that certain regions of the restoration are irradiated with less than 400 mW/cm^2 – the so-called cold zones, and conversely, that certain regions of the restoration are extremely highly irradiated, with as much as 5000 mW/cm^2 – the hot zones. Neither cold nor hot zones are desirable. These are spots where polymerization does not take place in optimal dynamics and completely, although the average value of irradiance for the given surface can be ideal (Figure 1).

For the real insight, finally, we should look for data on the 3D beam profile, which will inform us most precisely about the quality of the radiation to which the material will be exposed [7]. The goal is to find as homogeneous a beam as possible, without the so-called hot and cold zones, with sufficient radiation power, and an adequate emission spectrum, which matches the absorption spectrum of the photoinitiator system in the material.

The minimum radiation value that the composite material should receive is usually around 400 mW/cm^2 [8]. ISO standard 10650/2018 defines the maximum value of output irradiance in the part of the spectrum as 380–515 nm and is 4000 mW/cm^2 . Using stronger lamps or long-term light curing without air cooling and making breaks carries the risk of injuring the tissue due to the high temperature that develops during polymerization.

Another interest when choosing a lamp concerns the choice of emission spectrum. One of the big changes in the world of composite materials is the composition of photoinitiator systems. Camphorquinone is still the most commonly used one, with an absorption maximum at around 468 nm – blue light. Because of its intense yellow color, camphorquinone is now almost regularly replaced or supplemented with some of the alternative photoinitiators to achieve brighter shades and improve the polymerization process. These alternative photoinitiators, like Lucirin-TPO, have an absorption maximum in the violet part of the spectrum [9]. Unfortunately, the material composition and precise content of photoinitiator systems is often hidden and protected. For this reason, as well as due to the fact that dentists in their practices usually cure different materials with the same curing unit, the use of light-curing units with two or more emission spectra is recommended (Figure 2).

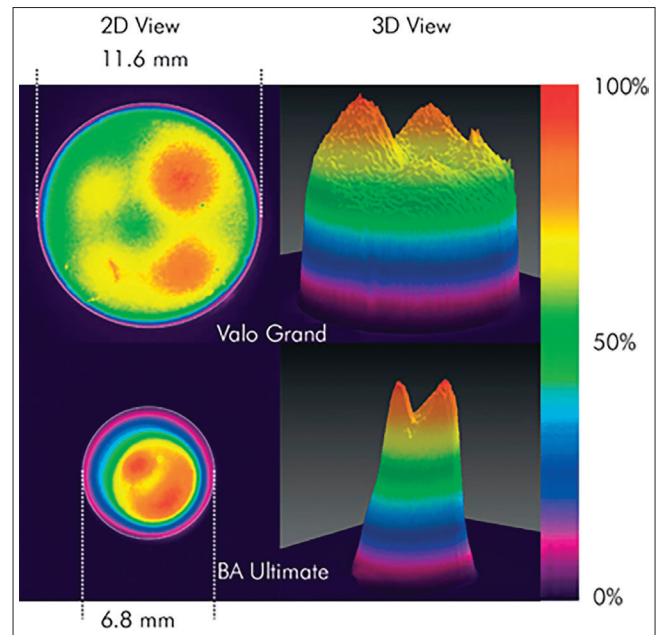


Figure 1. Light beam uniformity from two curing lights, one with a uniform light output (top figures) and one with “hot spots” of very bright light and “cold spots” (bottom figures); source: Rueggeberg et al., 2017 [6]

Slika 1. Analiza homogenosti svetlosnog snopa dve različite lampe, jedne sa uniformnim izvorom zračenja (gornje slike) i jedne sa „vrelim zonama“ veoma jakog svetla i „hladnim zonama“ (donje slike); izvor: Rueggeberg et al., 2017 [6]

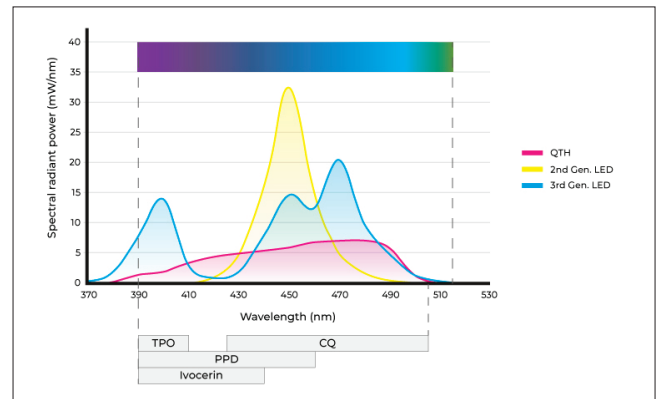


Figure 2. Emission spectra from quartz–tungsten halogen and light-emitting diode (LED) curing lights; the bars underneath show the relationship of the photo-initiators to the light-curing unit spectra; the second-generation LED shown in blue is “monowave” or curing unit with output wavelengths only in one part of the spectrum – blue light; the third-generation LED shown in green is “multiwave” or curing unit with output in two or more parts of the spectrum; source: Hasanin and Nassar, 2021 [10];

QTH – quartz–tungsten halogen; CQ – camphorquinone; TPO – diphenil (2,4,6-trimetilbenzoi) fosfin oksid; PPD – fenil-propanedion

Slika 2. Emisioni spektri iz kvarc-tungsten halogene (QTH) i svetlećih diodnih (LED) lampi za polimerizaciju. Ispod grafika prikazana je veza između fotoinicijatora i emisioinih spektara dentalnih lampi. Druga generacija LED označena plavom bojom je „monowave“ ili lampa koja zrači u okviru jednog dela spektra – plavo svetlo. Treća generacija LED označena zelenom bojom je „multiwave“ ili lampa koja zrači u dva ili više dela spektra; izvor: Hasanin, Nassar, 2021 [10]; CQ – kamforhinon, TPO – difenil (2,4,6-trimetilbenzoi) fosfin-oksidi; PPD – fenil-propanedion

Lately, there has been a tendency towards shortening the exposure time. However, any use of light-curing units outside the manufacturer's instructions, as well as self-calculated reduction of polymerization time when using curing units of higher radiant power, leads to inadequate polymerization and poorer mechanical characteristics of the material. Using higher power curing units does not mean a proportional reduction in polymerization time and cannot be calculated as easily. Although dentists have the need for faster polymerization and although curing units of increased radiant power and spectrum width appear on the market, it is believed that rapid polymerization can have a negative effect on the formation of the polymer network. Fast polymerization reaction does not leave enough time for the formation of long polymer chains before vitrification of the material. The formed chains are short, the material transitions to the solid phase faster, so a greater internal stress develops during polymerization, which directly leads to a greater degree of failure of the adhesive joint [4].

According to the classification of the Centers for Disease Control and Prevention of the United States, light polymerization units belong to the group of semi-critical instruments [11]. They are in contact with the mucous membrane, blood, saliva, as well as respiratory particles and viruses present in the oral cavity. Protection, not only of the lamp head, but of the entire lamp, control buttons, and the whole body is important in the fight against cross-infections in dental offices. In addition, the protection will prevent accidental contamination of the lamp head with adhesives, which often happens (35–68%) and endangers any subsequent polymerization [12]. On the market there are several different, disposable protective covers based on plastic (polyethylene, polyvinyl chloride) and less often latex. Although these covers are, to the eye, transparent, they attenuate some of the radiation. And that, when used properly, tightened, they attenuate 5–16% of radiation, while that percentage can reach up to 30% if they are wrinkled and not tightened over the lamp's head [13]. It is recommended to use protective covers based on plastic rather than latex – ordinary plastic rolls for food packaging have been shown to perform especially well [13].

CONCLUSION

There are many factors that influence the success of our restorations, and the quality and maintenance of light sources is certainly one of them. It is important to note

that we can control these factors by choosing the proper device, maintaining the hygiene of the device, using the protective covers correctly, as well as regularly measuring the radiation power of the light-curing units that we have been using for certain time.

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Lampe za svetlosnu polimerizaciju kompozitnih materijala

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KRATAK SADRŽAJ

Lampe za svetlosnu polimerizaciju su značajni instrumenti svake stomatološke ordinacije, a njihova pravilna upotreba ima direktan uticaj na fizičke karakteristike materijala koji se prosvetljava, njegovu biokompatibilnost, kao i na sveukupni klinički uspeh i dugotrajnost dentalnih kompozita. Iradijansa ili ozračenost predstavlja snagu zračenja po jedinici ozračenosti površine i treba je razlikovati od ozračenosti merene direktno uz glavu lampe, koja se zove izlazno ozračenje ili emitansa. Takođe, različite tačke na površini materijala mogu biti izložene različitim snagama zračenja, koje nekada značajno odudaraju od date prosečne vrednosti. Razlog za ovo je nehomogenost snopa zračenja. Najpreciznije informacije o kvalitetu ozračenja kojem će materijal biti izložen daje 3D profil svetlosnog snopa. Zbog postojanja različitih fotoinicijatornih sistema, danas se često preporučuje upotreba lampi šireg emisionog spektra, koji pokriva veći raspon talasnih dužina svetlosti. Značajna karakteristika lampe je i njena snaga, ali korišćenje lampi veće snage ne znači proporcionalno smanjenje vremena polimerizacije. Kvalitet i održavanje svetlosnih izvora svakako su jedan od bitnih faktora koji utiču na uspeh restauracija.

Ključne reči: polimerizacione lampe; iradijansa; kompozitni materijali; svetlosna polimerizacija

UVOD

Lampe za svetlosnu polimerizaciju su značajan i svakodnevno korišćen deo opreme svake stomatološke ordinacije. Kvalitet lampe, kao i njena pravilna upotreba, imaju direktan uticaj na fizičke karakteristike materijala koji se prosvetljava, njegovu biokompatibilnost, kao i na sveukupni klinički uspeh i dugotrajnost dentalnih fotopolimernih sistema (kompozita, adhezivnih sistema, zalivača, cemenata). Međutim, brojne studije svedoče o nedovoljnoj informisanosti stomatologa o karakteristikama svetlosnog izvora na koje treba da obrate pažnju pri odabiru, odnosno kupovini lampe, kao i o njihovom neadekvatnom korišćenju i održavanju u praksi [1, 2, 3]. Ovo može biti jedan od razloga neuspeha dentalnih restauracija.

Cilj tokom prosvetljavanja jeste dopremiti dovoljnu količinu svetlosne energije, tačno određene talasne dužine, koju zahteva fotoinicijatorni sistem materijala koji se prosvetljava. Pored toga, tokom prosvetljavanja, neophodno je da su svi delovi restauracije ozračeni, kao i da sve tačke dobijaju istu količinu energije [4]. Informacije koje proizvođači ističu, kao i informacije na koje stomatolozi obraćaju pažnju tokom odabira lampe, često nisu dovoljne da bi se stekao realan uvid o kvalitetu polimerizacije koji se može postići određenom lampom.

POLIMERIZACIONE LAMPE – ZNAČAJNI POJMOVI

Karakteristika koja se često stavlja u prvi plan jeste iradijansa. Iradijansa ili ozračenost predstavlja snagu zračenja [vat] po jedinici površine [m], odnosno za uslove stomatologije govori se o mW/cm^2 . Prema tome, iradijansa je obrnuto proporcionalna površini na kojoj se meri. Što je veća ozračena površina, ozračenost će biti manja i obrnuto. Drugim rečima, iradijansa zavisi od dva parametra: snage svetlosnog izvora i od udaljenosti materijala koji se prosvetljava. Laboratorijski podaci od kliničkog značaja su vrednosti iradijanse merene na realnim udaljenostima od svetlosnog izvora, kako bi se što bliže simulirali klinički uslovi.

Međutim, ono što je problematično jeste to što proizvođači često ističu jednu uopštenu vrednost iradijanse, merenu direktno uz svetlosni izvor. Budući da je u ovom slučaju merena površina zapravo površina glave lampe, ovako dobijena vrednost

iradijanse direktno zavisi od veličine glave lampe i nema veze sa realnom ozračenošću kojoj će materijal biti izložen. Ako pretpostavimo da dve lampe sa dva potpuno identična izvora zračenja, jednake snage [W], imaju glave različitih dimenzija, jasno je da ozračenost merena na njihovim glavama neće biti ista. Lampa čija je glava manja imaće drastično veću vrednost izlazne ozračenosti. Odnosno, slabija lampa manjeg dijametra glave može imati jednaku vrednost iradijanse kao lampa mnogo veće snage i veće glave, kakva je i potrebna da bi se prekrila cela restauracija. Na taj način, smanjivanjem dijametra glave lampe, proizvođač može lampu male snage zračenja da reklamira kao lampu visoke iradijanse. Kako ne bi dolazilo do zabune, za ozračenost merenu direktno uz glavu lampe trebalo bi koristiti drugi termin – izlazno ozračenje ili jednostavno emitansa. Ova vrednost, posmatrana izolovano, iz pomenutih razloga, nije od kliničkog značaja. Bilo bi korisnije tražiti podatke poput snage zračenja [W], dijametra glave lampe i vrednosti iradijanse sa klinički relevantnih udaljenosti po relevantnoj jedinici površine.

Jednako važno je i imati na umu da iradijansa predstavlja samo prosečnu vrednost snage zračenja po jedinici površine. Međutim, svetlosni izvor, a potom ni svetlosni snop nikada nisu homogeni [5]. Različite tačke na površini materijala mogu biti izložene različitim snagama zračenja, koje nekada značajno odudaraju od prikazane prosečne vrednosti. Tako se može desiti da određene regije restauracije budu osvetljene sa manje od $400 mW/cm^2$ – takozvane hladne zone, a i suprotno tome, da određene regije restauracije budu izuzetno visoko ozračene, čak i sa $5000 mW/cm^2$ – vrele zone. Ni hladne, ni vrele zone nisu poželjne. To su mesta gde se polimerizacija ne odvija optimalnom dinamikom i u potpunosti, iako prosečna vrednost iradijanse za datu površinu može biti idealna (Slika 1).

Za pravi uvid, konačno, trebalo bi tražiti podatke o 3D profilu svetlosnog snopa, koji će nas najpreciznije informisati o kvalitetu ozračenja kojem će materijal biti izložen [7]. Cilj je nametnut što homogenijeg snopa, bez takozvanih vrelih i hladnih zona, dovoljne snage zračenja i adekvatnog emisionog spektra, koji se poklapa sa apsorpcionim spektrom fotoinicijatornog sistema u materijalu.

Minimalna vrednost ozračenja koju kompozitni materijal treba da primi obično iznosi oko $400 mW/cm^2$ [8]. ISO standardom 10650/2018 definisana je maksimalna vrednost izlazne

iradijance u delu spektra između 380 i 515 nm i iznosi 4000 mW/cm². Korišćenje jačih lampi ili dugotrajno prosvetljavanje bez hlađenja i pauza nosi rizik od povređivanja tkiva visokom temperaturom koja se razvija u toku polimerizacije.

Druga nedoumica pri odabiru lampe tiče se odabira emisi-onog spektra. Jedna od velikih promena u svetu kompozitnih materijala jeste sastav fotoinicijatornih sistema. Kamforhinon je i dalje najčešće korišćen, sa maksimumom apsorpcije na oko 468 nm – plavo svetlo. Zbog intenzivno žute boje kamforhinon je sve češće zamenjen ili dopunjen nekim od alternativnih fotoinicijatora za postizanje svetlijih nijansi i poboljšavanje procesa polimerizacije. Ovi alternativni fotoinicijatori, poput Lucirin-TPO, imaju maksimum apsorpcije u ljubičastom delu spektra [9]. Nažalost, sastav materijala i precizan sadržaj fotoinicijatornih sistema je često sakriven i zaštićen. Iz tog razloga, kao i zbog činjenice da stomatolozi u svojim praksama najčešće istom lampom polimerizuju različite materijale, sve se više preporučuje korišćenje lampi sa dva ili više emisiona spektra (Slika 2).

U poslednje vreme postoji tendencija ka skraćivanju vremena polimerizacije. Međutim, svako korišćenje lampi van uputstva proizvođača, kao i samoinicijativno smanjivanje vremena polimerizacije kada se koriste lampe veće snage, dovodi do neadekvatne polimerizacije i lošijih mehaničkih karakteristika materijala. Korišćenje lampi veće snage ne znači proporcionalno smanjenje vremena polimerizacije i ne može se tako jednostavno izračunati. Iako stomatolozi imaju potrebu za što bržom polimerizacijom i iako se pojavljuju lampe sve veće snage i širine spektra, smatra se da brza polimerizacija može imati negativan uticaj na formiranje polimerne mreže. Brza polimerizacija ne ostavlja dovoljno vremena za formiranje dugih polimernih lanaca pre vitifikacije materijala. Formirani

lanci su kratki, materijal prelazi u čvrstu fazu brže, pa se razvija i veći unutrašnji stres tokom polimerizacije, koji direktno dovodi do većeg stepena neuspeha adhezivnog spoja [4].

Prema klasifikaciji Centra za prevenciju i kontrolu bolesti, lampe za svetlosnu polimerizaciju spadaju u grupu polukritičnih instrumenata [11]. U kontaktu su sa mukoznom membranom, krvlju, pljuvačkom, kao i respiratornim partikulama i virusima prisutnim u usnoj duplji. Zaštita, ne samo glave lampe, već cele lampe, komandnih dugmića i tela je od značaja u borbi protiv unakrsnih infekcija u stomatološkim ordinacijama. Pored toga, zaštita će sprečiti i slučajnu kontaminaciju glave lampe adhezivnim sredstvima, što se neretko dešava (35–68%) [12] i ugrožava svaku sledeću polimerizaciju. Na tržištu postoji nekoliko različitih, jednokratnih zaštitnih košuljica na bazi plastike (polietilen, polivinil-hlorid) i ređe lateksa. Iako ove košuljice jesu, na oko, transparentne, one atenuišu deo zračenja. I to, kada se koriste pravilno, zategnute, atenuišu 5–16% zračenja, dok taj procenat može dostići i do 30% ukoliko su naborane i nezategnute [13]. Preporuka je da se koriste pre košuljice na bazi plastike nego lateksa – posebno se obična plastična folija za pakovanje hrane pokazala dobro [13].

ZAKLJUČAK

Mnogo je faktora koji utiču na uspeh naših restauracija, a kvalitet i održavanje svetlosnih izvora svakako su jedan od njih. Ono što je važno jeste da ih možemo sami kontrolisati ispravnim odabirom lampe, održavanjem higijene lampe, pravilnim korišćenjem zaštitnih košuljica, kao i redovnim merenjem snage zračenja lampi koje neko vreme koristimo.

Restoration of teeth with extensive crown damage

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SUMMARY

This text reviews a book in the field of restorative dentistry, published at the end of 2023. Its content and importance for undergraduate and postgraduate teaching, as well as the entire dental professional and scientific public, were analyzed.

One of the biggest challenges in restorative dentistry is the reconstruction of teeth with extensive crown damage. The questions such as how to achieve adequate retention, what is the choice of suitable material and the type of filling as well as the maintenance of the achieved therapeutic results, are only some of the most dominant questions in the reconstructive therapy. In addition to this, unforeseen problems can occur directly during the performance of these procedures. Until now, there was no book available to the professional public with the exclusive subject of the restoration of teeth with extensive damage in the Serbian language. At the end of 2023, a textbook with this topic appeared, edited by prof. dr. Slavoljub Živković, and published by *Data Status* in Belgrade.

This is the first edition of the textbook in this field and is intended for students of integrated and postgraduate studies in dentistry. It can certainly be useful to doctors in their daily dental practice. The editor is Slavoljub Živković, an esteemed professor at the School of Dental Medicine at the University of Belgrade, and the authors of the chapters are also professors from the Department of Restorative Odontology and Endodontics of this Faculty – professors J. Ilić and K. Beljić-Ivanović and assistant professors J. Nešković, D. Manojlović, and M. Popović-Bajic. The book delves into the issue of tooth reconstruction with large defects in an interesting and receptive way, starting from diagnostics and creating a plan to therapeutic procedures and monitoring the achieved success of the therapy. In one part of the book, it also deals with dental traumatology as one of the causes of major damage to the tooth crown.

The textbook consists of nine chapters written by different authors from the domain of their competence. It contains many clinical photographs, diagrams, tables, and protocols, which significantly facilitates the understanding of this complex area. A detailed approach allows readers to follow and understand the presented data with ease. This makes the text easy to read and accessible to readers with different interests and levels of expertise in the field, including students, practitioners, and scientists.

The first chapter represents a kind of introduction to this complex area and deals with the making of a

treatment plan for teeth with extensive damage. The second chapter delves into the issue of reconstructing vital teeth with a small amount of remaining dental tissue. The pathophysiological changes in the pulp-dentine complex in case of large destruction of teeth, the application of bioactive materials and the possibilities of restoration of vital teeth with large crown destruction are analyzed. The third chapter analyzes the requirements and problems related to the restoration of endodontically treated teeth. The fourth chapter deals with traumatic injuries to permanent teeth, considering that they can potentially cause the loss of significant parts of the tooth crown. The fifth chapter provides a detailed analysis of materials used for the reconstruction of large tooth defects with direct fillings. This chapter also presents a useful review of the characteristics of composite materials, which are most commonly used for these purposes. The sixth chapter provides a detailed description and analysis of the use of retention posts in the reconstruction of teeth with extensive damage. Both root canal posts and para-pulpal pins are covered, from their design to indications and methods of application. Chapter seven deals with the application of indirect fillings in this area. Modern principles of cavity preparation, as well as material selection and manufacturing of this type of filling are described. Re-restorative treatment, starting from the correction of inadequate fillings to their complete replacement, is the topic of the eighth chapter. The final, ninth chapter deals with the evaluation of the success of the restorative therapy of teeth with extensive damage to the crown, as well as the factors affecting the durability of fillings.

The textbook represents completely new material in this field in our region. Thanks to the detailed descriptions, as well as the comprehensible and receptive writing style, it will help in the acquisition of basic knowledge for students within integrated studies, but also for those who already have knowledge in this field. It will help the practitioners to improve the diagnosis and development of the therapy plan, as well as the restorative procedure itself. For those involved in science, it will point to some new possible lines of research in this area. This book is full

of information that ultimately results in the improvement of the restorative procedure and the provision of more thorough and high-quality dental health care for patients.

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Restauracija zuba sa velikim oštećenjima krunice

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KRATAK SADRŽAJ

Ovaj tekst daje opis knjige iz oblasti restaurativne stomatologije, izašle iz štampe krajem 2023. godine. Analiziran je njen sadržaj i značaj za dodiplomsku i postdiplomsku nastavu, kao i celokupnu stomatološku stručnu i naučnu javnost.

Jedan od najvećih izazova u restaurativnoj stomatologiji predstavlja rekonstrukcija zuba sa velikim oštećenjima krunice. Pitanja načina ostvarivanja adekvatne retencije, izbora pogodnog materijala, odnosno vrste ispuna i održavanja postignutih terapijskih rezultata samo su neka od najdominantnijih u planu rekonstruktivne terapije u ovim situacijama. Pored ovoga, nepredviđeni problemi se mogu javiti i neposredno tokom izvođenja terapijskih postupaka. Stručnoj javnosti do sada nije bila dostupna knjiga na srpskom jeziku čija je tema isključivo restauracija zuba sa velikim oštećenjima. Krajem 2023. godine pojavio se udžbenik sa ovom tematikom, uređen od strane prof. dr Slavoljuba Živkovića, a u izdanju *Data Statusa* iz Beograda.

Ovo je prvo izdanje udžbenika iz ove oblasti i namenjen je studentima integrisanih i posle diplomskih studija stomatologije. Svakako može biti od koristi i lekarima u svakodnevnoj stomatološkoj praksi. Urednik je uvaženi profesor Stomatološkog fakulteta Univerziteta u Beogradu Slavoljub Živković, a autori poglavlja su, takođe, nastavnici sa Klinike za bolesti zuba ovog fakulteta – profesori J. Ilić i K. Beljić-Ivanović i docenti J. Nešković, D. Manojlović i M. Popović-Bajić. Knjiga na zanimljiv i prijemčiv način ulazi u problematiku rekonstrukcije zuba sa velikim defektima, počevši od dijagnostike i izrade plana terapije do terapijskih procedura i praćenja uspešnosti postignute terapije. U jednom svom delu knjiga se dotiče i dentalne traumatologije kao jednog od uzroka nastanka velikih oštećenja krunice zuba.

Udžbenik se sastoji od devet poglavlja, koja su pisali različiti autori iz domena svoje kompetentnosti. Sadrži brojne kliničke fotografije, dijagrame, tabele i protokole, što značajno olakšava razumevanje ove kompleksne oblasti. Detaljan pristup omogućava čitaocima da sa lakoćom prate i razumeju prezentovane podatke. To čini štivo lako čitljivim i prijemčivim čitaocima različitih interesovanja i predznanja iz ove oblasti, kako studentima tako i praktičarima i naučnicima.

Prvo poglavlje predstavlja vrstu uvoda u ovu kompleksnu oblast i bavi se izradom plana terapije zuba sa velikim

oštećenjima. Drugo poglavlje se do detalja upušta u problematiku rekonstrukcije vitalnih zuba sa malom količinom preostalog zubnog tkiva. Analiziraju se patofiziološke promene na pulpodentinskom kompleksu kod velikih destrukcija zuba, primena bioaktivnih materijala i mogućnosti restauracije vitalnih zuba sa velikim destrukcijama krunice. Treće poglavlje analizira zahteve i probleme u vezi sa restauracijom endodontski lečenih zuba. Četvrto poglavlje se bavi traumatskim oštećenjima stalnih zuba, imajući u vidu da su ona mogući uzročnik gubitka značajnih delova krunice zuba. U petom poglavlju se detaljno analiziraju materijali za rekonstrukciju velikih defekata na zubima direktnim ispunima. Ovo poglavlje predstavlja i korisni repertorijum karakteristika kompozitnih materijala, koji se u ove svrhe najčešće koriste. Šesto poglavlje do detalja opisuje i analizira primenu retencionih kočica u rekonstrukciji zuba sa masivnim oštećenjima. Obuhvaćeni su kako kanalni tako i parapulpni kočici, počevši od njihovog dizajna do indikacija i načina primene. Sedmo poglavlje se bavi primenom indirektnih ispuna u ovoj oblasti. Opisani su savremeni principi preparacije kaviteta, kao i izbora materijala i izrade ove vrste ispuna. Ponovni restaurativni tretman, počevši od korekcija neadekvatnih ispuna do njihove potpune zamene, tema je osmog poglavlja. Završno, deveto poglavlje bavi se procenom uspeha restaurativne terapije zuba sa velikim oštećenjima krunice, kao i faktorima koji utiču na dugotrajnost ispuna.

Udžbenik predstavlja potpuno novo štivo iz ove oblasti našim prostorima. Zahvaljujući kako detaljnim opisima, tako i razumljivom i prijemčivom stilu pisanja, pomoći će u usvajanju osnovnih znanja studentima u okviru integrisanih studija, ali i onima koji znanja iz ove oblasti već imaju. Pomoći će praktičarima da unaprede dijagnostiku i izradu plana terapije, ali i samu restaurativnu proceduru. Onima koji se bave naukom ukazaće na neke nove moguće pravce istraživanja u ovoj oblasti. Ova knjiga obiluje informacijama koje, konačno, dovode do unapređenja restaurativne procedure i pružanja potpunije i kvalitetnije stomatološke zdravstvene zaštite pacijenata.

Da li ste pažljivo čitali radove?

1. Za uspostavljanje apsolutno suvog polja rada neophodno je:
 - a) primenti koferdam
 - b) primenti vaterolne
 - c) primenti sisaljku
2. Apsolutno suvo polje rada:
 - a) unapređuje sprovođenje adhezivnih procedura tokom restaurisanja zuba
 - b) ne unapređuje sprovođenje adhezivnih procedura tokom restaurisanja zuba
 - c) ne utiče na sprovođenje adhezivnih procedura
3. Preporuka Evropskog udruženja endodontologa (ESE) definiše upotrebu koferdama:
 - a) kao obavezu tokom endodontske terapije i terapije vitalne pulpe
 - b) kao poželjnu tokom endodontske terapije i terapije vitalne pulpe
 - c) ne definiše ovo pitanje
4. Podaci iz literature pokazuju da bez obzira na razvoj savremene stomatologije i novih materijala, upotreba koferdama u različitim delovima Evrope:
 - a) jeste u porastu
 - b) nije u porastu
 - c) nema ovih podataka
5. Čađa i saradnici u svom radu nalaze da stomatolozi sa većim brojem godina radnog staža:
 - a) pokazuju manju zastupljenost primene koferdama
 - b) pokazuju veću zastupljenost primene koferdama
 - c) godine staža ne utiču na primenu koferdama
6. Procenat studenata završne godine studija koji smatra da će se upotreba koferdama smanjiti nakon diplomiranja zbog teškoće postavljanja i neprihvatanja od strane pacijenata je:
 - a) viši od 98%
 - b) oko 60%
 - c) manji od 30%
7. Istraživanje u okviru rada „Primena koferdama tokom izvođenja restaurativnih i endodontskih procedura – iskustva terapeuta i pacijenta“ obavljeno je:
 - a) popunjavanjem upitnika
 - b) analizom medicinske dokumentacije
 - c) eksperimentom
8. Prvi upitnik u ovoj studiji sastojao se od pitanja koja su se odnosila na:
 - a) opšte informacije o stomatolozima i njihovom prethodnom znanju o koferdamu
 - b) rad sa koferdamom tokom restaurativnih ili endodontskih procedura
 - c) stavove pacijenata nakon završene intervencije u kojoj je primenjen koferdam
9. Drugi upitnik u ovoj studiji se sastojao od pitanja koja su se odnosila na:
 - a) opšte informacije o stomatolozima i njihovom prethodnom znanju o koferdamu
 - b) rad sa koferdamom tokom restaurativnih ili endodontskih procedura
 - c) stavove pacijenata nakon završene intervencije u kojoj je primenjen koferdam
10. Treći upitnik u ovoj studiji se sastojao od pitanja koja su se odnosila na:
 - a) opšte informacije o stomatolozima i njihovom prethodnom znanju o koferdamu
 - b) rad sa koferdamom tokom restaurativnih ili endodontskih procedura
 - c) stavove pacijenata nakon završene intervencije u kojoj je primenjen koferdam
11. Za sprovođenje ovog istraživanja korišćen je:
 - a) osnovni koferdam set
 - b) prošireni koferdam set
 - c) nije korišćen koferdam set

12.]Svi podaci u ovom istraživanju statistički su analizirani u:
- SPSS programu
 - Sigma plot programu
 - Minitab programu
13. Grupisanjem podataka prema metodološkom planu dobijeno je da je najveći broj stomatologa u studiji imao:
- do 2 godine kliničkog iskustva
 - 2–4 godine kliničkog iskustva
 - 5–7 godina kliničkog iskustva
14. Stomatolozi sa 2–4 godine kliničkog iskustva su kao dodatne izvore učenja koristili najviše:
- internet izvore – YouTube
 - knjige
 - predavanja
15. Godine kliničkog iskustva:
- značajno su uticale na potrebu za dodatnim izvorima učenja
 - nisu značajno uticale na potrebu za dodatnim izvorima učenja
 - ovo nije ispitivano
16. Najveća učestalost rada sa koferdamom tokom sprovođenja endodontskih procedura zabeležena je kod stomatologa sa:
- do 2 godine kliničkog iskustva
 - 2–4 godine kliničkog iskustva
 - 5–7 godina kliničkog iskustva
17.]Stomatolozi sa najvećim kliničkim iskustvom pokazali su:
- podjednaku zastupljenost koferdama tokom sprovođenja kako restaurativnih tako i endodontskih procedura
 - veću zastupljenost koferdama tokom sprovođenja restaurativnih procedura
 - veću zastupljenost koferdama tokom sprovođenja endodontskih procedura
18. Godine kliničkog iskustva:
- nisu značajno uticale na nivo samostalnosti u postavljanju koferdama u jednostavnim kliničkim situacijama
 - značajno su uticale na nivo samostalnosti u postavljanju koferdama u jednostavnim kliničkim situacijama
 - ovo nije ispitivano
19. Pri težim kliničkim situacijama godine iskustva:
- značajno su uticale na nivo samostalnosti
 - nisu značajno uticale na nivo samostalnosti
 - ovo nije ispitivano
20. Kliničko iskustvo:
- nije značajno uticalo na izbor indikacija za postavljanje koferdama
 - jeste značajno uticalo na izbor indikacija za postavljanje koferdama
 - ovo nije ispitivano
21. Kod svih stomatologa, bez obzira na kliničko iskustvo, zabeležena je veća zastupljenost primene koferdama:
- u donjoj vilici kod obe kliničke procedure
 - u gornjoj vilici kod obe kliničke procedure
 - ovo nije ispitivano
22. U najvećem broju kliničkih situacija koferdamom su bili izolovani:
- donji bočni zubi
 - gornji bočni zubi
 - prednji donji zubi
23. Prosečno vreme za postavljanje koferdama iznosilo je:
- 5 minuta
 - 10 minuta
 - 15 minuta
24. Tokom postavljanja koferdama:
- veći procenat pacijenata nije osećao nikakav bol
 - veći procenat pacijenata je osećao bol
 - ovo nije ispitivano
25. Zaključak studije o koferdamu je da:
- pacijenti lako podnose rad sa koferdamom i imaju pozitivno mišljenje o ovoj proceduri
 - pacijenti ne podnose lako rad sa koferdamom i nemaju pozitivno mišljenje o ovoj proceduri
 - Pacijenti su indiferentni po pitanju ove procedure
26. Glavne prednosti kalcijum-silikatnih cementa su:
- velika mehanička otpornost, visok pH, dugotrajnije otpuštanje Ca jona
 - laka manipulacija
 - ne prebojavaju zube
27. Zaceljenje perforacija koje nastanu tokom preparacije pristupnog kaviteta, prostora za kanalski kočić ili kao posledica internih resorpcija:
- jesu indikacija za kalcijum-silikatne cemente
 - nisu indikacija za kalcijum-silikatne cemente
 - uslovna su indikacija za kalcijum-silikatne cemente
28. Slučajevi sa primenom kalcijum-silikatnih cementa za indirektno prekrivanje pulpe stalnih zuba:
- nisu često prikazivani u literaturi
 - često su prikazivani u literaturi
 - nikada nisu opisani
29. Glavni nedostatak trenutnih formulacija KS cementa za retrogradno punjenje kanala je:
- njegovo produženo očvršćavanje
 - njegovo brzo očvršćavanje
 - ovo nije indikacija za te materijale

30. RetroMTA (BioMTA, Juzna Koreja), prema uputstvu proizvođača, očvršćava za:
- 5 minuta
 - 15 minuta
 - 25 minuta
31. Glavni cilj retrogradnog punjenja je da se:
- spreči širenje infekcije u periapeksna tkiva
 - smanji širenje infekcije u periapeksna tkiva
 - ova procedura se ne odnosi na sprečavanje širenja infekcije
32. U prikazu tri klinička slučaja sa primenom kalcijum-silikatnih cemenata, korišćen je:
- MTA+ (Cerkamed, Poljska)
 - Bioroot (Septodont, Francuska)
 - RetroMTA (BioMTA, Južna Koreja)
33. Kod slučaja 1 u radu o primeni kalcijum-silikatnih cemenata, radiografijom je utvrđeno:
- perforacije u bifurkaciji na gornjem drugom levom premolaru
 - indirektno prekrivanje pulpe
 - velika periapikalna lezija
34. Kod slučaja 2 u radu o primeni kalcijum-silikatnih cementa, prikazana je terapija:
- perforacije u bifurkaciji na gornjem drugom levom premolaru
 - indirektno prekrivanje pulpe
 - velike periapikalne lezije
35. Kod slučaja 3 u radu o primeni kalcijum-silikatnih cemenata, prikazana je terapija:
- perforacije u bifurkaciji na gornjem drugom levom premolaru
 - indirektno prekrivanje pulpe
 - velike periapikalne lezije hirurškim putem
36. Bitan faktor za uspešan ishod lečenja perforacije korena je:
- vreme proteklo od nastanka perforacije do njenog tretmana
 - intenzitet krvarenja uzrokovan perforacijom
 - vreme potrebno za zaustavljane krvarenja
37. U slučaju gde je MTA upotrebljen za lečenje dubokog karijesa, prestanak bolnih senzacija kod pacijenta autori objašnjavaju:
- apsorpcijom pulpnog eksudata i sledstvenim smanjenjem hidrodinamskog pritiska u pulpnom tkivu
 - analgetskim dejstvom preparata
 - antiinflamatornim dejstvom preparata
38. Pretpostavka u ovom prikazu je da tanak sloj kalcijum-silikatnog cementa na podu periapeksne lezije može predstavljati barijeru za:
- „neizreagovan“ cement u kanalu korena zuba
 - zarastanje periapeksne rane
 - prodor eksudata u kanal korena
39. Cilj tokom prosvetljavanja kompozitnog materijala je da:
- dopremi dovoljnu količinu svetlosne energije, tačno određene talasne dužine, koju zahteva fotoinicijatorni sistem materijala koji se prosvetljava
 - dopremi dovoljnu količinu svetlosne energije, bilo koje talasne dužine
 - dopremi dovoljnu količinu svetlosne energije, tačno određene talasne dužine, koju zahteva monomer materijala koji se prosvetljava
40. Iradijansa je:
- snaga zračenja [Watt] po jedinici površine [m^2], odnosno za uslove stomatologije govori se o mW/cm^2
 - snaga zračenja [Watt] po jedinici zapremine [m^3], odnosno za uslove stomatologije govori se o mW/cm^3
 - jačina svetla [Cd] po jedinici površine [m^2], odnosno za uslove stomatologije govori se o mCd/cm^2
41. Što je veća ozračena površina materijala, ozračenost će biti:
- veća
 - manja
 - ne zavisi od površine
42. Proizvođači lampi za polimerizaciju često ističu jednu uopštenu vrednost iradijanse, merenu u odnosu na:
- površinu glave lampe
 - površinu celog svetlosnog nastavka
 - površinu standardizovanu po ISO standardu
43. Smanjivanjem dijametra glave lampe proizvođač može da:
- lampu male snage zračenja reklamira kao lampu visoke iradijanse
 - lampu male snage zračenja reklamira kao lampu visoke jačine svetla
 - smanji vreme prosvetljavanja
44. Emitansa je:
- izlazno ozračenje mereno direktno uz glavu lampe
 - izlazno ozračenje mereno uz matreijal
 - snaga lampe
45. Hladne zone osvetljenosti su:
- regije restauracije osvetljene sa manje od $400 mW/cm^2$
 - regije restauracije osvetljene sa više od $400 mW/cm^2$
 - neosvetljene zone restauracije
46. Vrela zone osvetljenosti su:
- regije restauracije izuzetno visoko ozračene, čak i sa $5000 mW/cm^2$
 - regije restauracije povećane temperature
 - regije restauracije osvetljene dva puta

47. Kamforhinon je i dalje najčešće korišćen u okviru inicijatorskog sistema, sa maksimumom apsorpcije na:
- a) 468 nm
 - b) 400 nm
 - c) 350 nm
48. Minimalna vrednost ozračenja koju kompozitni materijal treba da primi obično iznosi:
- a) oko 400 mW/cm²
 - b) oko 4000 mW/cm²
 - c) oko 40 mW/cm²
49. Prema klasifikaciji Centra za prevenciju i kontrolu bolesti, lampe za svetlosnu polimerizaciju spadaju u grupu:
- a) polukritičnih instrumenata
 - b) nekritičnih instrumenata
 - c) visoko kritičnih instrumenata
50. Zaštita lampe košuljicama na bazi plastike je od značaja:
- a) isključivo za zaštitu od kontaminacije glave lampe adhezivnim sredstvima
 - b) isključivo za zaštitu od unakrsnih infekcija
 - c) za obe pomenute zaštite

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. - Beograd (Džordža Vašingtona 19) :
Srpsko lekarsko društvo, 1955- (Beograd :
Službeni glasnik). - 29,5 cm

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