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Single-Visit Endodontic Therapy and Root Canal Identification Practices among Croatian Dentists: Insights from a National Survey

Jednoposjetna endodontska terapija i pronalaženje korijenskih kanala u praksi hrvatskih stomatologa: podatci iz nacionalne ankete

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Abstract

Objective: to analyze a single-visit endodontic treatment together with root canal detection practices in Croatia and investigate their relationship with reported postoperative pain, medication prescription, magnifying devices, rubber dam, radiographical checks before the procedure, cone-beam computed tomography (CBCT) and engine-driven instrumentation. **Materials and Methods:** A structured questionnaire was distributed via email to all Croatian dental practitioners, with 819 responses analyzed corresponding to an estimated 27% response rate. Statistical analyses included descriptive analysis and regression modelling. **Results:** Among Croatian practitioners, 27.9% frequently performed single-visit endodontic treatments. Male practitioners, practitioners with continuing education and ample experience, endodontic specialists, and those working in polyclinics or academic settings were more likely to adopt this approach. It correlated positively also with the use of advanced diagnostic and treatment tools (e.g., magnification devices, rubber dam, CBCT) and a reduction in antibiotic prescription. However, it was associated with increased reported analgesic prescription and a larger number of reported vertical tooth fractures. Practitioners reported less frequently using single-visit endodontic treatments for multi-rooted teeth and those with associated sinus tracts or periradicular lesions. Furthermore, practitioners more often performing single-visit endodontic treatment rate themselves better in finding additional canals, which is positively influenced by usage of radiography and magnification devices. In addition, continuing education has a positive effect on the root-finding abilities, but it decreases with years of their clinical experience. **Conclusions:** Single-visit endodontic treatment practice in Croatia is influenced by practitioner education, experience, and access to advanced equipment. While it offers benefits such as reduced antibiotic prescription, clinical attention and further research is needed to address potentially associated complications such as vertical tooth fractures and reliance on analgesics. Root finding abilities are positively influenced by continuing education. These findings underscore the role of education and resources in optimizing endodontic outcomes.

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Introduction

Single-visit endodontic treatment (ET) offers several advantages over conventional multi-visit treatment but may also carry an increased risk of complications (1). The benefits of single-visit treatment include greater patient convenience

Uvod

Jednoposjetna endodontska terapija (ET) ima nekoliko prednosti u odnosu prema konvencionalnom liječenju u više posjeta, ali može se pojaviti i povećani rizik od komplikacija (1). Prednosti jednosposjetnog liječenja uključuju ve-

due to shorter chair time, lower costs resulting from reduced use of dental materials, and a decreased risk of potential microleakage between treatment visits.

Previous research on single-visit endodontic treatments has primarily focused on the reduction of postoperative pain (2–15). Comparison between single-visit and multiple-visit treatments has been made from various perspectives, including timing and frequency (16), treatment outcome evaluation (17–30), and the incidence and intensity of post-endodontic pain (31–37). Additionally, several studies have investigated the criteria on which clinicians base their decision to perform single versus multiple-visits ET (38–40). Systematic reviews have compared these approaches (1,41–44), with the most recent review (42) concluding that there is currently no evidence to suggest one method is categorically superior to the other—except for "moderate-certainty evidence of higher proportion of participants reporting pain within one week in single-visit groups compared to multiple-visit groups". The review found no differences in swelling, flare-up incidence, sinus tract or fistula formation, or analgesic use—though the latter contrasts with findings from and earlier Cochrane review (28). Most outcomes were based on very low to low-certainty evidence, except for the absence of a difference in radiologic failure after at least one year (i.e. periapical radiolucency), and the pain reported within one week, for which the evidence was of a moderate certainty. This study, therefore, aims to contribute to the ongoing comparison between single-visit and multiple-visit ET with additional evidence.

In Croatia, previous research on ETs has examined the referral of problematic endodontically treated teeth to oral surgery (45), the use of antibiotics (46–48), and the overall state of endodontic practice (49). However, this is the first study to investigate single-visit ET practices specifically in Croatia. The primary aim is to analyze the prevalence of single-visit treatments and explore their relationship with reported pain, medication prescriptions, usage of radiographic assessment prior to the procedure, cone-beam computed tomography (CBCT), and engine-driven instrumentation. A secondary objective is to examine root canal detection practices.

Materials and methods

The Ethics Committee of the University of Zagreb approved this study under number 05-PA-24-3/2018.

Questionnaire

The Croatian Chamber of Dental Medicine has, via email, sent a link to the questionnaire to all dental practitioners in Croatia, the number of which is estimated to 3000 by using data from the Croatian Institute of Public Health and the Croatian Health Statistics yearbook for 2022. The responses were then collected in the period from May 2021 to March 2022. The questionnaire is available at https://forms.gle/nmUeQizSoN2U5SNYA.

Participants provided demographic information, including sex (female-F, male-M), years of practice, degree of clinical education (DCE) (DDM – Doctor of Dental Medicine,

ću pogodnost za pacijenta zbog kraćeg vremena provedenog u stomatološkoj ordinaciji, niže troškove zbog manje potrošnje dentalnih materijala te smanjeni rizik od mikropropuštanja između posjeta.

Dosadašnja istraživanja o jednoposjetnim ET-ima primarno su bila usmjerena na smanjenje postoperativne boli (2 – 15). Usporedbe između jednoposjetnog i višeposjetnog liječenja provedene su iz različitih perspektiva, uključujući vrijeme i učestalost zahvata (16), evaluaciju uspješnosti liječenja (17 – 30) te učestalost i intenzitet postendodontske boli (31 – 37). Uz to, u nekoliko studija autori su istraživali kriterije na temelju kojih se kliničari odlučuju na jednoposjetni ili višeposjetni ET (38 – 40). U sustavnim pregledima uspoređivali su te pristupe (1,41 – 44), pri čemu je u posljednjemu (42) zaključeno da trenutačno nema dokaza koji bi upućivali na jasnu prednost jednoga pristupa pred drugim – osim „umjerene razine sigurnosti u dokaze o većem udjelu sudionika koji prijavljuju bol unutar tjedan dana u skupinama s jednoposjetnim liječenjem u usporedbi s višeposjetnima". Također nisu pronađene razlike u pojavnosti oteklina, tzv. *flare-up* reakcija, sinus-trakta ili fistula, ni u potrošnji analgetika – premda je to posljednje u suprotnosti s rezultatima prethodnoga Cochraneova pregleda (28). Većina rezultata temelji se na vrlo niskoj ili niskoj razini statističke sigurnosti, osim za izostanak razlike u radiološkom neuspjehu nakon najmanje godinu dana (npr., periapikalna radiolucencija) te bol unutar tjedan dana, za koje je razina sigurnosti bila umjerena. Stoga je cilj ove studije pronaći dodatne dokaze u usporedbi jednoposjetnoga i višeposjetnog ET-a.

U Hrvatskoj su dosadašnja istraživanja o endodontskim zahvatima obuhvatila upućivanje problematičnih endodontski liječenih zuba na oralno-kirurške zahvate (45), primjenu antibiotika (46 – 48) te opće stanje endodontske prakse (49). Međutim, ovo je prvo istraživanje koje se posebno bavi praksama jednoposjetnog endodontskog liječenja u Hrvatskoj. Primarni cilj je analizirati učestalost primjene jednoposjetne terapije i ispitati njezinu povezanost s prijavljenom boli, propisivanjem lijekova, korištenjem radiološke procjene prije zahvata, CBCT-om i strojnom instrumentacijom. Sekundarni cilj je ispitati uspjeh pronalaženja korijenskih kanala.

Materijali i metode

Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu odobrilo je ovo istraživanje pod brojem 05-PA-24-3/2018.

Upitnik

Hrvatska komora dentalne medicine poslala je e-poštom poveznicu na upitnik svim doktorima dentalne medicine u Hrvatskoj, a njihov se broj procjenjuje na 3000 na temelju podataka Hrvatskoga zavoda za javno zdravstvo i Hrvatskoga zdravstveno-statističkog ljetopisa za 2022. godinu. Odgovori su prikupljani u razdoblju od svibnja 2021. do ožujka 2022. godine. Upitnik je dostupan na adresi: https://forms.gle/nmUeQizSoN2U5SNYA.

Sudionici su naveli demografske podatke, uključujući spol (ženski – F, muški– M), godine prakse, stupanj kliničke edukacije (DCE) [DDM – doktor dentalne medicine, En-

EndoS – Specialist in Endodontics, EndoR – Resident in Endodontics (a doctor of dental medicine referred to a specialist clinic with the aim of gathering theoretical, practical, professional and scientific knowledge in endodontics within three years, after the expiry of which the specialist exam is taken), Other), clinical settings (HC - Health Center, InConc - Dental Clinic with Concession Contract, Priv - Private Clinic, PrivSA - Private Clinic with a Health Fund Contract, Poly - Dental Polyclinic, SDM - School of Dental Medicine), and continuing education in endodontics taken in the last 5 years. The questionnaire included the following questions on endodontic clinical practices that are relevant for this paper. For almost all questions possible answers were as follows: Never / Very rarely / Rarely / Often / Almost always / Always. The questions that had different answers are specified with their answers:

- How many teeth do you treat per month? (number)
- Do you use an apex locator in your clinical practice?
- Do you use magnification devices in your clinical practice?
- Do you use additional lighting with magnification devices? (Yes / No)
- Do you use radiographs before the instrumentation of root canals?
- Do you use a rubber dam in your endodontic clinical practice?
- Do you perform manual instrumentation of root canals?
- Do you perform engine-driven instrumentation of root canals?
- Do you perform a combination of manual and engine-driven instrumentation of root canals?
- Do you perform final irrigation to remove the smear layer?
- Do you use CBCT in your clinical practice?
- How often do you perform single-visit ET?
- Do you perform pulp amputation procedures on permanent teeth?
- Do your patients report pain between visits or after endodontic treatment?
- Do you prescribe analgesics for endodontic procedures?
- Do you prescribe antibiotics for endodontic procedures?
- Have you observed vertical tooth fractures following your own endodontic procedures?
- How do you perform pulp extirpation? (Vital extirpation, fill in multiple visits/next visit/one visit; Mortal extirpation, fill in multiple visits/next visit/one visit)
- How often do you refer patients for apicoectomies?
- Do you find the second bucco-mesial canal in maxillary molars?
- Do you find a second canal in the distal root in mandibular molars?
- Do you find two canals in mandibular incisors?
- Free comment.

Statistical methods

Analysis was performed using R Project for Statistical Computing (ver. 4.4.1) with the Survey package. Using the

doS – specijalist endodoncije, EndoR – specijalizant endodoncije (doktor dentalne medicine upućen u specijalističku ustanovu s ciljem stjecanja teorijskog, praktičnog, stručnog i znanstvenog znanja iz endodoncije tijekom tri godine, nakon čega polaže specijalistički ispit), ostalo], tip kliničkog okruženja (HC – dom zdravlja, InConc – ordinacija dentalne medicine s koncesijskim ugovorom, Priv. – privatna ordinacija, PrivSA – privatna ordinacija s ugovorom s HZZO-om, Poly – dentalna poliklinika, SDM – stomatološki fakultet), te jesu li u sklopu cjeloživotnog obrazovanja pohađali tečajeve iz endodoncije u posljednjih pet godina. Upitnik je sadržavao pitanja o endodontskoj kliničkoj praksi relevantna za ovaj rad. Za gotovo sva pitanja bili su ponuđeni odgovori: Nikada/Vrlo rijetko/Rijetko/Često /Gotovo uvijek/Uvijek. Pitanja koja su imala drukčije odgovore su navedena zajedno s pripadajućim odgovorima:

- Koliko zuba liječite na mjesec? (broj)
- Koristite li se endometrom u svojoj kliničkoj praksi?
- Koristite li se povećalom u svojoj kliničkoj praksi?
- Koristite li se dodatnim osvjetljenjem uz povećalo? (Da / Ne)
- Tražite li RTG prije instrumentacije korijenskih kanala?
- Koristite li se koferdamom u svojoj endodontskoj praksi?
- Primjenjujete li ručnu instrumentaciju korijenskih kanala?
- Primjenjujete li strojnu instrumentaciju korijenskih kanala?
- Primjenjujete li kombinaciju ručne i strojne instrumentacije korijenskih kanala?
- Obavljate li završno ispiranje za uklanjanje zaostalog sloja?
- Koristite li se CBCT-om u svojoj kliničkoj praksi?
- Koliko često primjenjujete jednoposjetnu endodontsku terapiju?
- Amputirate li pulpu na trajnim zubima?
- Žale li se vaši pacijenti na bol između posjeta i poslije endodontskog liječenja?
- Propisujete li analgetike uz endodontski zahvat?
- Propisujete li antibiotike uz endodontski zahvat?
- Nalazite li vertikalne frakture zuba nakon vlastitih endodontskih zahvata?
- Na koji način obavljate ekstirpaciju pulpe? (vitalna ekstirpacija, punjenje u više posjeta / sljedeći posjet / jedan posjet; mortalna ekstirpacija, punjenje u više posjeta / sljedeći posjet / jedan posjet)
- Koliko često upućujete pacijente na apikotomiju?
- Nalazite li dva korijenska kanala u bukomezijalnom korijenu kod prvih gornjih kutnjaka?
- Nalazite li dva korijenska kanala u distalnom korijenu kod prvih donjih kutnjaka?
- Nalazite li dva korijenska kanala u donjim sjekutićima?
- Slobodni komentar.

Statističke metode

Analiza je provedena korištenjem programskog alata „R Project for Statistical Computing“ (verzija 4.4.1) uz paket

specialized Survey package is necessary because in this study the sample size is comparable to the population size, which makes the finite population correction factor not negligible.

The distribution of practitioners by sex, years of practice, and continuing education was examined. Ordinal and logistic regression models were constructed to assess all the factors influencing variables of interest. All regression models were adjusted for sex and years of practice. For all unordered predictor factors, except gender, sum contrast was used, meaning that the variables are contrasted to their mean. For ordered factors, Helmert contrasts were used meaning that variables are contrasted successively to their lower values.

Effects are reported as log odds (LO), with significance codes: 0.001, 0.01, 0.05, 0.1 designated in figures by three, two and one stars respectively. The dot corresponds to the 0.1 significance level. Slopes are designated with a corresponding number of stripes whereas a dotted stripe corresponds to a dot, i.e., to 0.1 significance. Reported are only the effects that were found significant.

Results

General description of respondents

A total of 819 responses were collected, representing a 27% response rate. By excluding 31 respondents who do not perform ETs (3.8%), the analysis focused on 788 respondents engaged in endodontics. Table 1 presents general numbers related to single-visit ET and related endodontic practices, whereas Figure 1 shows general characteristics of endodontic practitioners. Figure 2 presents self-perceived success in finding root canals in permanent teeth frequently exhibiting complex internal morphologies.

Single-Visit Endodontic Therapy and Root Canal Detection

In Croatia, it is estimated that 27.9% of practitioners perform single-visit ET *often* to *always* (Table 1). Among specialists and residents in endodontics, this percentage is 69.7%. Male practitioners perform significantly more single-visit ETs than female practitioners (LO=0.6), for whom the singe-visit practice drops significantly with years of experience (LO=-0.04) (Figure 3). Continuing education has a small positive effect (LO=0.33), whereas endodontic specialists (EndoS) are performing it significantly more often (LO=1.89), but with a notable significant drop with years of experience (LO=-0.15). Panel D shows that polyclinics (Poly) and schools of dental medicine (SDM) are the only clinical settings that use single-visit ET more often than others. The usage increases with the number of endodontically treated teeth (LO=0.04). Starting from panel F, we see that single-visit ET is associated with increased usage of magnifying devices, rubber dam, radiographical checks before the procedure, CBCT, and a small but significant increase in reported analgesic prescription (panel J). Antibiotics are significantly less often prescribed by practitioners who perform single-visit ET *often* to *almost always* (LO=-0.18) (panel K), but there

„Survey“. Korištenje specijaliziranog paketa „Survey“ bilo je nužno jer je u ovom istraživanju veličina uzorka usporediva s veličinom populacije, zbog čega korekcijski faktor za konačnu populaciju nije zanemariv.

Analizirana je raspodjela doktora dentalne medicine prema spolu, godinama prakse i pohađanju edukacije. Izgrađeni su slijedni i logistički regresijski modeli za procjenu svih čimbenika koji utječu na analizirane varijable. Svi regresijski modeli prilagođeni su za spol i godine prakse. Za sve neuređene prediktorske varijable, osim spola, korišten je tzv. „sum-kontrast“, što znači da se varijable uspoređuju s vlastitim prosjekom. Za uređene faktore korišten je pak „Helmert-kontrast“, što znači da se varijable uspoređuju sukcesivno s nižim vrijednostima.

Efekti su prikazani kao logaritamski omjeri izgleda (LO), uz oznake značajnosti: 0,001, 0,01, 0,05, 0,1, koje su na grafikonima označene trima, dvjema i jednom zvjezdicom. Točka označava razinu značajnosti od 0,1. Nagibi su prikazani s odgovarajućim brojem crta, pri čemu isprekidana crta odgovara točki, tj. razini značajnosti od 0,1. Prikazani su samo statistički značajni efekti.

Rezultati

Opći opis ispitanika

Ukupno je prikupljeno 819 odgovora, što je stopa odaziva od 27 %. Isključujući 31 ispitanika (3,8 %) koji ne primjenjuju endodontsku terapiju (ET), analiza se temelji na 788 ispitanika koji se bave endodoncijom. U tablici 1. osnovni su brojčani podatci vezani za jednoposjetni ET i povezanu endodontsku praksu, a na slici 1. opće su karakteristike endodontskih liječnika. Slika 2. prikazuje samoprocjenu uspješnosti u pronalasku korijenskih kanala u trajnim zubima koji često imaju složenu unutarnju morfologiju.

Jednoposjetna endodontska terapija i pronalaženje korijenskih kanala

Procjenjuje se da u U Hrvatskoj 27,9 % doktora dentalne medicine primjenjuje jednoposjetni ET *često* do *uvijek* (tablica 1.). Među specijalistima i specijalizantima endodoncije taj postotak iznosi 69,7 %. Liječnici znatno češće provode jednoposjetni ET od liječnica (LO = 0,6), pri čemu se kod liječnica učestalost jednoposjetne prakse znatno smanjuje s godinama iskustva (LO = -0,04) (slika 3.). Cjeloživotno obrazovanje ima mali pozitivan učinak (LO = 0,33), a specijalisti endodoncije (EndoS) znatno češće primjenjuju jednoposjetni ET (LO=1,89), no i kod njih se ta praksa smanjuje s godinama iskustva (LO = -0,15). Panel D prikazuje da su poliklinike (Poly) i stomatološki fakulteti (SDM) jedina klinička okruženja u kojima je jednoposjetni ET češći od prosjeka. Učestalost također raste s brojem endodontski liječenih zuba (LO = 0,04).

Počevši od panela F, vidi se da je jednoposjetni ET povezan s povećanom upotrebom povećala, koferdama i radioloških snimki prije zahvata, CBCT-a te s malim, ali značajnim porastom propisivanja analgetika (panel J). S druge strane, antibiotike značajno rjeđe propisuju doktori koji *često* do *gotovo uvijek* primjenjuju jednoposjetni ET (LO=-0.18) (panel

Table 1 Characteristics of endodontic practice (population estimate of percentages and related standard errors)
Tablica 1. Karakteristike endodontske prakse (procjena udjela u populaciji i pripadajuće standardne pogreške)

Single-visit ET (all practitioners) • Jednoposjetni ET (svi ispitanici)	
Never • Nikad	20.1% (0.01)
Very rarely • Veoma rijetko	32.4% (0.01)
Rarely • Rijetko	19.6% (0.01)
Often • Često	20.7% (0.01)
Almost always • Gotovo uvijek	4.1% (0.01)
Always • Uvijek	3.1% (0.01)
Single-visit ET (only specialists and residents in endodontics) • Jednoposjetni ET (specijalisti i specijalizanti endodoncije)	
Never • Nikad	3.6% (0.02)
Very rarely • Veoma rijetko	16,1% (0.05)
Rarely • Rijetko	10.7% (0.04)
Often • Često	30.4% (0.06)
Almost always • Gotovo uvijek	16.1% (0.05)
Always • Uvijek	23.2% (0.06)
Mortal pulp amputation • Mortalna amputacija	
Never • Nikad	27.5% (0.01)
Very rarely • Veoma rijetko	34% (0.01)
Rarely • Rijetko	19.7% (0.01)
Often • Često	14.7% (0.01)
Almost always- Always • Gotovo uvijek- Uvijek	4.2% (0.01)
Radiograph analysis before instrumentation • Radiografska analiza prije instrumentacije	
Never • Nikad	0.64% (0)
Very rarely • Veoma rijetko	2.3% (0)
Rarely • Rijetko	6.8% (0.01)
Often • Često	34.9% (0.01)
Almost always • Gotovo uvijek	24.1% (0.01)
Always • Uvijek	31.2% (0.01)
Use of magnifying devices • Upotreba povećala	
Never • Nikad	62.7% (0.01)
Very rarely • Veoma rijetko	8.6% (0.01)
Rarely • Rijetko	8.9% (0.01)
Often • Često	8.5% (0.01)
Almost always • Gotovo uvijek	3.3% (0.01)
Always • Uvijek	8.1% (0.01)
Use of CBCT • Upotreba CBCT-a	
Never • Nikad	58.9% (0.02)
Very rarely • Veoma rijetko	13% (0.01)
Rarely • Rijetko	16.8% (0.01)
Often • Često	11.3% (0.01)
Use of engine-driven instruments • Korištenje strojne instrumentacije	
Never • Nikad	27.2% (0.01)
Very rarely • Veoma rijetko	6.1% (0.01)
Rarely • Rijetko	7.7% (0.01)
Often • Često	27% (0.01)
Almost always • Gotovo uvijek	17.4% (0.01)
Always • Uvijek	14.6% (0.01)
Manual instrumentation only • Korištenje ručne instrumentacije	
Never • Nikad	2.3% (0)
Very rarely • Veoma rijetko	11.6% (0.01)
Rarely • Rijetko	14.1% (0.01)
Often • Često	29.1% (0.01)
Almost always • Gotovo uvijek	12.8% (0.01)
Always • Uvijek	30.1% (0.01)

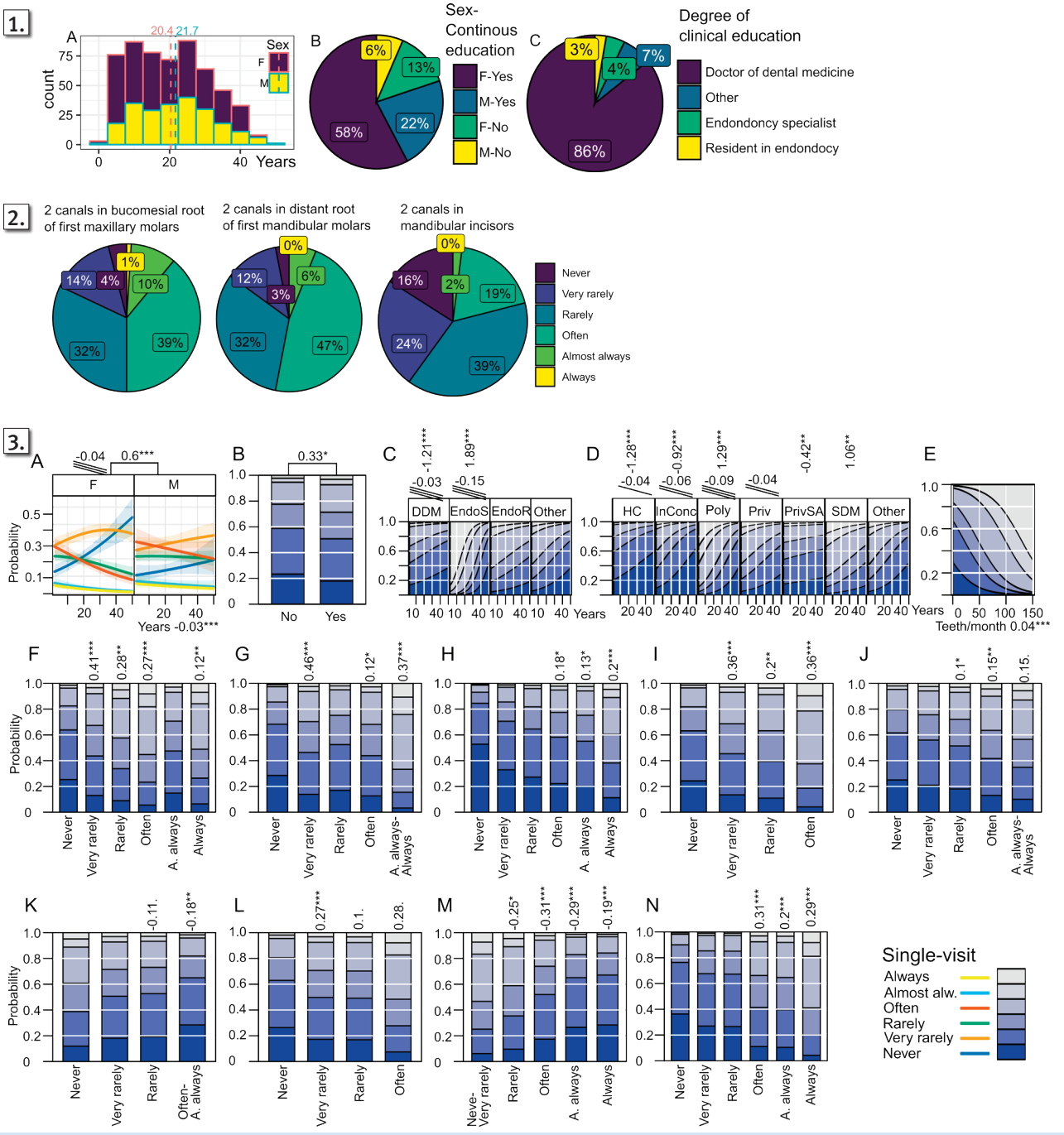

Figure 1 General characteristics of dental practitioners who participated in the survey: A-Years in practice; B- Continuing education in the last 5 years; C- Degree of clinical education

Slika 1. Opće karakteristike doktora dentalne medicine koji su sudjelovali u anketi

Figure 2 Self-perceived root canals finding performance (3 respondents answered always to first mandibular molars, and 1 answered always to mandibular incisors).

Slika 2. Samoprocjena uspješnosti u pronalaženju korijenskih kanala (3 ispitanika odgovorila su „uvijek" za prvi donji kutnjak, a 1 za donje sjekutiće)

Figure 3 Effects of various factors on the single-visit ET practice. A - sex and years in practice; B-Continuing education in the last 5 years; C - Degree of clinical education (DDM – Doctor of Dental Medicine, EndoS – Specialist in Endodontics, EndoR – Resident in Endodontics, Other); D-Clinical setting (HC - Health Center, InConc - Dental Clinic with Concession Contract, Priv - Private Clinic, Priva SA - Private Clinic with a Health Fund Contract, Poly - Dental Polyclinic, SDM - School of Dental Medicine); E - No. of endodontically treated teeth; F - Magnifying devices; G - Rubber dam isolation; H - Radiograph before procedure; I - CBCT use; J - Analgesic prescription; K - Antibiotics prescription; L - Vertical fractures; M - Manual root canal instrumentation; N - Engine-driven root canal instrumentation.

Slika 3. Učinci različitih čimbenika na praksu u primjeni endodontske terapije u jednom posjetu; A – spol i godine radnog iskustva; B – cjeloživotno obrazovanje u posljednjih 5 godina; C – stupanj kliničke edukacije (DDM – doktor dentalne medicine, EndoS – specijalist endodoncije, EndoR –specijalizant endodoncije, ostalo); D – tip kliničkog okruženja (HC – dom zdravlja, InConc –stomatološka ordinacija s koncesijom, Priv. – privatna ordinacija, PrivSA – privatna ordinacija s ugovorom s HZZO-om, Poly – stomatološka poliklinika, SDM – stomatološki fakultet); E – broj endodontski liječenih zuba; F – uporaba povećala; G – izolacija koferdamom; H – radiografija prije zahvata; I – uporaba CBCT-a; J – propisivanje analgetika; K – propisivanje antibiotika; L – vertikalne frakture; M – ručna instrumentacija korijenskih kanala; N – strojna instrumentacija korijenskih kanala

are more vertical fractures the more single-visit ET is practiced (panel L). As expected, manual instrumentation is less associated with single-visit ET, while engine-driven instrumentation is more used (panels M and N). We also tested if there were more apicectomies, if patients complained more about pain, and the influence of final irrigation, however, these three factors were not found significant.

Figure 4 shows that teeth with sinus tracts and periradicular lesions are less frequently treated in a single-visit, particularly in multiple-rooted teeth. Additionally, Figure 5 shows that pulpectomy is most frequently performed in one or two visits and that mortal extirpation is considerably used especially for molars (51.3%).

Figures 6 to 8 show that practitioners' self-perceived ability to find additional root canals decreases with years of clinical experience, while continuing education always has a positive effect. Furthermore, specialists (EndoS) are superior in finding canals than general dentists (DDM), as expected.

K), no broj prijavljenih vertikalnih fraktura zuba to je veći što se češće prakticira jednoposjetni ET (panel L). Očekivano, ručna instrumentacija rjeđe je povezana s jednoposjetnim ET-jem, dok se strojna instrumentacija češće primjenjuje (paneli M i N). Također smo ispitali postoji li više apikotomija, više pritužbi na bol, te utjecaj završnog ispiranja, ali nijedan od tih triju čimbenika nije bio značajan.

Na slici 4. zubi su s fistulama i periradikularnim lezijama koji se rjeđe liječe u jednom posjetu, osobito ako je riječ o višekorijenskim zubima. Nadalje, na slici 5. je ekstirpacija pulpe koja se najčešće obavlja u jednom ili dvama posjetima, a mortalna se ekstirpacija često primjenjuje, posebno kad je riječ o kutnjacima (51,3 %).

Slike od 6. do 8. pokazuju da se samoprocijenjena sposobnost liječnika u pronalaženju dodatnih korijenskih kanala smanjuje s godinama kliničkog iskustva te da cjeloživotno obrazovanje uvijek ima pozitivan učinak. Nadalje, specijalisti (EndoS) su uspješniji u pronalaženju kanala od općih dok-

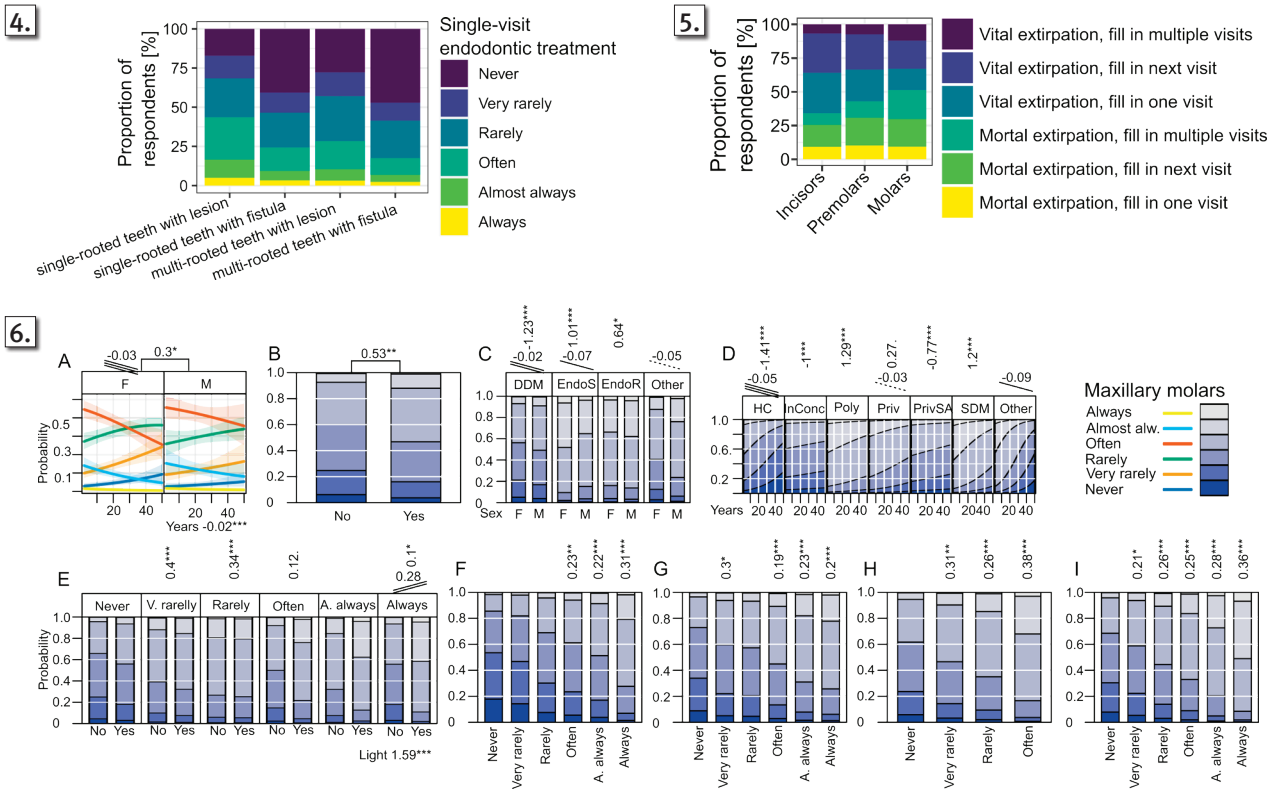

Figure 4 Frequency of single-visit endodontics considering the number of roots and the status of periapical tissue.
Slika 4. Učestalost pimjene endodontske terapije u jednom posjetu s obzirom na broj korijena i stanje periapikalnog tkiva
Figure 5 Pulp extirpation modality for incisors, premolars and molars.
Slika 5. Način uklanjanja pulpe kod sjekutića, pretkutnjaka i kutnjaka
Figure 6 Self-perceived performance in finding the second bucco-mesial canal in maxillary molars and its association with: A - sex and years in practice; B - Continuing education in the last 5 years; C - Degree of clinical education (DDM – Doctor of Dental Medicine, EndoS – Specialist in Endodontics, EndoR – Resident in Endodontics, Other); D-Clinical setting (HC - Health Center, InConc - Dental Clinic with Concession Contract, Priv - Private Clinic, Priva SA - Private Clinic with a Health Fund Contract, Poly - Dental Polyclinic, SDM - School of Dental Medicine); E-Magnification and light; F - Radiograph before procedure; G - Engine-driven instrumentation; H - CBCT use; I - Single-visit ET.
Slika 6. Samoprocjena uspješnosti u pronalaženju drugoga bukalno-mezijalnog kanala u gornjim kutnjacima; A – spol i godine radnog iskustva; B – cjeloživotno obrazovanje u posljednjih 5 godina; C – stupanj kliničke edukacije (DDM – doktor dentalne medicine, EndoS – specijalist endodoncije, EndoR – specijalizant endodoncije, ostalo); D – tip kliničkog okruženja (HC – dom zdravlja, InConc –stomatološka ordinacija s koncesijom, Priv. – privatna ordinacija, PrivSA – privatna ordinacija s ugovorom s HZZO-om, Poly – stomatološka poliklinika, SDM – stomatološki fakultet); E – upotreba povećala i dodatnog osvjetljenja; F – radiografija prije zahvata; G – strojna instrumentacija korijenskih kanala; H - upotreba CBCT-a; I - jednoposjetna endodoncija

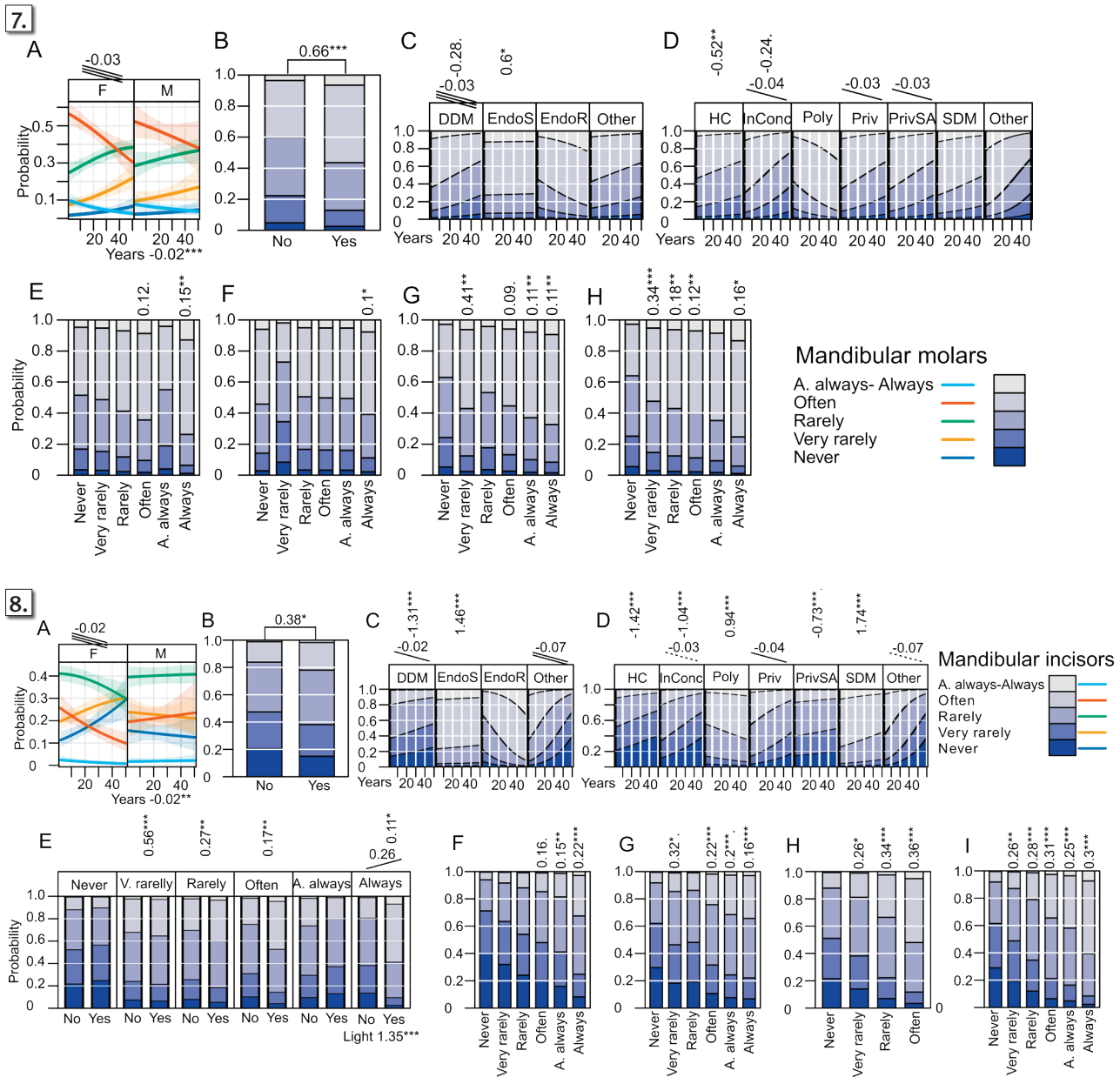

Figure 7 Self-perceived performance in finding a second canal in the distal root of mandibular molars and its association with: A-sex and years in practice Y; B- Continuing education in the last 5 years; C- Degree of clinical education (DDM – Doctor of Dental Medicine, EndoS – Specialist in Endodontics, EndoR – Resident in Endodontics, Other); D-Clinical setting (HC - Health Center, InConc - Dental Clinic with Concession Contract, Priv - Private Clinic, Priva SA - Private Clinic with a Health Fund Contract, Poly - Dental Polyclinic, SDM - School of Dental Medicine); E-Magnification (light was not significant); F- Radiograph before procedure; G-Engine-driven instrumentation; H-Single-visit ET.

Slika 7. Samoprocjena uspješnosti u pronalaženju drugog kanala u distalnom korijenu donjih kutnjaka; A – spol i godine radnog iskustva; B – cjeloživotno obrazovanje u posljednjih 5 godina; C – stupanj kliničke edukacije (DDM – doktor dentalne medicine, EndoS – specijalist endodoncije, EndoR – specijalizant endodoncije, ostalo); D – tip kliničkog okruženja (HC – dom zdravlja, InConc –stomatološka ordinacija s koncesijom, Priv. – privatna ordinacija, PrivSA – privatna ordinacija s ugovorom s HZZO-om, Poly – stomatološka poliklinika, SDM – stomatološki fakultet); E – upotreba povećala (dodatno osvjetljenje nije se pokazalo značajnim); F – radiografija prije zahvata; G – strojna instrumentacija korijenskih kanala; H- jednoposjetna endodoncija

Figure 8 Self-perceived performance in finding two canals in mandibular incisors. A-Effects of sex and years in practice; B- Continuing education in the last 5 years; C- Degree of clinical education (DDM – Doctor of Dental Medicine, EndoS – Specialist in Endodontics, EndoR – Resident in Endodontics, Other); D-Clinical setting (HC - Health Center, InConc - Dental Clinic with Concession Contract, Priv - Private Clinic, Priva SA - Private Clinic with a Health Fund Contract, Poly - Dental Polyclinic, SDM - School of Dental Medicine); E-Magnification and light; F- Radiograph before procedure; G-Engine-driven instrumentation; H- CBCT use; I - Single visit ET.

Slika 8. Samoprocjena uspješnosti u pronalaženju dvaju kanala u donjim sjekutićima; A – spol i godine radnog iskustva; B – cjeloživotno obrazovanje u posljednjih 5 godina; C – stupanj kliničke edukacije (DDM – doktor dentalne medicine, EndoS – specijalist endodoncije, EndoR – specijalizant endodoncije, ostalo); D – Tip kliničkog okruženja (HC – dom zdravlja, InConc – stomatološka ordinacija s koncesijom, Priv. – privatna ordinacija, PrivSA – privatna ordinacija s ugovorom s HZZO-om, Poly –stomatološka poliklinika, SDM – stomatološki fakultet); E – upotreba povećala i dodatnog osvjetljenja; F – radiografija prije zahvata; G – strojna instrumentacija korijenskih kanala; H – upotreba CBCT-a; I –jednoposjetna endodoncija

Considering that EndoS mostly work in SDM and Poly clinical settings, it is not surprising that these two clinical settings stand out in finding canals (panels D). Panels E show that magnification has a considerable positive effect on finding canals, with additional light being significant for finding the second buccal mesial canal in maxillary molars and two canals in mandibular incisors (the light is especially helpful for practitioners who *always* use magnification). Analyzing the radiograph before the procedure has a strong positive effect, as well as CBCT, except for the second canal in the distal root of mandibular molars for which CBCT was not found significant. The last panel in Figures 6–8 shows that practitioners who perform single-visit ETs more often rate themselves as more successful in finding the additional canals.

Discussion

The number of responses collected (819) is satisfactory compared to a similar global survey within specialist endodontic practice that garnered 543 responses (50). The respondents were unevenly distributed by years of experience (Figure 1A), with a higher percentage of female respondents (F = 69.2%) compared to male respondents (M = 30.8%). The mean years of practice for both sexes were nearly equal (M = 21.7 years, F = 20.4 years). In contrast, a U.S. study reported that 75% of respondents were male, with 56% having more than 20 years of experience (51). Additionally, 80% of the Croatian respondents reported having completed continuing education in endodontics, as explored in greater detail by Sovic et al. in (52).

In Croatia, it is estimated that 27.9% of practitioners perform single-visit ET *often* to *always*. Other studies report varying averages, from 19% single-visit ETs in South Africa (53) to 63% in the United States (51). A recent study indicates that over 70% of endodontists and endodontic postgraduate students in the U.S., Europe, and the Middle East prefer single-visit treatment (50), which in Croatia corresponds to 69.7% of specialists and residents in endodontics performing single-visit ET *often* to *always*.

Single-visit ET in Croatia is associated with increased use of magnification, rubber dam isolation, radiographic imaging, and CBCT. Encouragingly, the more practitioners rely on single-visit ETs, the less frequently they prescribe antibiotics. This is in line with recent findings on postoperative pain, which suggest that "to relieve the patient from postoperative pain where complete debridement is possible, antibiotics can be excluded from the regimen and only analgesics should be prescribed" (33). We did not observe a significant increase in reported pain between visits or immediately after ET, which is consistent with a 2017 systematic review (1). However, this finding does not fully align with the most recent Cochrane review (42), which has found moderate certainty evidence for more patients reporting pain within one week after single-visit ET.

The absence of a significant increase in reported pain in our study may be related to the significantly higher rate of analgesic prescription among those who perform single-visit

tora dentalne medicine (DDM), što je i očekivano. S obzirom na to da se EndoS uglavnom radi u ustanovama SDM i Poly, ne iznenađuje da se ta dva klinička okruženja ističu po uspješnosti u pronalaženju kanala (panel D). Paneli E pokazuju da povećala značajno poboljšavaju otkrivanje kanala, pri čemu dodatno svjetlo statistički znatno pridonosi pronalaženju drugoga bukalnomezijalnog kanala u gornjim kutnjacima i dva kanala u donjim sjekutićima (osobito je korisno za liječnike koji se *uvijek* koriste povećalom). Analiza RTG snimke prije zahvata također snažno pozitivno utječe, kao i CBCT, osim u slučaju drugog kanala u distalnom korijenu donjih kutnjaka za koji CBCT nije bio značajan. Završni paneli na slikama od 6. do 8. pokazuju da se liječnici koji češće primjenjuju jednoposjetni ET sami ocjenjuju uspješnijima u pronalaženju dodatnih kanala.

Rasprava

Broj prikupljenih odgovora (819) zadovoljava u usporedbi sa sličnim svjetskim istraživanjem među specijalistima endodoncije u kojemu su prikupljena 543 odgovora (50). Ispitanici su bili neravnomjerno raspoređeni prema godinama iskustva (slika 1. A), s većim udjelom žena (F = 69,2 %) u odnosu prema muškarcima (M = 30,8 %). Prosječne godine radnog iskustva bile su gotovo jednake za oba spola (M = 21,7 godina, F = 20,4 godine). Suprotno tomu, u jednom američkom istraživanju navodi se da je 75 % ispitanika bilo muškog spola, a 56 % imalo je više od 20 godina radnog iskustva (51). Nadalje, 80 % hrvatskih ispitanika izjavilo je da su završili dodatnu edukaciju iz endodoncije, što je detaljnije istraženo u radu Sovića i suradnika (52).

U Hrvatskoj se procjenjuje da 27,9 % doktora dentalne medicine primjenjuje jednoposjetni ET *često* do *uvijek*. U drugim istraživanjima navedeni su različiti prosjeci: 19 % u Južnoafričkoj Republici (53), a čak 63 % u SAD-u (51). Novo istraživanje pokazuje da više od 70 % specijalista i specijalizanata endodoncije u SAD-u, Europi i na Bliskom istoku preferira liječenje u jednom posjetu (50), što odgovara hrvatskom nalazu od 69,7 % među specijalistima i specijalizantima.

Jednoposjetni ET u Hrvatskoj povezan je s većom upotrebom povećala, koferdama, radiološke dijagnostike i CBCT-a. Ohrabruje da doktori koji češće primjenjuju jednoposjetni ET rjeđe propisuju antibiotike. To je u skladu s nedavnim nalazima o postoperativnoj boli koji sugeriraju da se "za ublažavanje postoperativne boli, kada je moguće potpuno čišćenje kanala, antibiotici mogu izostaviti i propisuju se samo analgetici" (33). Nismo zabilježili značajan porast prijavljene boli između posjeta ni neposredno poslije ET-a, što je u skladu sa sustavnim pregledom iz 2017. (1). No taj nalaz nije potpuno u skladu s najnovijim pregledom Cochrane (42) u kojemu se upozorava na umjerenu razinu dokaza da više pacijenata osjeća bol unutar tjedan dana nakon jednoposjetnog ET-a.

Odsutnost porasta boli u našem istraživanju mogla bi biti povezana s većim udjelom propisivanja analgetika među onima koji primjenjuju jednoposjetni ET — povezanost koja nije zabilježena u drugim zemljama (42). Također smo uo-

ET—an association not previously reported in studies from other countries (42). We also observed a significant increase in reported occurrence of vertical root fractures following treatment, which has not been documented in earlier studies. Although vertical root fractures can result from various factors such as improper design of the post-endodontic coronal restoration, inadequate preparation of the post space, excessive masticatory forces, and other mechanical stresses, the observed increase may also be related to the more frequent use of engine-driven instrumentation, which we found to be more commonly associated with single-visit ET. While engine-driven instruments are generally considered efficient, they have been perceived as having higher risk of root fractures. The stress levels leading to such fractures can vary depending on the instrument design, with stiffer instruments generating greater stress in the apical root dentin, particularly during shaping of curved canals (54). Further studies are needed to explore thoroughly specific types and usage protocols of engine-driven instruments.

Teeth with sinus tracts and periradicular lesions are less frequently treated in a single-visit, particularly in cases involving multiple-rooted teeth. Considering infected canals in teeth with periradicular lesions, with or without sinus tracts, and the highly complex anatomy of the endodontic space, particularly in multi-rooted teeth, it is understandable that clinicians may require additional time to establish the conditions necessary for completing treatment (1,33). Our findings suggest that clinical education and working conditions play a significant role in these decisions.

European Society of Endodontology and American Association of Endodontists support immediate and biologically based treatments, such as pulpectomy or vital pulp therapy, over devitalization methods (55,56). These approaches are associated with better patient outcomes and align with current evidence-based practices. Our respondents, however, reported using mortal amputation *often* in 14.7% and *almost always* to *always* in 4.2%, and mortal extirpation is considerably used especially for molars. We can only speculate that is mainly caused by the lack of time since heath centers in Croatia can be overcrowded. Supporting this claim is one respondent's free text entry "There are so many patients in the health center that I'm just proud I still do endodontics."

One of the primary reasons for endodontic treatment (ET) failure is the clinician's inability to identify all root canals, particularly those that are very small or difficult to locate that may go undetected during the procedure (57). The proportion of practitioners who responded *almost always* to *always* being able to find two canals in specific teeth/roots should be analyzed in light of the average anatomical occurrences of these canals. For instance, Ingle's textbook of endodontics (58) states that 40% of mandibular incisors have two canals, with only 2–3% having separate apical foramina. Gulabivala et al.,(59), reported two coronal canals in the distal root of first permanent mandibular molars in 34.7% of cases, with 28% of them having two apical foramina. Similarly, Gilles (60) and Sert (61) found a second buccal-mesial canal in first permanent maxillary molars in approximately 90% of cases, with 38–39% having separate apical foramina.

čili značajan porast prijavljenih vertikalnih fraktura korijena nakon liječenja, što nije dokumentirano u prijašnjim istraživanjima. Iako vertikalne frakture mogu prouzročiti razni čimbenici — poput nepravilnog dizajna nadogradnje, neadekvatne preparacije prostora za kolčić, pretjeranih žvačnih sila i drugih mehaničkih opterećenja — porast fraktura može biti povezan i s češćom upotrebom strojne instrumentacije koja je češća tijekom jednoposjetnoga ET-a. Dok se strojna instrumentacija smatra učinkovitom, neki je percipiraju kao rizičniju za frakture korijena. Razina stresa ovisi o dizajnu instrumenata, pri čemu čvršći instrumenti stvaraju veći stres u apikalnom dijelu korijena, osobito u slučaju zakrivljenih kanala (54). U budućim istraživanjima trebalo bi detaljnije proučiti vrste i načine korištenja strojne instrumentacije.

Zubi s fistulama i periradikularnim lezijama rjeđe se liječe u jednom posjetu, osobito ako su zubi višekorijenski. S obzirom na infekciju i složenu anatomiju endodontskog prostora — osobito kod višekorijenskih zuba — razumljivo je da liječnicima treba više vremena da postignu uvjete za završetak liječenja (1, 33). Naši rezultati pokazuju da su u tim odlukama važni edukacija i radni uvjeti.

Europsko društvo za endodonciju i Američko udruženje endodontista podupiru izravne i biološki utemeljene metode liječenja, poput pulpektomije ili vitalne pulpne terapije, umjesto metoda devitalizacije (55, 56). Ti pristupi omogućuju bolje ishode liječenja i u skladu su s modernim smjernicama temeljenima na dokazima. No naši ispitanici izjavili su da se *često* koriste mortalnom amputacijom u 14,7 % slučajeva, a *gotovo uvijek* do *uvijek* u 4,2 % slučaja. Mortalna ekstirpacija osobito je zastupljena kod kutnjaka. Možemo samo pretpostaviti da je to posljedica nedostatka vremena jer su domovi zdravlja često preopterećeni. Tome u prilog govori i izjava jednog ispitanika: „Toliko je pacijenata u domu zdravlja da sam ponosna što još uvijek radim endodonciju."

Jedan od glavnih razloga za neuspjeh endodontskog liječenja jest nemogućnost otkrivanja svih kanala, osobito onih uskih i teško dostupnih koji mogu ostati neotkriveni tijekom zahvata (57). Udio ispitanika koji su odgovorili da gotovo uvijek otkriju dva kanala u određenim zubima treba se analizirati u kontekstu stvarne anatomske pojavnosti tih kanala. Primjerice, Ingle navodi da 40 % donjih sjekutića ima dva kanala, a samo 2 do 3 % ima odvojene apikalne otvore (58). Gulabivala i suradnici (59) utvrdili su dva koronarna kanala u distalnom korijenu prvih donjih kutnjaka u 34,7 % slučajeva, a 28 % ima dva apikalna otvora. Slično, Gilles (60) i Sert (61) navode drugi bukalno-mezijalni kanal u prvim gornjim kutnjacima u oko 90 % slučajeva, od kojih od 38 do 39 % ima odvojene apikalne otvore.

Udio ispitanika koji često do *gotovo uvijek* pronalaze drugi bukalno-mezijalni kanal iznosi 50 %, što je znatno manje od 90 % stvarne pojavnosti. Slično, 50 % ispitanika prijavljuje otkrivanje drugoga distalnog kanala u donjem kutnjaku *često* do *gotovo uvijek*, a njegova je stvarna pojavnost 35 %. Kod donjih sjekutića samo 1 % ispitanika izjavljuje da *gotovo uvijek* nalazi dva kanala, a 19 % da ih *često* pronalazi, unatoč 40-postotnoj vjerojatnosti njihove pojavnosti. Ti nalazi pokazuju da se kanali najčešće propuštaju u donjim sjekutićima i gornjim kutnjacima.

The proportion of respondents who reported finding the second buccal-mesial canal *often* to *always* was 50%, compared to 90% likelihood of its presence. Similarly, 50% of respondents reported finding a second distal canal in the mandibular first molar *often* to *almost always* (Figure 2), which corresponds to 35% likelihood of its presence. For mandibular incisors, only 1% of respondents reported *almost always* finding two canals, and 19% reported finding them *often*, compared to a 40% likelihood of their presence. These findings suggest that, despite some subjectivity in responses, root canals are more frequently missed in the mandibular incisors and maxillary molars than in mandibular molars.

Figures 6–8 illustrate that efficiency in finding canals in molars and incisors declines with years of practice (significantly so for females). One might expect efficiency to improve with experience, but reduced eyesight, decreased investment in magnification tools, and a preference for more profitable and routine procedures may contribute to this decline.

Continuing education consistently shows a positive impact on the ability to locate root canals in all 3 Figures (0.53, 0.66, and 0.38 in LO, respectively). This aligns with the integration of courses covering root canal morphology, CBCT, magnification, and other relevant techniques into Croatian endodontic CE programs. Incorporating knowledge of canal anatomy into CE is essential, as the information learned during undergraduate education may become outdated over time (62).

Panel C in Figures 6-8 shows that endodontic specialists (EndoS) self-rate themselves as more adept at finding the mentioned canals, as expected, while general dental practitioners (DDMs) perceive themselves as less efficient. Practitioners at public health centers (HCs) and concessionary clinics (InConc) are less skilled at canal detection, while private clinics (PrivSA) perform significantly worse, except in mandibular molars. The School of Dental Medicine (SDM) excel in all areas except mandibular molars. These disparities are expected, as Poly and SDM settings are more populated with specialists and residents, unlike private clinics, which are primarily staffed by DDMs.

Magnifiers and added light result in a combined positive effect on finding canals in maxillary molars and incisors. Efficiency improves with magnification, and added light is especially beneficial for those who use magnifiers *always*. However, for distal roots in mandibular molars, light does not significantly affect efficiency, although magnifiers still improve outcomes. Pre-procedural radiographs also enhance canal detection (Panel F). Panel H shows that CBCT significantly improves detection of the second buccal-mesial canal in maxillary molars, consistent with findings that it is superior to digital radiography, magnification telescopes, and the naked eye (63). CBCT also positively affects canal detection in mandibular incisors, although no significant effect was observed for the second canal in distal mandibular molar roots.

While the benefits of magnifiers are clear, 63% of respondents reported *never* using them (Table 1). This is likely due to the high cost of magnifiers and their personalized nature,

Slike od 6. do 8. pokazuju da se učinkovitost u pronalaženju kanala u kutnjacima i sjekutićima smanjuje s godinama prakse (osobito kod žena). Iako bi se očekivala veća učinkovitost s iskustvom, moguće objašnjenje su slabiji vid, manja ulaganja u povećala te sklonost prema rutinskim i profitabilnijim zahvatima.

Cjeloživotno obrazovanje dosljedno pozitivno utječe na sposobnost da se pronađu kanali u svim trima slikama (LO = 0,53; 0,66; 0,38), što se može povezati s uvođenjem tečajeva o morfologiji korijenskih kanala, CBCT-u, povećalima i drugim relevantnim tehnikama u hrvatske programe cjeloživotnog obrazovanja. Znanje o anatomiji kanala ključno je jer informacije stečene tijekom studija mogu s vremenom zastarjeti (62).

Panel C u slikama od 6. do 8. pokazuje da se specijalisti endodoncije (EndoS) sami procjenjuju uspješnijima u pronalaženju spomenutih kanala, a opći doktori dentalne medicine (DDM) percipiraju se kao manje uspješni. Liječnici u domovima zdravlja (HC) i koncesijskim ordinacijama (InConc) rjeđe otkrivaju kanale, dok privatne ordinacije (PrivSA) ostvaruju značajno lošije rezultate, osim kad je riječ o donjim kutnjacima. Stomatološki fakulteti (SDM) ističu se u svim regijama, osim kod donjih kutnjaka. Te su razlike očekivane jer su SDM i Poly najčešće popunjeni specijalistima i specijalizantima, za razliku od privatnih ordinacija koje uglavnom vode doktori dentalne medicine.

Povećala i dodatno svjetlo zajedno poboljšavaju otkrivanje kanala u gornjim kutnjacima i sjekutićima. Učinkovitost raste s uporabom povećala, a svjetlo je osobito korisno kod onih koji se uvijek koriste povećalima. No kod distalnih korijena donjih kutnjaka svjetlo nema značajni učinak, iako povećala i dalje poboljšavaju ishod. Snimke prije zahvata također pomažu u otkrivanju kanala (Panel F). Panel H pokazuje da CBCT značajno poboljšava otkrivanje drugoga bukalnomezijalnog kanala u gornjim kutnjacima, što je u skladu s nalazima da je CBCT superioran u odnosu prema digitalnoj radiografiji, povećalima i golom oku (63). CBCT pozitivno utječe i na otkrivanje kanala u donjim sjekutićima, iako nije zabilježen značajan učinak za drugi kanal u distalnim korijenima donjih kutnjaka.

Iako su koristi od upotrebe povećala očite, 63 % ispitanika izjavilo je da ih nikada ne upotrebljava (tablica 1.). To se vjerojatno može objasniti visokom cijenom i personaliziranom prirodom povećala koja onemogućuje dijeljenje među liječnicima u istoj ordinaciji. Neki ih možda izbjegavaju i zbog osobnog uvjerenja da štete vidu.

Na kraju treba spomenuti ograničenja ovog istraživanja. Glavno ograničenje jest nemogućnost usporedbe s drugim svjetskim istraživanjima zato što nema standardiziranih upitnika. Razvoj harmoniziranog upitnika za međunarodna istraživanja znatno bi unaprijedio buduće usporedbe i olakšao usklađivanje endodontske prakse među državama. Također, budući da je riječ o anketi, nije moguće izravno povezati praksu s kliničkim ishodima.

which prevents sharing between clinicians in the same clinic. Some practitioners may also avoid magnifiers due to personal beliefs that they might negatively impact eyesight.

Finally, the limitations of this study should be acknowledged. One major limitation is the difficulty in comparing this study with others globally due to the lack of standardized questionnaires. Developing a harmonized questionnaire for international studies would greatly enhance future comparisons and facilitate efforts to align endodontic practices across countries. Additionally, as this study is based on a questionnaire, it cannot directly correlate practices with clinical outcomes.

Conclusion

This study presents the first investigation into single-visit ET practices in Croatia, revealing that 27.9% of practitioners frequently perform single-visit ETs. Factors such as the use of advanced equipment (magnifiers, rubber dam, radiography, CBCT), clinical education, and workplace setting, significantly influence the adoption of single-visit ETs. While single-visit ET is associated with reduced antibiotic prescriptions, it also correlates with self-reported higher rates of vertical tooth fractures and increased analgesic prescription.

Practitioners who more frequently perform single-visit ETs also rate themselves higher in the ability to detect additional canals—a skill positively influenced by the use of radiography and magnification tools. These findings highlight the importance of continuing education that emphasizes vital pulp therapy and supports the integration of advanced technologies to enhance endodontic outcomes.

The results offer valuable insights into how clinical practices, available resources, and educational background interact to influence treatment approaches and perceived outcomes. Further research is needed to explore the potential implications of single-visit procedures, particularly the causes behind the increased prescription of analgesics and the possible rise in treatment-induced vertical fractures.

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Author's contribution: J.S. – conceptualization, investigation, writing; **S.Š.** – conceptualization, investigation, methodology, project administration, supervision, writing; I.B. – validation, writing; **J.M.** – investigation, methodology; **I.T.** – conceptualization, data curation; formal analysis; investigation, project administration, methodology, software, visualization, supervision, writing.

Zaključak

Ovo je prvo istraživanje o praksi u primjeni endodontske terapije u jednom posjetu (ET) u Hrvatskoj koje je pokazalo da 27,9 % doktora dentalne medicine često primjenjuje ET u jednom posjetu. Čimbenici poput uporabe napredne opreme (povećalo, koferdam, radiografija, CBCT), stručnog usavršavanja i radnog okruženja znatno utječu na usvajanje toga pristupa. Iako je ET u jednom posjetu povezan s manjom učestalošću propisivanja antibiotika, istodobno je povezan s većom samoprijavljenom učestalošću vertikalnih fraktura zuba i povećanim propisivanjem analgetika.

Ispitanici koji češće primjenjuju ET u jednom posjetu također su se samoprocijenili uspješnijima u pronalaženju dodatnih kanala — vještina koja je pozitivno povezana s uporabom radiografije i povećanja. Dobiveni rezultati ističu važnost trajnoga stručnog usavršavanja koje stavlja naglasak na vitalnu pulpnu terapiju i podupire uvođenje naprednih tehnologija kako bi se poboljšali ishodi endodontske terapije.

Rezultati pružaju vrijedne uvide u to kako klinička praksa, dostupni resursi i obrazovna podloga zajedno utječu na odabir terapije i percipirane ishode. Potrebna su daljnja istraživanja kako bi se istražile moguće posljedice provođenja ET-a u jednom posjetu, osobito uzroci češćeg propisivanja analgetika i potencijalni porast vertikalnih fraktura prouzročenih terapijom.

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Doprinos autora: J. S. – konceptualizacija, istraživanje, pisanje; **S. Š.** – konceptualizacija, istraživanje, metodologija, upravljanje projektom, nadzor, pisanje; **I. B.** – validacija, pisanje; **J. M.** – istraživanje, metodologija; **I. T.** – konceptualizacija, obrada podataka, formalna analiza, istraživanje, upravljanje projektom, metodologija, softver, vizualizacija, nadzor, pisanje.

Sažetak

Cilj: Analizirati provođenje jednoposjetne endodontske terapije u Hrvatskoj zajedno s uspjehom u pronalaženju korijenskih kanala te ispitati njihovu povezanost s prijavljenom postoperativnom boli, propisivanjem lijekova, korištenjem povećala, koferdama, radiološkom provjerom prije zahvata, kompjutoriziranom tomografijom s konusnim snopom (CBCT) i upotrebom strojne instrumentacije. **Materijali i metode:** Strukturirani upitnik poslan je e-poštom svim doktorima dentalne medicine u Hrvatskoj, a analizirano je 819 odgovora, što odgovara procijenjenoj stopi odgovora od 27 %. Statistička analiza obuhvaćala je deskriptivnu analizu i regresijsko modeliranje. **Rezultati:** Među hrvatskim stomatolozima njih 27,9 % često primjenjuje jednoposjetnu endodontsku terapiju. Stomatolozi (muškarci), oni s dodatnim edukacijama i većim iskustvom, specijalisti endodoncije te oni zaposleni u poliklinikama ili akademskim ustanovama, češće primjenjuju taj pristup. Također je zabilježena pozitivna povezanost s korištenjem naprednih dijagnostičkih i terapijskih alata (npr., povećalo, koferdam, CBCT) te smanjenim propisivanjem antibiotika. No ta praksa povezana je s češćim propisivanjem analgetika i većim brojem prijavljenih vertikalnih fraktura zuba. Stomatolozi se rjeđe koriste jednoposjetnom terapijom kad je riječ o zubima s više korijena te u slučaju sa sinus-traktom ili periradikularnim lezijama. Nadalje, stomatolozi koji češće primjenjuju jednoposjetnu terapiju ocjenjuju sebe uspješnijima u pronalaženju dodatnih kanala, što je pozitivno povezano s korištenjem radiografije i povećala. Cjeloživotno obrazovanje također pozitivno utječe na sposobnost da se pronađu kanali, iako ta sposobnost opada s godinama kliničkog iskustva. **Zaključci:** Primjena jednoposjetne endodontske terapije u Hrvatskoj ovisi o edukaciji, iskustvu i dostupnosti suvremene opreme. Iako ovaj pristup ima prednosti poput smanjenoga propisivanja antibiotika, potrebna je dodatna klinička pažnja te istraživanja zbog moguće povezanosti s komplikacijama poput vertikalnih fraktura zuba i povećane uporabe analgetika. Sposobnosti da se pronađu kanali pozitivno su povezane s cjeloživotnim obrazovanjem. Ti nalazi ističu važnost edukacije i dostupnost resursa u postizanju optimalnih endodontskih ishoda.

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