

# Liječenje karioznih lezija kemijsko-mehaničkim postupkom

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## Sažetak

**Svrha:** Uobičajeni strah od boli pri mehaničkom odstranjivanju zubnoga karijesa konvencionalnim rotirajućim instrumentima potaknuo je razvoj nove kemijsko-mehaničke metode kojom se omekšavaju kariozne mase upotrebom posebne tekućine. Otopina, koje je osnovni sastojak aminobuterična kiselina, otapa kariozne mase razarajući njihove kolagenske strukture.

**Materijal i metode:** Postupak se sastoji u tome da se u karioznu leziju elektronskom napravom usmjeravaju pulzirajući mlazevi zagrijane tekućine. Tekućina omekšava i otklanja kariozne mase. Upotreba elektronske naprave omogućuje selektivnost i odstranjenje karioznih masa sa zuba. Tekućina ne djeluje na zdravi dentin, zubnu pulpu ili na okolna meka tkiva i ne uzrokuje alergijske reakcije.

**Rezultati:** Rezultati našeg istraživanja temelje se na uzorku od 60 pacijenata. Nakon uporabe otopine, kariozne su mase kod svih pacijenata očišćene ekskavacijom ili vrlo laganim struganjem bez pritiska. Rezultati među pacijentima pokazuju da 77% pacijenata nije osjećalo bol ni bilo kakav poseban okus tekućine, te da 87% pacijenata nije zahtijevalo anesteziju tijekom preparacije karijesa.

**Zaključak:** Kariozna masa uspješno je odstranjena u 75%-100% pacijenata. Dentin je bio čist, neravan sa širokim dentinskim kanalima idealnima za retenciju kompozitne građe. Postupak takva odstranjenja karijesa preporučuje se u slučajevima velikih karioznih lezija u mekom i umjerenotvrdom dentinu, kod preparacije V. klase, tijekom rada s prestrašenim pacijentima, malom djecom ili s pacijentima alergičnima na anestetike.

**Ključne riječi:** karijes, Caridex, kemomehanički tretman, aminobuterična kiselina, klorinacija

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## Uvod

Karijes je jedna od najraširenijih bolesti čovječanstva, a već legendarni strah od bolova pri mehaničkom odstranjivanju oboljela zubnog tkiva, konvencionalnim metodama rotirajućim sredstvima potaknuo je razvoj nove kemomehaničke metode s pomoću koje nastojimo odstraniti kariozne mase do zdrava zubnoga tkiva.

U dosadašnjim je studijama ustanovljeno da 80% pacijenata strahuje od stomatološkog zahvata. Najveći se strah iskazuje od injekcije i od brušenja kojega prati bol, vibracija i neugodan vonj, pa bi bilo poželjno i za pacijenta i za terapeuta kada bi način odstranjenja kariozno promijenjena zubnog tkiva isključio uporabu rotirajućih sredstava (1).

Analizirajući kariozni proces u dentinu, vidljivo je da on ima dva različita sloja. Oni pak imaju različitu ultramikroskopsku i kemijsku strukturu. Vanjski sloj dentina (inficirani sloj) ireverzibilno je promijenjen, inficiran bakterijama, bez mogućnosti remineralizacije, te ga treba odstraniti. Unutarnji sloj dentina (aficirani sloj) reverzibilno je promijenjen, nije inficiran, s mogućnošću remineralizacije, te se može sačuvati (2,3,4). Promatrajući dentin elektronskim mikroskopom, u vanjskom se sloju vide rijetko razbacane kolagene niti, a unutarnji sloj karioznog dentina ima guste, pravilno složene kolagene niti s karakterističnim mostićima sličnim onima zdravu, neoštećenu dentinu.

U kliničkoj praksi već je nekoliko godina znan kemomehanički CARIDEX sustav odstranjivanja zubnoga karijesa kao alternativa mehaničkom odstranjivanju zubnoga karijesa (5,6). Temelj je te metode da se kariozne mase omekšaju popuštanjem kolagenskih struktura s pomoću otopine Caridex sustava i odstrane laganim struganjem posebnim kiretama (7,8). Razvoj te metode možemo pratiti još od godine 1976. kada su Goldman i Kronman (5,6) objavili prvo javno mišljenje o toj metodi odstranjivanja karijesa (Slika 1).

Sustav se sastoji od tri dijela:

1. Bočica (spremnik za tekućinu)
2. Pumpica
3. Držač s posebno oblikovanim nastavkom-kiretom

Otopina označena incijalima istraživača Goldmana i Kronmana GK 101 derivat je aminobuterične kiseline koja odstranjuje kariozne mase a pri tome



Slika 1. Caridex sustav  
Figure 1. Caridex system

nema nikakav učinak na zdravo zubno tkivo. Mehanizam djelovanja je klorinacija, kojom se omekšava i odstranjuje već djelomice promijenjeno tkivo karioznog dentina razarajući njegovu kolagenu strukturu. Istraživanja *in vitro* i *in vivo* pokazala su da je otopina biološki upotrebljiva. Ona ne utječe na zdrav dentin i na zdravu pulpu, ne iritira okolna tkiva i ne uzrokuje alergijske reakcije (7,8).

Tekućina GK 101 sastavljena je iz jednakih dijelova: A i B. Sastavnica A sadržava natrij-hipoklorit i destiliranu vodu, a sastavnica B sadržava natrijev hidroksid, natrijev klorid, N-monokolor DL-2 aminobuteričnu kiselinu i destiliranu vodu. Obje se sastavnice prije uporabe pomiješaju u jednakom omjeru u spremniku od 500 ml, te se prije zahvata griju u samom uređaju na 37 °C. Pomiješana tekućina je bezbojna, slankasta okusa, i mirisa sličnog hipokloritu. Ta je otopina sigurna i djelotvorna, te je godine 1985. Američka stomatološka udruga prihvatila njezinu široku primjenu (9).

## Svrha rada

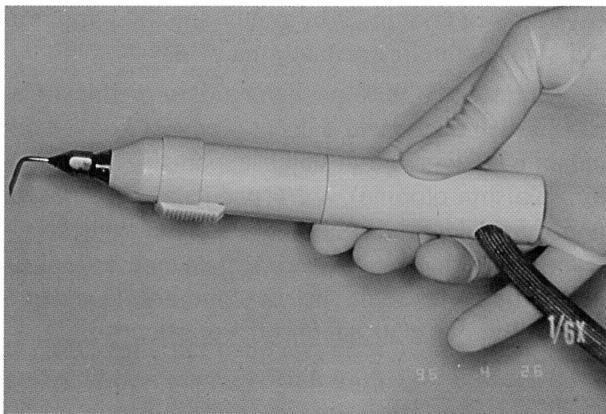
Svrha ovoga istraživanja bila je procijeniti uporabu, djelotvornost i pogodnost odstranjivanja karioznog dentina, te ocijeniti koliko pacijenti prihvaćaju tu tehniku rada. U svakog je pacijenta bio izabran jedan kariozan zub, vitalan, opsežnije kariozne destrukcije, koji se je mogao prikazati klinički i rendgenološki. Zubi su bili bez upalnih promjena na parodontu.

### Ispitanici i metode

Postupku je bilo podvrgnuto 60 pacijenata u dobi od 4 do 16 godina, a svaki je pacijent prije zahvata ispunio anketni listić s pitanjima:

- Zašto sudjelujete u istraživanjima?
- Koliko često posjećujete zubnoga liječnika?
- Kakvim smatrate brušenje, odnosno stomatološki zahvat?
- Je li obično trebate lokalnu anesteziju?
- Biste li radije posjećivali zubnoga liječnika ako biste mogli liječiti zube bez brušenja i lokalne anestezije?
- Smeta li Vam metoda, budući da traje nešto duže od metode s brušenjem?

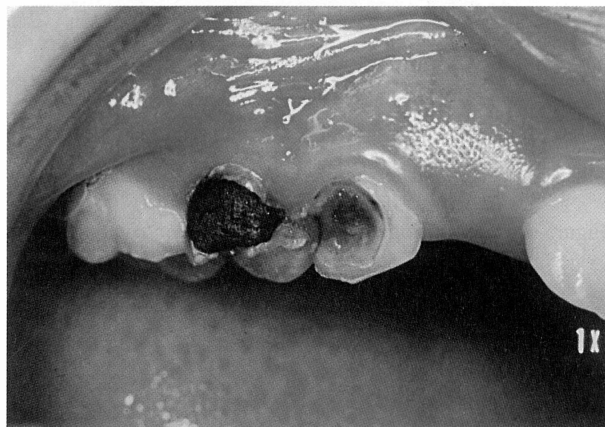
Caridex otopina se nakon zagrijavanja u pumpi na 37 °C pokreće brzinom od 650 pulzacija u minuti (45 ml/min). Nastavkom-kiretom se usmjeri mlaz prema karioznom kavitetu te se uz aplikaciju tekućine istodobno obavlja sasvim lagana abrazija-struganje. Postupak se ponavlja nekoliko puta u razmacima od par minuta, a za vrijeme čišćenja karioznih masa nije potrebno praviti pritisak jer on može pacijentu izazvati neugodnost ili bol (Slika 2).



Slika 2. *Nastavak-kireta*  
Figure 2. *Handpiece-curette*

Obje sastavnice otopine - A i B - pomiješali smo u spremniku neposredno prije zahvata te 2 minute grijali na 37 °C. Prva (A) tekućina sadržavala je natrijev hipoklorit i destiliranu vodu, a druga (B) je sadržavala natrijev hidroksid, natrijev klorid, N-monoklor-DL-2 aminobuteričnu kiselinu i destiliranu vodu. Za svakoga je pacijenta izmiješana svježa oto-

pina (Slika 2). Da bi nastala kemijska reakcija klorinacije bilo je potrebno aplicirati otopinu u kariozni kavitet i ostaviti je da djeluje nekoliko minuta, te taj postupak nekoliko puta ponoviti. Uobičajenim inspeksijskim i optičkim mjerilima dijagnosticirali smo je li sav inficirani, vanjski sloj dentina bio smešan, ili pak odstranjen (Slike 3 i 4). U slučaju

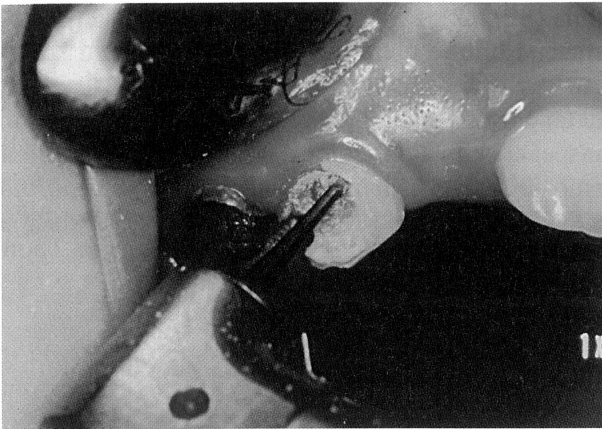


Slika 3. *Opsežna kariozna lezija na mliječnom ocnjaku prije tretmana Caridex-om*  
Figure 3. *Carious defects before treatment*



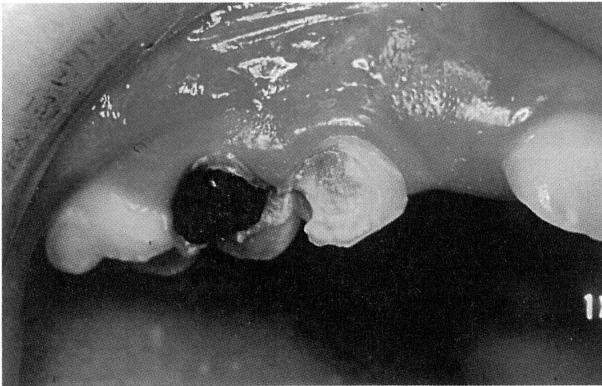
Slika 4. *Rad s Caridex-sustavom*  
Figure 4. *Caridex system procedure*

da je bilo zaostala karioznog dentina bila je izvedena dodatna preparacija ručnim ili rotirajućim instrumentima, no ona je bila bez pritisa i boli jer su se kariozne mase lako odstranjivale, a brušenje, ako je i bilo potrebno, trajalo je mnogo kraće. Pošto je odstranjen karijes, oblikovani su kaviteti i ispunjeni kompozitnim materijalima, a podminirana je caklina bila zadržana kako bi osiguralo mehaničko spajanje (Slike 5 i 6).



Slika 5. *Primjena niskoturažnih instrumenata nakon aplikacije otopine Caridex*

Figure 5. *Use of rotating instruments after application of Caridex solution*



Slika 6. *Gotova preparacija nakon primjene Caridexa i niskoturažnog instrumenta prije definitivnog ispuna kompozitom*

Figure 6. *Defects after treatment before filling*

## Rezultati

Svih 60 ispitanika s tretmanom Caridex otopinom GK 101 odgovorili su na pitanja u našem upitniku. 66% izjavilo je da posjećuju zubnoga liječnika samo kad imaju neki problem. Kada su bili upitni bi li radije posjećivali zubnoga liječnika ako bi bilo manje brušenja i potrebe za anestezijom, 93% je odgovorilo potvrdno. Djelotvornost opisanoga sustava ocijenjena je s pomoću postotka odstranjenoga karijesa koji je bio očišćen bez pomoći drugih dentalnih zahvata. Caridex je kod 60% zuba odstranio karijes u 100% opsegu, a kod 26% zuba u 90-95% opsegu. Kod preostalih zuba upotrebljeni su još i rotirajući instrumenti - niskoturažni i visokoturažni. Opet je važno napomenuti da je rad s roti-

rajućim instrumentima i u našim istraživanjima bio bez pritiska i bolnog osjeta te je za pacijenta bio ugodan, jer su se razmekšane kariozne mase lako čistile a brušenje je trajalo mnogo kraće.

Trajanje zahvata definirano je kao pristup kavitetu koji predstavlja vrijeme od kada je kavitet otvoren do početka ekskavacije i samo odstranjenje karijesa, što predstavlja vrijeme od početka otvaranja karijesa do završetka ekskavacije. Nakon mjerenja mogli smo vidjeti da je vrijeme za ekskavaciju kod Caridex metode bilo dulje od konvencionalnog. To je produljilo i cijeli tretman, ali zapažanja pacijenta često su se razlikovala od ovih mjerenja. Lokalni anestetik nije bio upotrebljen u ni jednog od 60 ispitanika, niti je bilo tko od njih tražio da ga se upora-

Kada smo pacijente zamolili da uporede opseg brušenja pri Caridex metodi i pri konvencionalnom zahvatu, 99% pacijenata je smatralo da su imali manje brušenja pri Caridex metodi, a samo 1% pacijenata je reklo da nije opazilo razliku. Isto tako, kada se je uspoređivalo trajanje cijeloga tretmana, pacijetni nisu zaključili da Caridex tretman traje duže od konvencionalne metode. Osvrćući se na mišljenje pacijenta o Caridex metodi kao ispravnom stomatološkom zahvatu, svi su ispitani pacijenti smatrali da su njihovi zubi pravilno tretirani tom metodom i svi su izjavili da bi tu novu metodu preporučili svojoj obitelji i prijateljima.

Zaključno je 90% pacijenata dalo prednost Caridexu, 3% pacijenata dalo je prednost konvencionalnoj metodi (svoje su stajalište obrazložili neugodnim okusom otopine), a 2% pacijenata nije posebno isticalo jednu metodu. Svi su ispitani pacijenti više voljeli Caridex jer su zaključili da ta metoda skraćuje vrijeme brušenja, ne uzrokuje bol, te omogućuje potpun osjećaj udobnosti i opuštenosti.

## Rasprava

Otklanjanje karijesa Caridex metodom mnogo je ugodnije od konvencionalne metode, pa je većina pacijenata jedva i zapazila da je taj tretman trajao duže nego konvencionalni. Uporaba rotirajućih instrumenata nakon primjene Caridex sustava bila je vrlo rijetka, a ako je i bila potrebna provedena je bez jakog pritiska i bez boli. Za uporabom lokalnog anestetika nije ni bilo potrebe. Pacijenti su bili manje



preplašeni jer odstranjivanje karijesa s pomoću Caridex otopine nije uzrokovalo nelagodu neanestezi-ranom pacijentu čak i kad je vršak aplikatora - ki-rete oštro strugao po tvrdom dentinu. Ipak, to za sa-da neće eliminirati potrebu za ručnim instrumenti-ma i lokalnom anestezijom, jer je Caridex sustav ne-prikladan za vrlo male kariozne lezije i ne odstra-njuje karioznu caklinu. U slučajevima u kojima na-kon odstranjenja karijesa nije bila postavljena adhe-zivna restauracijska građa, kompozitni ispun ili sta-kleni ionomerni cementi, retencioni kaviteti i dalje će biti potrebni, a tada preparacija tvrdoga dentina može biti bolna. Inače, s pomoću Caridex metode potrebno je više vremena za pripremu i čišćenje ka-rijesa, ali to ne bi trebao biti problem ako se uzme u obzir da tada nije potrebno čekati djelovanje lo-kalne anestezije.

Caridex će biti koristan za sve velike kariozne lezije tamo gdje je moguć lak pristup kavitetu i za vrlo duboke karijese dentina jer su tako mogućno-sti za traumatsko oštećenje pulpe znatno reducira-ne. Kod pacijenata koji se boje stomatološkog za-hvata, brušenja, buke, vibracije, i vonja, pogotovo kod djece, Caridex je vrlo koristan. Cervikalne le-zije mogu se uspješno, gotovo potpuno preparirati sa Caridexom i ručnim instrumentima, bez uporabe rotirajućih instrumenata. Osobito je ta metoda po-godna za lezije kod kojih nakon preparacije dolazi kompozitni ispun.

## Zaključak

Najbolji učinak Caridex sustava pri mekanom i srednjtvrdom karijesu postiže se ako poštujemo 4 osnovna načela u radu:

1. otvaranje kariozne lezije,
2. dobra preglednost svih karioznih područja,
3. kemomehaničko odstranjivanje karijesa,
4. provjera potpunog odstranjivanja karijesa.

Za jednu prosječnu karioznu leziju dimenzija 4x3x1,5 mm bilo je potrebno 30 minuta da bi se ka-rijes potpuno očistio. Za prosječnu preparaciju na-vedenih dimenzija potrebno je oko 175 ml Caridex otopine. Iskustva stečena u našoj studiji pokazuju da je karijes otklonjen u 75-100% pacijenata; dno ka-viteta i dentinske stijenke obrađene Caridex otopi-nom ostaju čiste, bez ostataka sloja koji inače na-

staje pri radu s rotirajućim instrumentima a koji se mora otkloniti posebnim čistilima. Dentinska pov-ršina je po obradi Caridexom nepravilna s mnogim izbočinama i široko otvorenim dentinskim kanalima koji služe kao dobra retencija kompozitnoj građi.

Zaključno se može reći da Caridex metoda eva-kuacije karijesa ima svoje prednosti i nedostatke.

### Prednosti:

- a) karijes se odstranjuje bez oštećenja zdravog den-tina i zubne pulpe,
- b) manja je upotreba lokalne anestezije,
- c) manja je upotreba rotirajućih instrumenata,
- d) pacijenti je dobro primaju,
- e) uspješna upotreba kompozitne građe,
- f) jednostavna i laka upotreba,
- g) lakši i kraći rad s rotirajućim instrumentima.

### Nedostatci:

- a) potrebno je više vremena nego pri konvencional-noj metodi,
- b) potrebno je dodatno obrađivati kavitet s rotira-jućim instrumentima zbog dostupnosti, pregled-nosti i retencije,
- c) relativno skup postupak.

Ipak, djelotvornost Caridexa i njegova dobra pri-hvaćenost od pacijenata osiguravaju vrsnu alterna-tivnu metodu za liječenje karijesa.

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# Treatment of Carious Lesions by a Chemomechanical Procedure

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## Summary

**Objectives:** *The known fear of pain during mechanical removal of dental caries by conventional rotating instruments has led to the development of a novel, chemomechanical method, based on carious tissue softening by the use of a special solution. The main constituent of the solution is aminobutyric acid, which dissolves carious tissue by decomposition of its collagenous structure.*

**Material and Methods:** *The procedure consists of directing pulsating jets of warmed solution at the carious lesion using an electronic device. The layers of carious tissue are softened by the solution, and the use of an electronic device allows selectivity and evacuation of carious tissue from a particular tooth. The solution has no effect on healthy dentin, tooth pulp or surrounding soft tissue, and causes no allergic reactions.*

**Results:** *The study was performed in a sample of 60 patients. After the use of the solution, carious lesions were removed in all study subjects, either by excavation or by very light grating without pressure. Study results showed that 77% of the patients felt no pain or any strange taste of the solution, and 87% of the patients required no anesthesia during caries preparation.*

**Conclusion:** *Carious tissue was successfully evacuated in 75%-100% of the study patients. Dentin areas remained clean and uneven, with wide dentin channels providing ideal retention for composite materials. This procedure for caries removal is recommended in the case of large carious lesions in soft and moderately hard dentin, in the preparation of class V, and in work with frightened patients, small children or patients allergic to anesthetics.*

**Key words:** *caries, Caridex, chemomechanical treatment, aminobutyric acid, chlorination*

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## Introduction

Caries is one of the most widely spread diseases in humans. The well known fear of pain during mechanical removal of the diseased dental tissue by conventional methods, using rotating devices has led to the development of a novel, chemomechanical method of carious tissue removal and exposure of healthy dental tissue.

Previous studies have shown 80% of patients to feel fear from dental procedures, mostly from injections and grinding accompanied by pain, vibration and smell. Therefore, both the patient and therapist would obviously prefer a method of carious tissue removal without the use of rotating devices (1). Analysis of the carious process involving dentin shows it to consist of two layers with different ultramicroscopic and chemical structure. The outer, infected dentin layer shows irreversible alterations, with bacterial invasion and without the possibility of remineralization, thus it should be removed. The inner, affected dentin layer has undergone reversible alterations, is free from bacterial infection, and has the possibility of remineralization, thus it can be preserved (2-4). On electron microscopy, the outer layer of dentin shows scarcely scattered collagenous fibers, whereas the inner layer of carious dentin has dense, regularly aligned collagenous fibers with characteristic bridges similar to those found in normal, intact dentin.

In clinical practice, the Caridex chemomechanical system of dental caries removal as an alternative to mechanical dental caries removal has been known for several years (5,6). The method is based on carious tissue softening with collagenous structure loosening by the action of Caridex system solution and tissue removal by gentle scraping with special curettes (7,8). Development of the method can be traced back to 1976, when Goldmann and Kronman (5,6) published the first opinion on this method of caries removal (Figure 1). The system consists of three components, i.e. a bottle (solution reservoir), a pump, and a holder with a specially shaped handpiece, a curette. The solution, designated by the researchers' initials, GK 101, is a derivative of aminobutyric acid, which is capable of removing carious tissue without any effect on the healthy tooth tissue. The mechanism of its action includes chlorination to soften and remove the partially alte-

red tissue of carious dentin by decomposition of its collagenous structure. *In vitro* and *in vivo* studies have shown that the solution is biocompatible, does not affect the healthy dentin and healthy pulp, does not cause irritation to the surrounding tissue, and causes no allergic reactions (7,8).

The GK 101 solution contains equal amounts of A and B components. Component A contains sodium hypochlorite and distilled water, and component B contains sodium hydroxide, sodium chloride, N-monochlorine-DL-2 aminobutyric acid, and distilled water. Before use, the two components are mixed in an equal ratio in a 500-ml reservoir, and are warmed within the device to 37 °C before the procedure. The mixed solution is a colorless fluid of saltish taste and smelling like hypochlorite. The solution is safe and efficacious, and has been accepted for wide use by the American Dental Association since 1985 (9).

## Aim of the Study

The aim of the study was to assess the use, efficiency, and appropriateness for carious dentin removal, and to evaluate the acceptability of this technique from the patient's point of view. One carious, vital tooth with extensive carious destruction, which could be clinically and radiographically visualized, was chosen in each study subject. The teeth were free from inflammatory lesions to the periodontium.

## Patients and Methods

The study included 60 patients aged 4-16 years. Before the procedure, each study subject was asked to fill out a questionnaire with the following questions:

- Why do you participate in the study?
- How often do you see your dentist?
- What do you think about grinding and dental procedure?
- Do you usually need local anesthesia?
- Would you visit your dentist more frequently if the treatment could be performed without grinding and local anesthesia?



- Would you mind the use of a new method which would last longer than the method with grinding?

Upon warming up to 37 °C in the pump, Caridex solution is started at a rate of 650 pulsations *per* minute (45 ml/min). Using the handpiece-curette, the pulsating jet is directed to the carious cavity, whereby the action of the solution is combined with very light, simultaneous scraping-abrasion. The procedure is repeated several times with intervals of several minutes. No pressure is required during the carious tissue removal, as any pressure may cause discomfort or pain in the patient (Figure 2).

In our study, the A and B components were mixed in the reservoir just before the procedure, and warmed up to 37 °C for two minutes. Component A contained sodium hypochlorite and distilled water, and component B contained sodium hydroxide, sodium chloride, N-monochlorine-DL-2 aminobutyric acid, and distilled water. Fresh solution was mixed for each patient (Figure 2). The solution should be applied into the carious cavity and the above mentioned mechanism of action should be allowed to act for several minutes to induce the chemical reaction of chlorination. The procedure should be repeated several times. Routine inspection and optic measures were used to determine whether the entire infected, outer layer of dentin was softened and removed (Figure 3). In the case of carious dentin remnants, additional preparation by manual or rotating instruments was used, without pressure and painful sensations, because the carious layers were easy to remove and the procedure of grinding, if necessary, took much less time. Upon caries removal and cavity shaping, the cavities were filled with composite materials, whereas the undermined enamel was retained in order to ensure mechanical fusion (Figures 5 and 6).

## Results

All the 60 study patients treated with Caridex GK 101 solution completed the questionnaire, which revealed that 66% of them visit their dentist only in case of a problem. When asked whether they would have visited their dentist more frequently if there had been less grinding and need of anesthesia, 93%

of the study patients gave an affirmative answer. The efficacy of the system described was assessed by the percentage of removed caries, evacuated without the use of other dental procedures. Thus, a 100% and 90% - 95% caries removal with Caridex was recorded in 60% and 26% of the teeth, respectively. In the rest of the teeth, low- and high-speed rotating instruments were used. It should be emphasized that in the present study, the work with rotating instruments excluded any pressure and painful sensations, and caused no discomfort to the patients, whereas the carious layers were easy to evacuate and the grinding procedure was of a considerably shorter duration.

The duration of the procedure is defined as the approach to the cavity, from the time of cavity opening to the beginning of excavation and caries removal, i.e. time from the beginning of caries opening until the completion of excavation. Our measurements showed the time of excavation with the Caridex method to be longer than that required for the conventional method. Therefore, the entire treatment had a longer duration, but the patients' observations frequently differed from these measurements. Local anesthesia was not used in any of the 60 study patients nor did any of them ask for it.

When the patients were asked to compare the extent of grinding in the Caridex method and in the conventional procedure, 99% of them reported they had felt less grinding with the Caridex method, and only 1% of the patients reported they had observed no difference. Comparison of the duration of the complete procedure revealed that the patients did not observe the prolonged duration of the Caridex procedure, compared to the conventional method. Considering the patients' opinion about the Caridex method as an appropriate dental procedure, all study subjects believed their teeth were properly treated by this method, and were ready to recommend it to their families and friends.

In total, 90% of the patients preferred Caridex and 3% conventional method (the latter explained their decision by the bad taste of the solution), whereas 2% of the patients did not specify either of the methods. Accordingly, all study patients preferred Caridex because of the reduced need for grinding, absence of painful sensations, and a complete sense of comfort and relaxation.

## Discussion

Caries removal by the Caridex method is by far more comfortable than by the conventional method, and most patients failed to notice the longer duration of the procedure compared to the conventional one. Work with rotating instruments was rarely needed following the application of the Caridex system, and if necessary it was used without pressure and painful sensation, as well as without the need for local anesthesia. The patients were less frightened, because caries removal with Caridex solution caused no discomfort to non-anesthetized patients, even when scraping with the tip of the curette against hard dentin. However, the need for manual instruments and local anesthesia will not be completely eliminated for the time being, because the Caridex system is inappropriate for very small carious lesions and cannot remove carious enamel. When no adhesive restoration material, composite filling or glass ionomer cement has been placed after caries removal, and retention cavities are still needed, the preparation of hard dentin may be painful. Although, the preparation and removal of caries by the Caridex method take more time, it should not be considered a problem, as there is no need to wait for the introduction of local anesthesia.

Caridex is useful in all extensive carious lesions with easy approach to the cavity, and in very deep dentinal caries because of the considerably reduced possibility of traumatic damage to the pulp. Caridex is highly useful in patients fearing dental procedures, grinding, noise, vibration and smell, and especially in children. Cervical lesions can be successfully and almost completely prepared with Caridex and manual instruments, without the use of rotating instruments. The method is especially appropriate for lesions where the procedure is to be followed by placement of a composite filling.

## Conclusion

In soft and moderately hard caries, the best effects of the Caridex system are produced, provided the following basic principles are met during the procedure:

1. opening of the carious lesion;
2. good visualization of all carious areas;
3. chemomechanical removal of caries; and
4. control of complete caries removal.

Complete evacuation of an average carious lesion of 4x3x1.5 mm took 30 minutes. Average preparation of these dimensions required about 175 ml of Caridex solution. According to the experience acquired in the present study, caries was removed in 75% - 100% of the patients, leaving the cavity bed and dentin walls treated by Caridex solution clean and free from any layer remnants which are formed during the work with rotating instruments and have to be removed by special cleaners. The preparation with Caridex solution leaves the dentin surface irregular, with many protrusions and widely open dentinal canals that serve as good retention sites for composite materials.

In conclusion, the Caridex method of caries evacuation has both advantages and shortcomings.

### *Its advantages are:*

- a) removal of carious tissue without damage to healthy dentin and dental pulp,
- b) reduced use of local anesthesia,
- c) reduced use of rotating instruments,
- d) good patient compliance,
- e) successful use of composite materials,
- f) simple and easy use; and
- g) easier and shorter work with rotating instruments.

### *Its shortcomings are:*

- a) prolonged duration compared to the conventional method,
- b) the need for additional cavity preparation with rotating instruments for accessibility, visualization and retention, and
- c) a relatively expensive procedure.

However, the efficacy of Caridex and high level of patient compliance with the procedure make it a high quality alternative method for management of dental caries.