ACTA
STOMATOLOGICA
CROATICA
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Acta stomatol Croat. 2024;58(4):382-393.
DOI: 10.15644/asc58/4/7

ORIGINAL SCIENTIFIC PAPER
IZVORNI ZNANSTVENI RAD

Jure Martinić[1], Lidija Gavić[2], Antonija Tadin[3], Ante Mihovilović[4], Petra Stazić[4], Daniel Jerković[4]

The Impact of Surgical Trauma, BMI and Analgesics Intake on Postoperative Pain after Periapical Surgery in the Anterior Maxillary Region

Utjecaj kirurške traume, indeksa tjelesne mase i konzumacije analgetika na postoperativnu bol poslije periapikalnoga kirurškog zahvata u prednjoj regiji gornje čeljusti

[1] Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
Studij dentalne medicine Medicinskog fakulteta Sveučilišta u Splitu, Hrvatska
[2] Department for Oral Medicine and Periodontology, Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
Katedra za oralnu medicinu i parodontologiju Studija dentalne medicine Medicinskog fakulteta Sveučilišta u Splitu, Hrvatska
[3] Department of Restorative Dental Medicine and Endodontics, Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
Katedra za restaurativnu dentalnu medicinu i endodonciju Studija dentalne medicine Medicinskog fakulteta Sveučilišta u Splitu, Hrvatska
[4] Department of Oral and Maxillofacial Surgery, Clinical Hospital Centre Split, Split, Croatia
Zavod za maksilofacijalnu i oralnu kirurgiju Kliničkoga bolničkoga centra Split, Hrvatska

Abstract

Objective: To investigate whether factors associated with surgical trauma influence postoperative pain in the first postoperative week. **Study design:** The study included 30 healthy, non-smoker adults of both genders, with an indication for periapical surgery on a single tooth in the upper anterior region, no history of prior surgery, no allergies to lidocaine with adrenaline or ibuprofen, no acute inflammation or pain, and a PAI of 3, 4, or 5. A single surgical team treated all patients by following the same surgical protocol. In the first postoperative week, each patient received the same postoperative instructions and a pain questionnaire to record pain intensity and analgesic consumption. **Results:** The highest pain intensity was recorded on the day after surgery, while the highest analgesics consumption was recorded on the day of surgery. Participants with a BMI correlated positively with the amount of analgesics taken in the postoperative period ($P<0.05$). The duration of the operation correlated negatively with the intensity of pain and the consumption of analgesics after the operation ($P<0.05$). The volume, height and width of the alveolar bone defect after the operation did not significantly influence the intensity of pain and the consumption of analgesics in the postoperative period ($P>0.05$). The presence of a fistula correlated negatively with analgesic consumption after surgery ($P<0.05$), while preoperative fenestration correlated negatively with the intensity of postoperative pain ($P<0.05$). **Conclusion:** Patients with a preoperative fistula and fenestration reported less pain and lower analgesic consumption in the postoperative period. These results indicate a potential relationship between the severity of postoperative pain and the degree of surgical trauma.

Received: September 1, 2024
Accepted: December 1, 2024

Address for correspondence
Daniel Jerković, DMD, Ph.D., Assistant Professor
Clinical Hospital Centre Split,
University of Split School of Medicine
Department of Oral and Maxillofacial Surgery, Split, Croatia,
Phone: +385 91 755 9980
dajerkovic@kbsplit.hr

MeSH Terms: Apicoectomy; Oral Surgery; Postoperative Pain; Analgesia
Author Keywords: Apicoectomy; Oral Surgery; Postoperative Pain; Analgesia

Jure Martinić - https://orcid.org/0009-0003-6003-0033
Lidija Gavić - https://orcid.org/0000-0003-2882-934X
Antonija Tadin - https://orcid.org/0000-0002-5365-9816
Ante Mihovilović - https://orcid.org/0009-0008-8499-1089
Petra Stazić - https://orcid.org/0000-0002-8285-9278
Daniel Jerković - https://orcid.org/0000-0001-5624-1944

Introduction

Periapical surgery is a surgical procedure that is recommended when non-surgical treatment of the tooth is unsuccessful or unfeasible (1). Like any surgical procedure, periapical surgery can lead to certain complications which include: pain, swelling, bruising, bleeding and infection (2, 3). Swelling that occurs after surgery is due to trauma to the surgical site. The trauma causes tissue damage manifested by hyperemia, vasodilation, increased capillary permeability with fluid accumulation in the interstitium, and migration of mono-

Uvod

Periapikalni kirurški zahvat preporučuje se kada je nekirurško liječenje zuba neuspješno ili neizvedivo (1). Kao i svaki kirurški zahvat, tako i ovaj može prouzročiti određene komplikacije, uključujući bol, oteklinu, hematome, krvarenje i infekciju (2, 3). Oteklina koja se pojavljuje poslije operacije rezultat je traume na mjestu kirurškoga zahvata. Trauma uzrokuje oštećenje tkiva koje se očituje hiperemijom, vazodilatacijom, povećanom propusnošću kapilara s nakupljanjem tekućine u intersticiju te migracijom monocita i granulocita

cytes and granulocytes (4). Swelling after periapical surgery is most evident between the first and second day after surgery, and it gradually decreases thereafter (5-7).

According to the International Association for the Study of Pain (IASP), pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage and is therefore entirely subjective (8, 9). Postsurgical pain is acute and results from the nociceptive stimulation of the surgical procedure, tissue trauma and swelling, stretching of ligaments and generally from all situations related to surgical manipulation. In general, pain after periapical surgery is of short duration, with maximum intensity occurring on the day of surgery or the following day (3, 5-7, 10-13).

There are numerous preoperative, intraoperative, and postoperative factors that can affect postoperative complications. These factors include age, gender, oral hygiene, smoking, systemic diseases as well as factors related to surgical trauma such as flap shape and size, location and number of teeth operated on, presence of fistula, presence of fenestration, duration of surgery, surgical technique and size of alveolar bone defect after surgery (1, 3, 12, 13).

The main aim of this study was to investigate the influence of factors associated with surgical trauma on the incidence and intensity of postoperative pain after periapical surgery. The null hypothesis of the study was that there was no difference in the occurrence and intensity of pain in patients postoperatively, regardless of factors associated with surgical trauma.

Subjects and Methods

Study design

This cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery, University Hospital of Split and was carried out from November 2022 to May 2023. It was approved by the Ethics Committee of the University Hospital of Split and was performed in accordance to all ethical principles defined by the Helsinki Declaration of the World Medical Association. All participants included in the study signed an informed consent form to participate in the study and were timely informed about its purpose and objectives.

Subjects

This study included 30 participants. Participation in the clinical research was voluntary. Only participants who had an indication for periapical surgery and who fulfilled the inclusion criteria were included in this study. The inclusion criteria were as follows: healthy individuals of both genders (ASA I); adults (18 years or older) with an indication for periapical surgery on only one tooth; individuals with no known allergies to lidocaine with adrenaline and ibuprofen; without signs of acute inflammation (abscess) and pain in the surgical area, non-smokers; the periapical index (PAI) 3, 4, and 5; teeth in the upper anterior region; without significant bone loss. If antibiotics were taken, the period between the last antibiotic intake and the surgical procedure had to be at least 30 days.

(4). Oteklina poslije periapikalnoga zahvata najizraženija je između prvoga i drugoga dana poslije operacije, a zatim se postupno smanjuje (5 – 7).

Prema Međunarodnom udruženju za proučavanje boli (IASP), bol je definirana kao neugodno osjetno i emocionalno iskustvo povezano s aktualnim ili potencijalnim oštećenjem tkiva ili opisano u terminima takvog oštećenja, te je zato potpuno subjektivna (8, 9). Postoperativna bol je akutna i rezultat je nociceptivne stimulacije tijekom kirurškog postupka, traume tkiva i oticanja, rastezanja ligamenata te općenito svih situacija povezanih s kirurškom manipulacijom. Općenito, bol poslije periapikalnoga zahvata kratka je, s maksimalnim intenzitetom na dan operacije ili sljedeći dan (3, 5 – 7, 10 – 13).

Mnogobrojni preoperativni, intraoperativni i postoperativni čimbenici mogu utjecati na postoperativne komplikacije, primjerice, dob, spol, oralna higijena, pušenje, sistemske bolesti te čimbenici povezani s kirurškom traumom poput oblika i veličine režnja, lokacije i broja operiranih zuba, prisutnosti fistule, fenestracije, trajanja operacije, kirurške tehnike i veličine koštanoga defekta poslije operacije (1, 3, 12, 13).

Glavni cilj ovog istraživanja bio je ispitati utjecaj čimbenika povezanih s kirurškom traumom na učestalost i intenzitet postoperativne boli poslije periapikalnoga kirurškog zahvata. Nulta hipoteza istraživanja bila je da kod pacijenata ne postoji razlika u pojavi i intenzitetu boli poslije operacije, bez obzira na čimbenike povezane s kirurškom traumom.

Ispitanici i metode

Dizajn istraživanja

Ovo presječno istraživanje provedeno je u Zavodu za oralnu i maksilofacijalnu kirurgiju Kliničkoga bolničkoga centra Split od studenoga 2022. do svibnja 2023. Odobrilo ga je Etičko povjerenstvo Kliničkoga bolničkoga centra Split i provedeno je u skladu sa svim etičkim načelima definiranima Helsinškom deklaracijom Svjetske medicinske udruge. Svi ispitanici uključeni u istraživanje potpisali su informirani pristanak za sudjelovanje te su pravodobno obaviješteni o svrsi i ciljevima istraživanja.

Ispitanici

U istraživanje je bilo uključeno 30 ispitanika. Sudjelovanje je bilo dobrovoljno i bili su uključeni samo ispitanici s indikacijom za periapikalni kirurški zahvat koji su zadovoljavali kriterije za sudjelovanje. Kriteriji za uključivanje bili su: zdrave osobe obaju spolova (ASA I), odrasli (18 godina i stariji) s indikacijom za periapikalni zahvat na samo jednom zubu, osobe bez poznatih alergija na lidokain s adrenalinom i ibuprofen, bez znakova akutne upale (apsces) i boli u području operacije, nepušači, periapikalni indeks (PAI) 3, 4 i 5, zubi u prednjem dijelu gornje čeljusti i bez značajnoga gubitka kosti. Ako su ispitanici uzimali antibiotike, razdoblje između posljednje doze i kirurškoga zahvata moralo je biti najmanje 30 dana.

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The exclusion criteria were as follows: individuals who had taken medications 7 days before the surgical procedure or antibiotics 30 days before the surgical procedure; pregnancy; breastfeeding; individuals with congenital or acquired pathological conditions (ASA II, III, IV, V, VI); abuse of analgesics and/or opioids and narcotics; acute inflammation; advanced periodontitis; smokers; individuals who do not have an indication for periapical surgery; patients who already had periapical surgery; the periapical index (PAI) 1 and 2.

Surgical protocol

All patients were treated according to the same surgical protocol and by the same surgical team. Prior to surgery, participants underwent a comprehensive medical and dental history as well as clinical and radiological examination. In addition, a preoperative rinse with the antiseptic mouthwash Hexetidin (BELOSEPT, BELUPO, and Koprivnica, Croatia) was performed to reduce the number of bacteria in the surgical field. Local anesthesia was administered with 2 % lidocaine with 1:100 000 epinephrine (lidocaine, BELUPO). A single 2 ml ampoule was used for all participants. The incision was made using the surgical scalpel No. 15 (Carl Martin GmbH, 42657 Solingen, Germany), and the full-thickness semilunar Partsch flap was elevated using a Willinger periosteal elevator (Carl Martin GmbH, 42657 Solingen, Germany). The osteotomy was performed in the buccal bone using a round bur (REF: H267104016, H141104010, Komet Dental, Brasseler Gmbh & Co, Lemgo, Germany) at a high speed of 40,000 rpm under continuous sterile saline irrigation to expose the root apex. Some patients already had buccal fenestration, which was extended if necessary. All pathological changes, granulomatous tissue and foreign bodies were removed with curettes (Langer curette 3MY4, Deppeler, Rolle, Switzerland). After debridement of a lesion, a root was resected perpendicular to the longitudinal axis of the root using a fissure bur (D254.314.012 PU 5, Komet Dental, Brasseler Gmbh & Co, and Lemgo, Germany). Approximately 3 mm of the apical part of the root was removed in all patients. The root end was prepared with an intra-micro head (Intra Micro Head L22, KaVo, Biberach, Germany) and a round bur (0.549.0062, KaVo, Biberach, Germany) not less than 3 mm into the root canal following the long axis of the tooth. Mineral trioxide aggregate (ENDO-EZE MTA FLOW, Ultradent Products, South Jordan, USA) was used as root–end filling material and placed in the root–end preparation with disposable plastic applicators after adequate hemostasis. Prior to wound closure, the periapical bone defect was rinsed with a sterile saline solution to remove residual material and bone debris. In addition, the volume of the alveolar bone defect was measured by filling the bone cavity with sterile water using an insulin syringe (BRAUN Omnifix® - F Luer Solo 1 ml, Bad Arolsen, Germany), while the height and width of the vestibular bone defect was measured using a periodontal probe (UNC 15-mm, Devemed GmbH, Tuttlingen, Germany). The flaps were repositioned with simple interrupted sutures (Vicryl 4/0 Johnson and Johnson; Somerville, NJ).

After surgery, patients were given verbal and written rou-

Kriteriji za isključivanje bili su: osobe koje su uzimale lijekove 7 dana prije kirurškoga zahvata ili antibiotike 30 dana prije kirurškoga zahvata, trudnoća, dojenje, osobe s kongenitalnim ili stečenim patološkim stanjima (ASA II, III, IV, V, VI), zloupotreba analgetika i/ili opioida i narkotika, akutna upala, uznapredovali parodontitis, pušači, osobe bez indikacije za periapikalni kirurški zahvat, pacijenti koji su već imali periapikalni zahvat, periapikalni indeks (PAI) 1 i 2.

Kirurški protokol

Ispitanici su tretirani prema istome kirurškom protokolu i to je učinio isti kirurški tim. Prije operacije svima je uzeta detaljna medicinska i stomatološka anamneza te je obavljen klinički i radiološki pregled. Uz to, provedeno je preoperativno ispiranje antiseptičkim sredstvom Hexetidin (BELOSEPT, BELUPO, Koprivnica, Hrvatska) da bi se smanjio broj bakterija u operacijskom području. Lokalna anestezija obavljena je 2-postotnim lidokainom s 1 : 100 000 epinefrina (lidokain, BELUPO). Za sve ispitanike korištena je jedna ampula od 2 mL. Incizija je učinjena kirurškim skalpelom br. 15 (Carl Martin GmbH, 42657 Solingen, Njemačka), a semilunarni Partschov režanj pune debljine podignut je s pomoću elevatora prema Willingeru (Carl Martin GmbH, 42657 Solingen, Njemačka). Kako bi se prikazao vršak korijena zuba, osteotomija je obavljena na vestibularnoj kosti s pomoću okruglog svrdla (REF: H267104016, H141104010, Komet Dental, Brasseler Gmbh & Co, Lemgo, Njemačka) s maksimalnom brzinom okretaja od 40 000 r/min. i konstantnim hlađenjem. Neki pacijenti već su imali vestibularnu fenestraciju koja je, ako je bilo potrebno, proširena. Svi patološki procesi, granulomatozno tkivo i strani predmeti uklonjeni su kiretama (Langer kireta 3MY4, Deppeler, Rolle, Švicarska). Nakon debridmana lezije, korijen je reseciran okomito na longitudinalnu os korijena fisurnim svrdlom (D254.314.012 PU 5, Komet Dental, Brasseler Gmbh & Co, Lemgo, Njemačka). Svim ispitanicima uklonjeno je približno 3 mm apikalnoga dijela korijena. Retrogradni kavitet učinjen je kolječnikom s mikroglavom (Intra Micro Head L22, KaVo, Biberach, Njemačka) i okruglim svrdlom (0.549.0062, KaVo, Biberach, Njemačka) minimalno 3 mm prateći longitudinalnu os zuba. Mineralni trioksid agregat (ENDO-EZE MTA FLOW, Ultradent Products, South Jordan, SAD) korišten je kao materijal za retrogradno punjenje. Poslije postizanja hemostaze, MTA je apliciran s pomoću jednokratnih plastičnih aplikatora. Prije reponiranja režnja periapikalni koštani defekt ispran je fiziološkom otopinom da bi se uklonio višak materijala i koštani ostatci. Uz to, volumen alveolarnoga koštanog defekta izmjeren je fiziološkom otopinom s pomoću inzulinske štrcaljke (BRAUN Omnifix® - F Luer Solo 1 ml, Bad Arolsen, Njemačka), a visina i širina vestibularnoga koštanog defekta izmjerena je parodontološkom sondom (UNC 15-mm, Devemed GmbH, Tuttlingen, Njemačka). Na kraju kirurškoga zahvata režanj je vraćen u početni položaj te učvršćen pojedinačnim šavovima (Vicryl 4/0 Johnson i Johnson; Somerville, NJ).

tine postsurgical instructions that were the same for all of them. All participants were allowed to take only 400 milligrams ibuprofen tablets (Neofen forte 400 mg, Belupo, Koprivnica, Croatia). All participants who used other analgesics and other pharmacological agents were excluded. No antibiotics were prescribed. For rinsing the oral cavity, participants used a 0.12 % chlorhexidine aqueous solution twice a day for 1 minute over period of 7 days. Participants were informed to contact the surgeon if they experienced severe pain, persistent swelling, fever, bleeding, or any other concerns after the surgical procedure.

Postoperatively, all participants were given a questionnaire with questions about the presence and intensity of pain and the amount of analgesics taken. Pain intensity was measured using a visual analogue scale (VAS). The scale was a 10 cm long line with one end labelled as 'no pain' (0 cm) and the other end as 'worst possible pain' (10 cm). Participants brought the completed questionnaire to the follow-up appointment 7 days after surgery, where wound healing was assessed and sutures were removed. If a secondary infection developed, participants were prescribed antibiotic therapy. Participants were excluded from the study if a secondary infection had developed.

Statistical analysis

All collected data from properly and completely filled questionnaires were entered into a statistical table using Microsoft Office Excel 2019 (Microsoft Corporation, Redmond, Washington, USA). The SPSS software package (IBM Corp., Armonk, New York) was used for data analysis. Descriptive statistical methods were employed to calculate basic statistical values. The normality of distribution was estimated using the Kolmogorov-Smirnov test, and the results were compared using the Mann-Whitney U test for independent samples. Quantitative variables were presented as either mean ± standard deviation or median and interquartile range, while qualitative variables were presented as whole number and percentage. The Spearman correlation coefficient was utilized to assess the relationships between the variables under study and socio-demographic characteristics. The level of statistical significance was set at $P<0.05$ for all tests.

The minimum sample size was calculated according to the results from the study of Chonge et al. investigating postoperative pain after root-end resection and filling. A power analysis was conducted, with the effect of Cohen's size d=0.995 of mentioned study, 80% power, and 95% confidence interval, minimum total sample size was 28. A sample of 30 per study was chosen to compensate for a possible withdrawal, loss to follow up or exclusion of participants after enrolment due to adverse effects (8).

Results

The study included 30 participants, 16 (53.3 %) men and 14 (46.7 %) women. The mean age was 37.00 ± 12.47 years, the youngest participant was 20 years old, and the oldest was 79 years old. The participant's body mass index (BMI) ranged from 19.47 to 29.21, with a mean value of

Poslije operacije ispitanici su dobili usmene i pisane rutinske postoperativne upute koje su bile jednake za sve. Svi su smjeli uzimati samo tablete ibuprofena od 400 miligrama (Neofen forte 400 mg, Belupo, Koprivnica, Hrvatska). Oni koji su se koristili drugim analgeticima ili drugim farmakološkim sredstvima isključeni su iz istraživanja. Antibiotici se nisu propisivali. Za ispiranje usne šupljine ispitanici su upotrebljavali 0,12-postotnu vodenu otopinu klorheksidina dva puta na dan tijekom 1 minute u razdoblju od 7 dana. Također im je rečeno da se obrate kirurgu ako osjete jaku bol, uoče perzistirajuću oteklinu, dobiju vrućicu ako se pojavi krvarenje ili bilo što drugo zabrinjavajuće poslije kirurškoga zahvata.

Postoperativno svi su ispitanici dobili upitnik s pitanjima o prisutnosti i intenzitetu boli te o količini uzetih analgetika. Intenzitet boli mjeren je vizualnom analognom ljestvicom (VAS). Ljestvica je bila linija duga 10 cm, na jednom kraju sa znakom 'bez boli' (0 cm), a na drugome je pisalo 'najgora moguća bol' (10 cm). Ispitanici su donijeli popunjeni upitnik na kontrolni pregled 7 dana poslije operacije, na kojem se procijenilo cijeljenje rane te su uklonjeni šavovi. U slučaju sekundarne infekcije, ispitanicima je propisana antibiotička terapija i bili su isključeni iz istraživanja.

Statistička analiza

Svi prikupljeni podatci iz pravilno i potpuno ispunjenih upitnika uneseni su u statističku tablicu Microsoft Office Excela 2019 (Microsoft Corporation, Redmond, Washington, SAD). Za analizu podataka korišten je SPSS softverski paket (IBM Corp., Armonk, New York). Primijenjene su deskriptivne statističke metode za izračun osnovnih statističkih vrijednosti. Normalnost distribucije procijenjena je Kolmogorov-Smirnovljevim, testom, a rezultati su uspoređivani korištenjem Mann-Whitneyjeva U testa za nezavisne uzorke. Kvantitativne varijable predstavljene su kao srednja vrijednost ± standardna devijacija ili medijan i interkvartilni raspon, a kvalitativne varijable prikazane kao cijeli broj i postotak. Spearmanov koeficijent korelacije korišten je za procjenu odnosa između varijabli u istraživanju i socijalno-demografskih karakteristika. Razina statističke značajnosti postavljena je na $P < 0,05$ za sve testove.

Minimalna veličina uzorka izračunata je prema rezultatima istraživanja Chongea i suradnika koji su istraživali postoperativnu bol poslije resekcije vrška korijena i retrogradnog punjenja. Provedena je analiza snage s učinkom Cohenove veličine d = 0,995 iz spomenutog istraživanja, 80 % snage i 95-postotnim intervalom pouzdanosti, a minimalna ukupna veličina uzorka bila je 28. Odabran je uzorak od 30 ispitanika kako bi se kompenziralo moguće odustajanje, nedolazak na kontrolni pregled ili isključivanje ispitanika zbog nuspojava (8).

Rezultati

U istraživanje je bilo uključeno 30 ispitanika – 16 muškaraca (53,3 %) i 14 žena (46,7 %). Prosječna dob bila je 37,00 ± 12,47 godina, najmlađi ispitanik imao je 20 godina, a najstariji 79. Indeks tjelesne mase (BMI) ispitanika kretao se od 19,47 do 29,21, s prosječnom vrijednošću od 24,59 ±

24.59 ± 2.47. The duration of the operation ranged from 13 to 27 minutes, with an average of 19.87 ± 3.88 minutes. The majority of participants, 16 (53.3%), had a periapical index (PAI) of grade 4, 11 (36.7%) participants had a PAI of grade 5, while 3 participants (10%) had a PAI of grade 3.

Postoperative pain values on VAS scale reported at different time intervals are shown in Figure 1. The mean pain score at 4 hours after the surgery was 2.13, and at 12 hours after the surgery, it was 3.53. Furthermore, the mean pain score for the first postoperative day was 3.63, and for the second day, it was 2.90. There were differences in patients' pain between the first 24 hours after surgery, and from the first to the seventh postoperative day. In the first 24 hours, a difference in pain was observed between the pain measured in the second hour compared to the pain measured in the sixth hour after surgery (P=0.002), the twelfth hour (P≤0.001), and the 24th hour after surgery (P≤0.001). During the days following the surgical procedure, a significant difference in pain was observed between the second day after surgery and the fourth, fifth, sixth, and seventh days after surgery (P≤0.001). Furthermore, a difference in pain was observed between the third day after surgery compared to the fifth (P≤0.001), sixth (P=0.009), and seventh (P=0.018) days after surgery, as well as the fourth and seventh days after surgery (P=0.002).

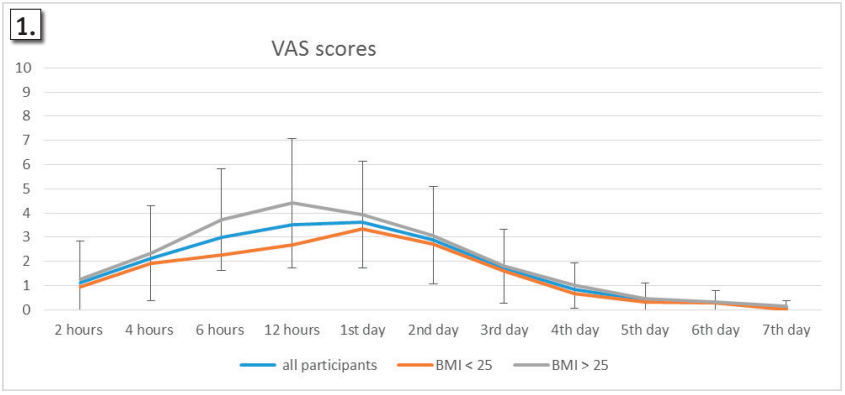
Figure 2 presents the quantities of postoperative analgesics consumed. On the day of the surgery, participants consumed the highest number of analgesics. The median of the total number of taken analgesics over the seven postoperative days was 6 (IQR = 3.5, and $\bar{x}$ = 5.57). The median time of taking the first analgesic was 5 hours from the surgery (IQR = 3, and $\bar{x}$ = 5.43).

2,47. Trajanje operacije variralo je od 13 do 27 minuta, prosječno od 19,87 ± 3,88 minuta. Većina ispitanika, njih 16 (53,3 %), imala je periapikalni indeks (PAI) 4. stupnja, kod 11 njih (36,7 %) zabilježen je PAI 5. stupnja, a kod 3 (10 %) je bio 3. stupnja.

Vrijednosti postoperativne boli na VAS ljestvici zabilježene u različitim vremenskim intervalima prikazane su na slici 1. Prosječna vrijednost boli 4 sata poslije operacije iznosila je 2,13, a 12 sati poslije operacije 3,53. Nadalje, prosječna vrijednost boli prvoga postoperativnog dana bila je 3,63, a drugoga dana 2,90. Uočene su razlike u boli pacijenata unutar prva 24 sata poslije operacije i između prvoga i sedmoga postoperativnog dana. Tijekom prva 24 sata razlika u boli primijećena je između boli izmjerene u drugom satu u usporedbi s boli izmjerenom u šestom satu poslije operacije (P = 0,002), dvanaestom satu (P ≤ 0,001) i dvadeset i četvrtom satu poslije operacije (P ≤ 0,001). Idućih dana značajna razlika u boli zabilježena je između drugoga dana poslije operacije i četvrtoga, petoga, šestoga i sedmoga dana poslije operacije (P ≤ 0,001). Razlika u boli također je primijećena između trećega dana poslije operacije u usporedbi s petim (P ≤ 0,001), šestim (P = 0,009) i sedmim (P = 0,018) danom poslije operacije, te između četvrtoga i sedmoga dana poslije operacije (P = 0,002).

Na slici 2. označene su količine konzumiranih analgetika postoperativno. Na dan operacije ispitanici su uzeli najviše analgetika. Medijan ukupnoga broja uzetih analgetika tijekom sedam postoperativnih dana bio je 6 (IQR = 3,5, $\bar{x}$ = 5,57). Medijan vremena uzimanja prvog analgetika bio je 5 sati poslije operacije (IQR = 3, $\bar{x}$ = 5,43).

S obzirom na spol ispitanika, jedina zabilježena razlika odnosila se na vrijeme uzimanja prvoga analgetika



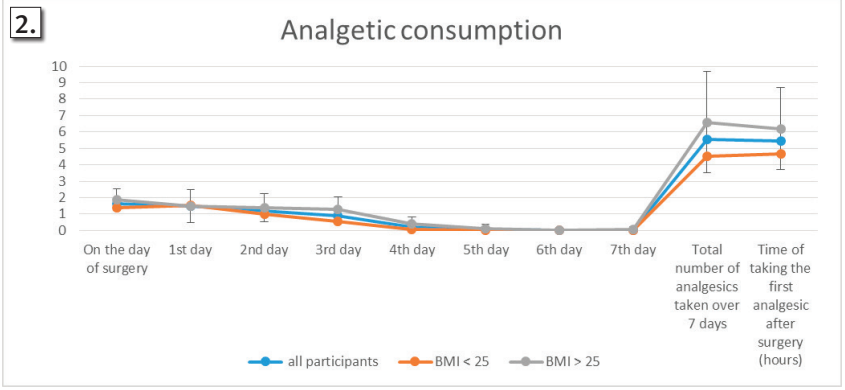


Figure 1 Mean VAS scores for postoperative pain
Slika 1. Srednji VAS rezultati za postoperativnu bol
Figure 2 Consumption of analgesics after surgery (mean score)
Slika 2. Potrošnja analgetika nakon operacije (srednji rezultat)

Table 1 The impact of preoperative presence of fenestration or fistula and volume of the alveolar bone defect on postoperative pain
Tablica 1 Utjecaj prijeoperacijske prisutnosti fenestracije ili fistule i volumena defekta alveolarne kosti na postoperativnu bol

Postoperative pain after surgery		Preoperative fenestration (yes/no)	Preoperative fistula (yes/no)	Volume of the alveolar bone defect
Personal experience of the procedure	R	0.096	0.089	0.158
	P-Value	0.614	0.641	0.403
2 hours	R	-0.037	0.319	0.065
	P-Value	0.845	0.086	0.723
4 hours	R	-0.187	-0.221	0.202
	P-Value	0.323	0.241	0.284
6 hours	R	0.035	-0.362	0.252
	P-Value	0.853	0.050	0.180
12 hours	R	0.070	-0.342	0.265
	P-Value	0.712	0.064	0.157
1st day	R	-0.008	-0.323	0.248
	P-Value	0.967	0.082	0.186
2nd day	R	-0.027	-0.212	0.326
	P-Value	0.886	0.260	0.079
3rd day	R	-0.275	-0.193	0.168
	P-Value	0.141	0.306	0.375
4th day	R	-0.368	-0.240	0.113
	P-Value	0.045	0.202	0.551
5th day	R	-0.391	-0.132	0.011
	P-Value	0.033	0.487	0.953
6th day	R	-0.364	0.017	0.123
	P-Value	0.048	0.928	0.519
7th day	R	-0.267	0.147	-0.217
	P-Value	0.153	0.437	0.248

The values are presented as R – correlation coefficient and *P* – value.
Statistical significance and correlation coefficient were tested using the Spearman's Rank Correlation.
Statistical significance was set to $P<0.05$.

Regarding the gender of the participants, the only observed difference was in the timing of the first analgesic intake (P = 0.038). Specifically, the median time to the first analgesic intake was 6.5 hours after surgery for men and 4.5 hours after surgery for women. The age of the participants did not significantly influence the occurrence or intensity of postoperative pain at all examined time points (P > 0.05).

The BMI index of the participants positively correlated with the time of taking the first analgesic after the surgery (R=0.401, *P*=0.028), as well as with the amount of analgesics taken on the third day after the surgery (R=0.492, *P*=0.006). Among BMI categories (BMI greater and less than 25), there were differences in analgesic intake on the third (*P*=0.006) and fourth (*P*=0.031) day after the surgery. Specifically, participants with a BMI less than 25 consumed a maximum of two analgesics per day (average 1.00 ± 0.76) on the third postoperative day. Meanwhile, participants with a BMI greater than 25 consumed up to three analgesics per day on the third day (average 1.4 ± 0.91). On the fourth day, participants with a BMI less than 25 consumed a maximum of one analgesic per day (average 0.53 ± 0.52), while those with a BMI greater than 25 consumed up to three analgesics (average 1.26 ± 0.79) (Figure 1 and Figure 2).

The duration of the operation negatively correlated with the pain perception at 6 hours (R=-0.483, *P*=0.005), 12 hours (P = 0,038). Naime, medijan uzimanja prvoga analgetika bio je 6,5 sati poslije operacije kod muškaraca i 4,5 sati kod žena. Dob ispitanika nije znatno utjecala na pojavu ili intenzitet postoperativne boli ni za jedno ispitivano vrijeme (P > 0,05).

Indeks tjelesne mase (BMI) ispitanika pokazao je pozitivnu korelaciju s vremenom uzimanja prvog analgetika poslije operacije (R = 0,401, P = 0,028), te s količinom uzetih analgetika trećeg dana poslije operacije (R = 0,492, P = 0,006). Među BMI kategorijama (BMI veći ili manji od 25) postojale su razlike u unosu analgetika trećega (P = 0,006) i četvrtoga dana (P = 0,031) poslije operacije. Naime, ispitanici koji su imali BMI manji od 25 konzumirali su maksimalno dva analgetika na dan (prosjek 1,00 ± 0,76) trećega postoperativnoga dana. S druge strane, oni s indeksom tjelesne mase većim od 25 konzumirali su do tri analgetika na dan trećega dana (prosjek 1,4 ± 0,91). Četvrtoga dana ispitanici s BMI-jem manjim od 25 uzimali su maksimalno jedan analgetik na dan (prosjek 0,53 ± 0,52), a oni s većim od 25 do tri analgetika (prosjek 1,26 ± 0,79) (slike 1. i 2.).

Trajanje operacije pokazalo je negativnu korelaciju s osjećajem boli 6 sati (R = -0,483, P = 0,005), 12 sati (R = -0,496, P = 0,005) i 24 sata (R = -0,431, P = 0,017) poslije operacije te s brojem analgetika uzetih prvoga dana poslije operacije (R = -0,363, P = 0,048) i ukupnim brojem analgetika kon-

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Table 2 The impact of preoperative presence of fenestration or fistula and volume of the alveolar bone defect on consumption of analgesics after surgery
Tablica 2. Utjecaj prijeoperacijske prisutnosti fenestracije ili fistule i volumena defekta alveolarne kosti na potrošnju analgetika nakon operacije

Analgesics consumption after surgery		Preoperative fenestration (yes/no)	Preoperative fistula (yes/no)	Volume of the alveolar bone defect
Time of taking the first analgesics after surgery (hours)	R	-0.023	-0.390	0.196
	P-Value	0.903	0.033	0.299
On the day of surgery	R	0.264	-0.196	0.304
	P-Value	0.158	0.298	0.102
1st day	R	0.074	-0.029	0.210
	P-Value	0.698	0.879	0.266
2nd day	R	0.151	-0.063	0.340
	P-Value	0.426	0.742	0.066
3rd day	R	0.000	-0.468	0.127
	P-Value	1.000	0.009	0.505
4th day	R	0.079	-0.255	0.082
	P-Value	0.679	0.174	0.665
5th day	R	0.267	0.147	0.132
	P-Value	0.153	0.437	0.487
6th day	R	/	/	/
	P-Value	/	/	/
7th day	R	0.186	0.102	0.313
	P-Value	0.326	0.590	0.092
Total number of analgesics taken over 7 days	R	0.132	-0.294	0.219
	P-Value	0.486	0.114	0.244
The width of the alveolar bone defect (mm)	R	0.282	0.047	0.043
	P-Value	0.131	0.805	0.015
The height of the alveolar bone defect (mm)	R	0.421	0.074	0.500
	P-Value	0.020	0.696	0.005
Preoperative fenestration (yes/no)	R	1.000	0.552	0.050
	P-Value		0.002	0.792
Preoperative fistula (yes/no)	R	0.552	1.000	-0.073
	P-Value	0.002		0.792

The values are presented as R – correlation coefficient and *P* – value.
Statistical significance and correlation coefficient were tested using the Spearman's Rank Correlation.
Statistical significance was set to $P<0.05$.

(R=-0.496, *P*=0.005), and 24 hours (R=-0.431, *P*=0.017) after the surgery, as well as with the number of analgesics taken on the first day after the operation (R=-0.363, *P*=0.048), and the total number of analgesics taken over the seven postoperative days (R=-0.407, *P*=0.025).

The height and width of the alveolar bone defect after the operation did not significantly influence the occurrence and intensity of postoperative pain at any examined time point (*P*>0.05). Furthermore, there were no significant differences in the time patients took the first analgesic, the number of analgesics taken at any examined time, or the total number of analgesics concerning the height and width of the defect (*P*>0.05).

Additionally, the smallest volume of alveolar bone defect was 50 mm³, while the largest was 270 mm³. The mean volume was 148.6 mm³. No difference was observed between groups in alveolar bone defect concerning preoperative presence of fistula (*P*=0.701) and fenestration (*P*=0.786). Similar-

zumiranih tijekom sedam postoperativnih dana (R = -0,407, P = 0,025).

Visina i širina alveolarnoga koštanog defekta poslije operacije nisu značajno utjecale na pojavu i intenzitet postoperativne boli ni za jedno ispitivano vrijeme (P > 0,05). Također nema značajne razlike ni u trenutku kad su pacijenti uzeli prvi analgetik te u broju uzetih analgetika ni za jedno ispitivano vrijeme kao ni u ukupnom broju analgetika s obzirom na visinu i širinu defekta (P > 0,05).

Najmanji volumen alveolarnoga koštanog defekta iznosio je 50 mm³, a najveći 270 mm³. Prosječni volumen bio je 148,6 mm³. Nije uočena razlika u volumenu alveolarnoga koštanoga defekta s obzirom na preoperativnu prisutnost fistule (P = 0,701) i fenestracije (P = 0,786). Slično tomu, nije bilo razlike u odnosu na BMI (P = 0,486) i spol (P = 0,129). Volumen alveolarnoga koštanog defekta poslije operacije nije značajno utjecao na pojavu ili intenzitet postoperativne boli za sva ispitivana vremena (P > 0,05) (tablica 1.). Ni volumen

ly, there was no difference concerning the BMI (*P*=0.486) and gender (*P*=0.129). The volume of the alveolar bone defect after the operation did not significantly affect the occurrence or intensity of postoperative pain at all examined time points (*P*>0.05) (Table 1). Similarly, the volume of the alveolar bone defect did not significantly influence the amount of consumed analgesics at all examined time points (*P*>0.05) (Table 2).

The presence of a fistula negatively correlated with pain six hours after the procedure (R=-0.362, *P*=0.050), the time of taking the first analgesic (R=-0.390, *P*=0.033), and the amount of analgesics taken on the third day after the surgery (R=-0.468, P=0.009) (Table 1 and Table 2). Namely, participants with a fistula typically consumed the first analgesic after five to nine hours after the operation (average after 7 ± 1.52). In contrast, participants without a fistula took the first analgesic after one to ten hours (average after 4.95 ± 2.52).

Additionally, the preoperatively present fenestration positively correlated with the presence of a fistula (R 0.552, *P*=0.002), while negatively correlating with the occurrence of pain on the fourth (R=-0.368, *P*=0.045), fifth (R=-0.391, *P*=0.033), and sixth (R=-0.364, *P*=0.048) day after the operation (Table 1 and Table 2).

Discussion

This study thoroughly investigated the influence of preoperative and intraoperative factors related to surgical trauma on the occurrence and intensity of pain and the amount of analgesics taken after periapical surgery.

Our study showed that the duration of the surgical procedure correlated negatively with the postoperative pain perception and the total number of analgesics taken in the seven days following the procedure. These findings contradict the available literature, which states that prolonged manipulation of soft and hard tissues leads to increased inflammation, damage to blood vessels and nerves, and increased sensitivity to pain, which increases the risk of developing postoperative edema, hematoma and infection (13, 14). However, it is important to note that the duration of all procedures in our study ranged from 13 to 27 minutes, with an average of 19.87 ± 3.88 minutes. Therefore, all interventions in this study were within two standard deviations. It can be concluded that the manipulation time was homogeneous for all and differed only insignificantly. Therefore, we cannot attribute the pain solely to the duration of the procedure, but rather to some other factors.

The results of this study show that participants with a higher BMI consumed a greater amount of analgesics compared to participants with a lower BMI. Overweight and obesity may be associated with a higher incidence of postoperative pain and a higher need for analgesics (15). In addition, a positive correlation between BMI and the amount of analgesics taken can be explained by an increased need for analgesics due to a higher body weight. It has also been shown that the duration of the surgical procedure is prolonged in participants with higher BMI, which may consequently affect the occurrence and intensity of postoperative complications (14-17).

koštanoga defekta nije značajno utjecao na količinu konzumiranih analgetika za sva ispitivana vremena (P > 0,05) (tablica 2.).

Prisutnost fistule negativno korelira s boli šest sati poslije zahvata (R = -0,362, P = 0,050), vremenom uzimanja prvog analgetika (R = -0,390, P = 0,033) i količinom uzetih analgetika trećeg dana poslije operacije (R = -0,468, P = 0,009) (tablice 1. i 2.). Naime, ispitanici s fistulom obično su uzimali prvi analgetik između petoga i devetoga sata poslije operacije (prosječno poslije 7 ± 1,52 sati). Suprotno tomu, ispitanici bez fistule uzimali su prvi analgetik između prvoga i desetoga sata (prosječno poslije 4,95 ± 2,52 sata).

Dodatno, preoperativno prisutna fenestracija pokazala je pozitivnu korelaciju s prisutnošću fistule (R = 0,552, P = 0,002), a negativno je korelirala s pojavom boli četvrtoga (R = -0,368, P = 0,045), petoga (R = -0,391, P = 0,033) i šestoga (R = -0,364, P = 0,048) dana poslije operacije (tablice 1. i 2.).

Rasprava

Autori ovog istraživanja detaljno su istražili utjecaj preoperativnih i intraoperativnih čimbenika povezanih s kirurškom traumom na pojavu i intenzitet boli te količinu analgetika uzetih poslije periapikalnoga kirurškog zahvata.

U istraživanju se ističe da trajanje operacijskoga zahvata negativno korelira s osjećajem boli poslije operacije, te ukupnim brojem uzetih analgetika u sedam dana postoperativno. Dobiveni rezultati oprečni su onima iz dostupne literature u kojoj prolongirano vrijeme manipulacije mekim i tvrdim tkivom uzrokuje pojačanu upalu, oštećenje krvnih žila i živaca te povećanu osjetljivost na bol, što povećava rizik od pojave postoperativnog edema, hematoma i infekcije (13, 14). No potrebno je istaknuti da je trajanje svih zahvata u našem istraživanju bilo od 13 do 27 minuta, prosječno 19,87 ± 3,88 minuta. Dakle, sve operacije u ovom istraživanju obuhvaćene su unutar dviju standardnih devijacija. Iz navedenoga se može zaključiti da je vrijeme manipulacije kod svih bilo homogeno i zanemarivo različito. Time bol ne možemo pripisati samo trajanju operacije, nego i nekim drugim čimbenicima.

Rezultati u ovom istraživanju pokazuju da su ispitanici s višim BMI indeksom konzumirali veću količinu analgetika u usporedbi s ispitanicima s nižim indeksom tjelesne mase. Prekomjerna tjelesna težina i pretilost mogu biti povezane s većom incidencijom postoperativne boli i potrebom za većom količinom analgetika (15). Osim toga, pozitivna korelacija između indeksa tjelesne mase i količine uzetih analgetika može se objasniti povećanom potrebom za analgeticima zbog veće tjelesne mase. Dokazano je također da je trajanje operacijskoga zahvata produljeno kod osoba s većim indeksom tjelesne mase, što posljedično može utjecati na pojavnost i intenzitet postoperativnih komplikacija (14 – 17).

Prema našim rezultatima volumen defekta alveolarne kosti ne utječe na intenzitet i pojavnost postoperativne boli, ni

According to our results, the volume of the alveolar bone defect has no influence on the intensity and occurrence of postoperative pain, nor on the amount of analgesics taken. Christiansen et al. also found no correlation between the volume of the alveolar bone defect and postoperative pain (18). This result could be due to the fact that the size of the alveolar bone defect was not primarily caused by surgical manipulation, but by chronic periapical inflammation leading to bone destruction. However, the alveolar bone defect after periapical surgery plays an important role in the final outcome of the therapy. According to Von Arx et al. it was also found that cases that healed had a smaller volume (395 mm^3) of alveolar bone defects comparing those that did not heal (554 mm^3) (19). In large periapical lesions, the proliferation of fibroblasts from the periosteum into the bone defect can lead to the formation of scar tissue instead of bone regeneration after surgery, which reduces the healing potential (20). A larger volume of the bone defect, a greater width and height of the vestibular defect and the presence of bilateral fenestration are associated with a poorer final surgical outcome (19-21). In this study, the maximum defect was 270 mm^3, which is significantly smaller than the values determined in the Von Arx study (19).

The preoperative presence of a fistula and fenestration were also parameters observed in our study. Participants with preoperative fenestration had less postoperative pain. Sometimes a defect caused by a periapical pathological process invades the bone, a condition known as fenestration of the alveolar bone, in which the periapical area is already exposed, hence less hard tissue needs to be removed than in cases where the vestibular bone is intact. Therefore, the results related to preoperative fenestration could be explained as a consequence of a less invasive surgical procedure, as it is known that less trauma leads to less postoperative pain. Conversely, greater surgical trauma leads to the release of a greater amount of inflammatory mediators (histamine, serotonin, quinin and prostaglandin), which subsequently influence the intensity of pain and swelling after the procedure (6, 22). In study of Pecora et al., postoperative pain and swelling were compared in patients who underwent surgery with or without the use of a dental operating microscope. They found significantly less postoperative pain in the group treated with a microscope, although there was no statistical difference in swelling. The authors believe this could be due to the reduced traumatic impact on the tissue, including minimal osteotomy, accuracy of area curettage and optimized visualization of the surgical site (23). Similar results were obtained in the studies of Tsesis et al. and Iqbal et al. in which a lower pain sensation was reported in the group treated with the microscopic technique, which was due to minimal surgical traumatic effects on the hard tissue and precise execution of all surgical steps (7, 10). In conclusion, larger defects in the alveolar bone after surgery together with greater surgical trauma may lead to the development of more severe postoperative complications (13).

Furthermore, participants with a preoperative fistula consumed a lower number of analgesics. This result could also be explained as a consequence of less surgical trauma lead-

na količinu uzetih analgetika. Christiansen i suradnici također nisu pronašli povezanost između volumena defekta alveolarne kosti i postoperativne boli (18). Takav rezultat može biti posljedica toga što veličina defekta alveolarne kosti nije primarno nastala zbog kirurške manipulacije, nego kronične periapikalne upale koja je rezultirala destrukcijom kosti. Međutim, defekt alveolarne kosti poslije periapikalnoga kirurškoga zahvata važan je u konačnome ishodu terapije. U istraživanju Von Arxa i suradnika također je utvrđeno da su slučajevi koji su zacijelili imali manji volumen (395 mm^3) defekta alveolarne kosti u usporedbi sa slučajevima koji nisu zacijelili (554 mm^3) (19). Kod velikih periapikalnih lezija, proliferacija fibroblasta iz periosta u koštani defekt može rezultirati stvaranjem ožiljnoga tkiva umjesto koštane regeneracije poslije operacije, što smanjuje mogućnost zacjeljivanja (20). Veći volumen defekta kosti, veća širina i visina vestibularnog defekta, te obostrane fenestracije povezuju se s lošijim konačnim ishodom operacije (19 – 21). U ovom istraživanju maksimalni defekt iznosio je 270 mm^3, što je znatno manje od vrijednosti utvrđenih u istraživanju Von Arxa i suradnika (19).

Preoperativna prisutnost fistule i fenestracije također su bili parametri koje smo pratili u našem istraživanju. Ispitanici s preoperativnom fenestracijom imali su manju postoperativnu bol. Katkad defekt prouzročen periapikalnim patološkim procesom perforira kost, to je takozvana fenestracija alveolarne kosti, pri čemu je periapikalno područje već izloženo, što zahtijeva manje uklanjanje tvrdoga tkiva u usporedbi sa slučajevima kada je vestibularna kost intaktna. Zato se rezultati vezani za preoperativnu fenestraciju mogu objasniti kao posljedica manje invazivnoga kirurškog zahvata, jer je poznato da manja trauma izaziva manju postoperativnu bol. Suprotno tomu, u slučaju veće kirurške traume oslobađaju se veće količine upalnih medijatora (histamin, serotonin, kinin i prostaglandin) koji posljedično utječu na intenzitet boli i oteklinu poslije zahvata (6, 22). Pecoro i suradnici u svojem su istraživanju uspoređivali postoperativnu bol i oteklinu kod pacijenata koji su operirani uz upotrebu dentalnoga operativnog mikroskopa i bez toga uređaja. Utvrđeno je znatno manje postoperativne boli u skupini liječenoj mikroskopom, a nije zabilježena statistička razlika u oticanju. Autori vjeruju da je to rezultat smanjenoga traumatskog utjecaja na tkivo, uključujući minimalnu osteotomiju, preciznost kiretaže područja i optimiziranu vizualizaciju kirurškoga polja (23). Slični rezultati dobiveni su u istraživanjima Tsesisa i suradnika te Iqbala i suradnika koji su zabilježili manju osjetljivost na bol u skupini liječenoj mikroskopskom tehnikom, što se pripisuje minimalnim traumatskim učincima zahvata na tvrda tkiva i preciznoj izvedbi svih kirurških postupaka (7, 10). Zaključno, veći defekti alveolarne kosti poslije zahvata, zajedno s većom kirurškom traumom, mogu rezultirati pojavom težih postoperativnih komplikacija (13).

Ispitanici s preoperativnom fistulom također su konzumirali manji broj analgetika. Taj rezultat također bi se mogao objasniti kao posljedica manje kirurške traume koja je prouzročila manju postoperativna bol i posljedično manju konzumaciju analgetika. Takvo objašnjenje potkrepljuje i rezultat našeg istraživanja koji je pokazao da preoperativna fe-

ing to less postoperative pain, and consequently less analgesic consumption. Such an explanation is also supported by the result of our study, which showed that preoperative fenestration correlates positively with the presence of a fistula. Contrary to our results, in the study by Seymour et al. the presence or absence of a fistula did not affect postoperative pain scores (12). In conclusion, the participants without preoperative fistula and fenestration had a longer postoperative recovery time, which we can be attributed to greater surgical trauma, as a larger portion of bone had to be removed in these participants to gain access to the periapical area. Unfortunately, we cannot compare the results regarding fistula and fenestration with the available literature, as there were no studies that found an association between these factors and postoperative pain. However, according to the available literature, the presence of a preoperative fistula and the presence and size of fenestration are considered risk factors for the long-term success of the therapy (19-21).

Postoperative pain following periapical surgery represents one of the most common complications of this procedure (3, 8, 12). According to our results, the most severe pain was recorded in the participants on the day after the surgery, and the pain intensity decreased over time. These results are comparable to most studies that have investigated the occurrence of postoperative pain after periapical surgery. In these studies, participants experienced the greatest pain on the day of surgery and during the first postoperative day (5, 7, 8, 10-12). However, Garcia et al. and Penarrocha et al. found the most severe pain on the second postoperative day (3, 13).

In our study, the highest consumption of analgesics was recorded on the day of surgery, while consumption gradually decreased over time. In the study by Tuk et al., 14.3% of patients reported not using analgesics on the first postoperative day. This percentage increased to 30.8% on the second day and 42.1% on the third day. On the seventh day, 23.3% of patients used analgesics (11). In conclusion, over-the-counter analgesics have been shown to be sufficient and effective for the relief of postoperative pain after periapical surgery.

There are several limitations to this study. The study included a small number of participants, and further research on a larger patient sample and across multiple hospital centers is needed to make these results clinically more relevant. Furthermore, the measurement of alveolar bone defect was performed at the end of the surgical procedure in our study. It would be preferable for the defect to be measured both before and after the surgery to ultimately determine the size of the defect caused solely by manipulation of hard and soft tissues. Moreover, an operating microscope was not used in the surgical procedure in this study, and some studies have reported that the use of microsurgical techniques is associated with less postoperative pain and faster recovery. Additionally, it would be beneficial for future research to examine other factors associated with surgical trauma and to monitor other postoperative complications following periapical surgery.

nestracija pozitivno korelira s prisutnošću fistule. Suprotno našim rezultatima, u istraživanju Seymoura i suradnika, prisutnost ili odsutnost fistule nije utjecala na postoperativnu bol (12). Zaključno, ispitanici bez preoperativne fistule i fenestracije dulje su se oporavljali poslije zahvata, što možemo pripisati većoj kirurškoj traumi jer je kod tih ispitanika trebalo ukloniti veći dio kosti da bi se pristupilo periapikalnom području. Nažalost, rezultate vezane uz fistulu i fenestraciju ne možemo usporediti s podatcima iz dostupne literature zato što nisu pronađene studije koje povezuju te čimbenike s postoperativnom boli. No prema dostupnoj literaturi, prisutnost preoperativne fistule te prisutnost i veličina fenestracije smatraju se čimbenicima rizika kad je riječ o dugoročnom uspjehu terapije (19 – 21).

Postoperativna bol poslije periapikalnoga kirurškog zahvata jedna je od najčešćih komplikacija (3, 8, 12). Prema našim rezultatima, najveća bol među ispitanicima zabilježena je dan poslije operacije, a zatim se njezin intenzitet smanjivao. Ti se rezultati mogu usporediti s većinom istraživanja koja su pratila pojavnost postoperativne boli poslije periapikalnoga zahvata. U takvim istraživanjima ističe se da bol doseže najveći intenzitet na dan operacije te tijekom prvoga postoperativnoga dana (5, 7, 8, 10 – 12). No, Garcia i suradnici, te Penarrocha i suradnici zabilježili su vrhunac boli drugoga postoperativnoga dana (3, 13).

U našem istraživanju, na dan operacije zabilježena je najveća konzumacija analgetika, a zatim se njihova primjena s vremenom postupno smanjivala. U istraživanju Tuka i suradnika, prvoga je postoperativnoga dana 14,3 % pacijenata izvijestilo da ne uzima analgetike. Taj postotak porastao je na 30,8 % drugoga dana i 42,1 % trećega dana. Sedmoga dana se 23,3 % pacijenata koristilo analgeticima (11). Zaključno, pokazalo se da su analgetici koji se nabavljaju bez recepta dovoljni i učinkoviti da se ublaži postoperativna bol poslije periapikalnoga zahvata.

Ovo istraživanje ima nekoliko ograničenja. Bio je uključen mali broj ispitanika pa su potrebna daljnja istraživanja na većem uzorku pacijenata i u više bolničkih centara kako bi rezultati bili klinički relevantniji. Osim toga, u našem istraživanju mjerenje defekta alveolarne kosti provedeno je na kraju kirurškoga zahvata. Bilo bi poželjno da se defekt mjeri i prije i poslije operacije da bi se konačno odredila veličina defekta prouzročena isključivo manipulacijom tvrdim i mekim tkivima. Nadalje, u ovom istraživanju nije korišten operacijski mikroskop tijekom kirurškoga zahvata, a u nekim istraživanjima istaknuto je da je primjena mikrokirurških tehnika povezana s manjom postoperativnom boli i bržim oporavkom. Dodatno, u budućim istraživanjima bilo bi korisno ispitati i druge čimbenike povezane s kirurškom traumom te pratiti druge postoperativne komplikacije poslije periapikalnoga kirurškog zahvata.

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Conclusion

The null hypothesis of the study was rejected. The results of the present study suggest that postoperative pain after periapical surgery is most severe on the day after surgery. In addition, analgesic consumption was the highest on the day of surgery. Among the factors associated with surgical trauma, the presence of preoperative fistula and preoperative fenestration of the alveolar bone and the BMI index of the participants had an influence on the incidence and intensity of postoperative pain. In conclusion, we can say that there is a correlation between surgical trauma, namely the manipulation of hard and soft tissue, and the incidence and intensity of postoperative pain.

Conflict of interest: The authors declare no conflict of interest.

Funding: This research received no external funding

Ethical approval: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the University Hospital of Split

Informed consent: Informed consent was obtained from all individual participants included in the study

Author's contribution: **J.M.** - Conceptualization, Methodology, Writing, Data collection, Writing – original draft, Data curation; **L.G.** - Validation, Visualization, Investigation, Data collection; **A.T.** - Supervision, Data curation. **A.M.** - Supervision, Data curation. **P.S.** - Software, Validation, Data collection. **D.J.** - Conceptualization, Writing – review & editing, Data collection.

Zaključak

Nulta hipoteza istraživanja je odbačena. Rezultati ovog istraživanja pokazuju da je postoperativna bol poslije periapikalnoga zahvata najveća dan poslije operacije. Konzumacija analgetika bila je najveća na dan operacije. Među čimbenicima povezanima s kirurškom traumom, preoperativne fistule, preoperativne fenestracije alveolarne kosti i indeks tjelesne mase ispitanika utjecali su na pojavnost i intenzitet postoperativne boli. Zaključno možemo reći da postoji povezanost između kirurške traume, odnosno manipulacije tvrdim i mekim tkivom te pojavnosti i intenziteta postoperativne boli.

Sukob interesa: Autori nisu bili u sukobu interesa.

Financiranje: Autori za ovo istraživanje nisu dobili vanjsko financiranje.

Etičko odobrenje: Istraživanje je provedeno u skladu sa smjernicama Helsinške deklaracije i odobrilo ga je Etičko povjerenstvo Kliničkoga bolničkoga centra Split.

Informirani pristanak: Informirani pristanak dali su svi ispitanici uključeni u studiju.

Doprinos autora: **J. M.** – glavni istraživač, osmišljavanje i oblikovanje studije, pisanje teksta; **A. T.** – analiza rezultata i kritički pregled rukopisa; **L. G.** – tumačenje rezultata i pisanje teksta; **A. M.** – analiza i tumačenje rezultata te kritički pregled teksta; **P. S.** – prikupljanje podataka i kritička revizija teksta; **D. J.** – osmišljavanje i oblikovanje studije te kritički pregled teksta. Svi autori dali su konačno odobrenje i slažu se da su odgovorni za sve aspekte rada kako bi osigurali integritet i točnost.

Sažetak

Cilj: Istražiti utječu li čimbenici povezani s kirurškom traumom na postoperativnu bol tijekom prvoga postoperativnoga tjedna. **Dizajn istraživanja:** U istraživanje je bilo uključeno 30 zdravih odraslih osoba, nepušača, obaju spolova, s indikacijom za periapikalni kirurški zahvat na jednome zubu u prednjem dijelu gornje čeljusti, bez povijesti ranijih operacija, alergija na lidokain s adrenalinom ili ibuprofen, bez akutne upale ili boli te s PAI-om 3, 4 ili 5. Sve kirurške zahvate obavio je isti tim prema istom protokolu. Tijekom prvoga postoperativnoga tjedna svi su pacijenti dobili jednake postoperativne upute i upitnik za praćenje intenziteta boli i konzumacije analgetika. **Rezultati:** Najveći intenzitet boli zabilježen je dan poslije operacije, a najveća konzumacija analgetika zabilježena je na dan operacije. BMI ispitanika pozitivno je korelirao s količinom uzetih analgetika u postoperativnom razdoblju ($P < 0,05$). Trajanje operacije negativno je korelilo s intenzitetom boli i uzimanjem analgetika poslije operacije ($P < 0,05$). Volumen, visina i širina alveolarnoga koštanoga defekta poslije operacije nisu značajno utjecali na intenzitet boli i uzimanje analgetika u postoperativnom razdoblju ($P > 0,05$). Prisutnost fistule negativno je korelirala s konzumacijom analgetika poslije operacije ($P < 0,05$), a preoperativna fenestracija negativno je korelirala s intenzitetom postoperativne boli ($P < 0,05$). **Zaključak:** Pacijenti s preoperativnom fistulom i fenestracijom prijavili su manju bol i manju konzumaciju analgetika u postoperativnom razdoblju. Ti rezultati upućuju na moguću povezanost intenziteta postoperativne boli i opsega kirurške traume.

Zaprimljen: 1. rujna 2024.
Prihvaćen: 1. prosinca 2024.

Adresa za dopisivanje
Daniel Jerković, dr. med., doc.
Klinički bolnički centar Split,
Medicinski fakultet Sveučilišta u Splitu
Klinika za oralnu i maksilofacijalnu kirurgiju,
Split, Hrvatska,
Telefon: +385 91 755 9980
dajerkovic@kbsplit.hr

MeSH pojmovi: xxx
Autorske ključne riječi: apikotomija, oralna kirurgija, postoperativna bol, analgezija

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