

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).

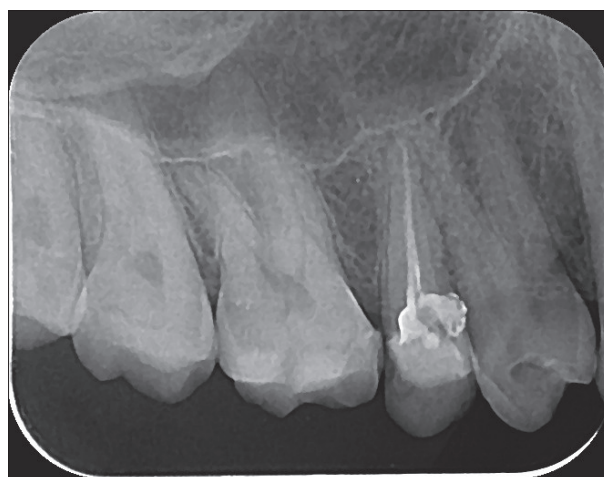


Figure 1. The radiograph of the root canal perforation of the upper left second premolar sealed with mineral trioxide aggregate and temporary restored (one day after the treatment)

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 treatmana). 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 mekotkivnih 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 koštanog 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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