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ORIGINAL SCIENTIFIC PAPER
*IZVORNI ZNANSTVENI RAD*

Magdalena Coga[1], Daniel Jerkovic[2], Lidia Gavic[3], Antonija Tadin[4], Kristian Jerkovic[5], Darko Macan[6]

# Correlation between Body Mass Index and the Occurrence of Postoperative Complications after Surgical Removal of the Lower Third Molar

# *Povezanost indeksa tjelesne mase i pojave komplikacija poslije operacijskog uklanjanja donjega trećeg kutnjaka*

[1] Study of Dental Medicine, School of Medicine, University of Split, Croatia.
*Studij dentalne medicine – Medicinski fakultet Sveučilišta u Splitu, Hrvatska*
[2] Department of Maxillofacial Surgery, Clinical Hospital Centre Split, Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
*Zavod za maksilofacijalnu kirurgiju Kliničkoga bolničkoga centra Split, Studij dentalne medicine – Medicinski fakultet Sveučilišta u Splitu, Hrvatska*
[3] Department for Oral Medicine and Periodontology, Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
*Zavod za oralnu medicinu i parodontologiju, Studij dentalne medicine – Medicinski fakultet Sveučilišta u Splitu, Hrvatska*
[4] Department of Restorative Dental Medicine and Endodontics, Study of Dental Medicine, School of Medicine, University of Split, Split, Croatia
*Zavod za restauratívnu dentalnu medicinu i endodonciju, Studij dentalne medicine – Medicinski fakultet Sveučilišta u Splitu, Hrvatska*
[5] Clinical Department of Diagnostic and Interventional Radiology, Clinical Hospital Centre Split, Split, Croatia
*Klinički odjel za dijagnostičku i intervencijsku radiologiju Kliničkoga bolničkoga centra Split, Hrvatska*
[6] Department of Maxillofacial and Oral Surgery, University of Zagreb, School of Dental Medicine, University Hospital Dubrava, Zagreb, Croatia
*Zavod za maksilofacijalnu i oralnu kirurgiju Stomatološkog fakulteta u KBC-u Dubrava, Sveučilišta u Zagrebu, Hrvatska*

**Abstract**
**Objectives:** Swelling, pain and trismus after the surgical removal of the mandibular third molars are the most common and expected postoperative complications. The aim of this cross-sectional study was to assess the association of those postoperative complications and BMI after surgical removal of the mandibular third molars. **Material and methods:** 84 patients who required the surgical removal of their lower third molar were enrolled in this study and were divided into 4 groups dependent on their BMI. Data were tested by one-way analysis of variance (Welch's ANOVA). The differences were tested by the intragroup using the Games-Howell test. **Results**: The effect of BMI on pain had a statistically significant difference within the first 24 postoperative hours: 4 hours (p=0.014), 6 hours (p=0.034, p=0.049), 12 hours (p= 0.00.P=0.023), and 24 hours (p=0.010). For swelling and trismus in the exception on first postoperative day between underweight and normal weight groups (p=0.026), and underweight and overweight groups (p=0.014) no statistically significant correlation was found **Conclusion**: BMI has an impact on a patient's early postoperative recovery.

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**Address for correspondence**
Daniel Jerkovic
Clinical Hospital Centre
Department of Maxillofacial Surgery
Spinciceva 1, 21000 Split, Croatia
Phone: +385917559980
dajerkovic@kbsplit.hr

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## Introduction

The mandibular third molar is the most common impacted tooth with a prevalence between 16.7% and 68.6%, and its surgical extraction, taking into account indications and contraindications, is one of the most performed procedures in oral and maxillofacial surgery (1-3). This surgical procedure includes various surgical procedures (incision, mucoperiosteal flap elevation, targeted removal of the part of the bone that interferes with the tooth extraction, tooth extraction, flap repositioning and suturing) that can lead to the most frequently expected postoperative complications in the form of trismus, pain and swelling (4, 5).

## Uvod

Treći kutnjak donje čeljusti najčešći je impaktirani zub s prevalencijom impakcije između 16,7 % i 68,6%, a njegovo je kirurško uklanjanje, uzimajući u obzir indikacije i kontraindikacije, jedan od najčešćih operacijskih zahvata oralne i maksilofacijalne kirurgije (1 – 3). Taj kirurški zahvat uključuje različite postupke (incizija, odizanje mukoperiostalnoga režnja, ciljano uklanjanje dijela kosti koji ometa ekstrakciju, reponiranje i šivanje režnja) koji mogu rezultirati najčešćim očekivanim postoperativnim komplikacijama – otežanim otvaranjem usta (trizmus), boli i oteklinom (4, 5).

Oslobađanje histamina i bradikinina zbog kirurške trau-

The release of histamine and bradykinin, due to surgical trauma, leads to vasodilatation, hyperemia and increased permeability followed by accumulation of fluid in the *interstitium*, and migration of monocytes and granulocytes. The above mentioned release leads to development of clinical visible swelling or edema. Histamine and bradykinin, along with the important role in development of edema, participate in development of pain by sensitizing nociceptors. Their effect is noticeable in the initial postoperative phase as a result of a very short half-life (6). Although it is an expected physiological response to the tissue damage, pain is the most common complication that significantly affects the patient's quality of life (7, 8).

Trismus is a prolonged spasm of one or more masticatory muscles resulting in the formation of connective tissue contractures. It is most often caused by improper application of *nervus alveolaris* inferior anesthesia, needle penetration of the *pterygoideus medialis* or blood vessel resulting in mild bleeding and hematoma formation. In addition, it can be caused by a mild infection or a mucoperiosteal flap elevation above the external oblique ridge. The condition is characterized by difficulty in opening of the mouth and the diagnosis is made, clinically, by measuring the maximum interincisal distance (MID), the values of which in the case of trismus are less than 35 to 40 mm. (9-11).

There exist a large number of preoperative and postoperative factors that can influence postoperative complications such as age, gender, systemic diseases, oral hygiene level, cigarette smoking, surgeon's experience, duration of the surgical extraction, tooth angulation, depth of impaction, amount of removed bone, tooth separation, the shape and size of the mucoperiosteal flap, suturing techniques and BMI which is processed in this clinical trial etc. (12-14). Obesity has ceased to be just an aesthetic problem. As one of the listed factors influencing the development of complications, an overweight patient is a challenge for the surgeon when removing third molars due to potential clinical postoperative repercussions on the patient's recovery, restoration of vital functions and decisions on oral surgery in the future (15, 16).

The Body Mass Index (BMI), formerly known as the Quetelet index, is a measure indicating nutritional status in adults. It is considered to be the most accurate way to determine the relationship between body weight and health risk. It is defined as body weight in kilograms divided by height squared in meters (kg/m2) (15, 17).

According to WHO data from 2008, 57.7% of the population in Croatia was overweight or obese. Such a "negative trend" has affected not only Croatia, but also every region of the world apart from sub-Saharan Africa and Asia (18, 19).

When planning and performing the procedure on an obese patient, the surgeon must consider numerous health implications and anatomical aspects of obesity. Although white adipose tissue (WAT) has been considered an inert and energy storage site for a long period of time, current research has shown that it actively participates in the regulation of physiological and pathological processes and is associated with immune and inflammatory changes. Moreover, there is a characteristically elevated number of inflammatory cytome potiče vazodilataciju, hiperemiju i povećanu propusnost praćenu nakupljanjem tekućine u intersticiju i migracijom monocita i granulocita. To vodi prema pojavi klinički vidljive otekline ili edema. Osim važne zadaće u nastanku edema, histamin i bradikinin sudjeluju u pojavi boli podraživanjem nociceptora. Njihov učinak je primjetan u početnoj postoperativnoj fazi zbog kratkoga poluživota (6). Iako je bol očekivani fiziološki odgovor na oštećenje tkiva, ujedno je i najčešća komplikacija u kliničkoj praksi te znatno utječe na kvalitetu postoperativnoga oporavka pacijenta (7, 8).

Ograničeno otvaranje usta ili trizmus produljeni je grč jednoga ili više žvačnih mišića koji rezultira stvaranjem kontraktura vezivnoga tkiva. Najčešće je prouzročen nepravilnim apliciranjem anestezije u *n. alveolaris inferior*, točnije probojem igle u *m. pterygoideus medialis* ili krvnu žilu, što rezultira blagim krvarenjem i stvaranjem hematoma. Uz spomenuto, može biti izazvan i blagom infekcijom ili podizanjem mukoperiostalnoga režnja iznad *linea oblique externa*. Stanje karakterizira otežano otvaranje usta. Dijagnoza se postavlja klinički mjerenjem maksimalne interincizalne udaljenosti (engl. *maximum interincisal distance* – MID) čije su vrijednosti u slučaju trizmusa manje od 35 do 45 milimetara (9 – 11).

Utjecaj na postoperativne komplikacije mogu imati mnogobrojni preoperativni i postoperativni čimbenici poput dobi, spola, sistemskih bolesti, razine oralne higijene, pušenja, iskustva kirurga, trajanja operacije, angulacije zuba, dubine impakcije zuba, količine uklonjene kosti, separacije zuba, oblika i veličine mukoperiostalnoga režnja, tehnike šivanja i BMI-ja koji je tema ovoga kliničkoga istraživanja. (12 – 14). Pretilost je odavno prestala biti samo estetski problem. Kao jedan od navedenih čimbenika koji utječu na pojavu postoperativnih komplikacija, pacijenti s prekomjernom tjelesnom težinom izazov su oralnome kirurgu pri uklanjanju donjega trećega kutnjaka zbog potencijalnih kliničkih postoperativnih komplikacija u oporavku pacijenata, obnovi vitalnih funkcija i odluka o oralno-kirurškim zahvatima u budućnosti (15, 16).

Indeks tjelesne mase (engl. *body mass indeks – BMI*), prethodno poznat kao Quetelet indeks, mjera je za procjenu stanja uhranjenosti osobe. Smatra se najtočnijim načinom određivanja odnosa između tjelesne težine i zdravstvenoga rizika. Definira se kao tjelesna težina u kilogramima podijeljena s kvadratom visine u metrima ($kg/m^2$) (15, 17).

Prema podatcima Svjetske zdravstvene organizacije (*World Health Organization* – WHO) iz 2008. godine, 57,7 % hrvatske populacije imalo je prekomjernu tjelesnu težinu ili je bilo pretilo. Takav negativan trend nije zahvatio samo Republiku Hrvatsku, nego sve regije svijeta osim supsaharske Afrike i Azije (18, 19).

Kada se planira i obavlja zahvat na pretilome pacijentu, oralni kirurg mora uzeti u obzir mnogobrojne zdravstvene implikacije i anatomske aspekte pretilosti. Iako se bijelo masno tkivo (engl. *white adipose tissue – WAT*) dugo smatralo inertnim te mjestom skladištenja energije, novija istraživanja pokazuju da ono aktivno sudjeluje u regulaciji fizioloških i patoloških procesa te da je povezano s imunosnim i upalnim promjenama. Štoviše, povišen broj upalnih citokina (TNF-α, IL-1, IL-6) upozorava na to da je povišena tjelesna težina po-

kines (TNF-α, IL-1, IL-6) indicating that being overweight is associated with chronic low-grade systemic inflammation. The main source of tumor necrosis factor (TNF-α) and part of the produced IL-6 are macrophages found in white adipose tissue, and their number is associated with obesity and adipocyte size (15, 20, 21).

Due to the lack of scientific evidence on this issue and a relatively small number of studies that have yielded conflicting results, the aim of this study was to investigate whether there is a correlation between body mass index and the incidence of the most common expected postoperative complications such as trismus, pain and swelling. The null hypothesis of the study is that body mass index is not related to the development and severity of the most common postoperative complications: pain, trismus and swelling.

## Material and methods

This cross sectional clinical trial, which was approved by the Committee of University Hospital Dubrava, was performed at the Department of Oral and Maxillofacial Surgery, University Hospital Dubrava, Zagreb, Croatia. The clinical trial was in full consent with the ethical principles defined in the World Medical Association's Declaration of Helsinki and written in accordance with the Consort recommendation. Participation in the clinical trial was voluntary. Each patient was informed of the purpose and design of the study and was asked to sign a consent form.

### Participants

In the period from April 2017 to February 2020, 84 patients with detailed medical and dental histories, and with impacted lower third molars were included in this clinical study.

The sample size was calculated by the G Power software. With a 95% confidence interval, an 80% power, and an effect size of 80% (22), a total sample size of 80 individuals was necessary.

The inclusion criteria were healthy adults of both genders (ASA I physical status), with no allergies to any of the medications administered during this clinical research. All participants needed to be pain free and without signs of inflammation in surgical field. They were not allowed to take any pharmacological agents that could have an impact on postoperative recovery 7 days prior to the surgical procedure. Exclusion criteria were pregnancy, breastfeeding, tobacco or cigarette smokers, and drug abuse.

Before the surgical removal of mandibular third molars, for each patient it was confirmed radiographically by orthopantomograph that all lower third molars were in the same bone position and angulation. All surgically removed mandibular third molars belonged to the Parant 3 scale (the scale for predicting the difficulty of removing third molars).

### Surgical procedure

All participants rinsed their oral cavities for 1 minute with 15 ml 0.2% Chlorhexidine (Miradent, Mouth Rinse paragard chx, Hager Pharma GmbH, Duisburg, Germany) prior to local anesthesia administration. The surgery was

vezana s kroničnom sistemskom upalom niskoga stupnja. Glavni čimbenik nekroze tumora α (engl. *tumor necrosis factor – TNF*) i dijela proizvedenoga interleukina 6 (IL-6) su makrofagi pronađeni u WAT-u te je njihov broj povezan s debljinom i veličinom adipocita (masnih stanica) (15, 20, 21).

Zbog nedostatka znanstvenih dokaza kad je riječ o toj temi, te malobrojnih istraživanja koja su dala oprečne rezultate, cilj ovoga istraživanja jest istražiti postoji li povezanost između BMI-ja te pojavnosti najčešćih postoperativnih komplikacije poput boli, trizmusa i otekline. Nulta hipoteza kliničkoga istraživanja glasi da indeks tjelesne mase nije povezan s razvojem i težinom najčešćih postoperativnih komplikacija – boli, trizmusom i oteklinom.

## Materijali i metode

Presječno istraživanje provedeno je u Kliničkome zavodu za oralnu kirurgiju Klinike za kirurgiju lica, čeljusti i usta Kliničke bolnice Dubrava u Zagrebu. Istraživanje je odobrilo Etičko povjerenstvo KB-a Dubrava te je bilo potpuno u skladu s etičkim načelima definiranima u Helsinškoj deklaraciji Svjetskoga zdravstvenog udruženja (World Medical Association's Declaration) i napisano prema preporukama Consorta. Sudjelovanje u kliničkom istraživanju bilo je dobrovoljno. Odabrani ispitanici vlastoručno su potpisali informirani pristanak nakon što su bili obaviješteni o ciljevima i svrsi te o mogućim rizicima tijekom istraživanja.

### Ispitanici

U razdoblju između travnja 2017. i veljače 2020. u ovu su kliničku studiju uključena 84 pacijenta s impaktiranim donjim trećim kutnjakom i svima je uzeta detaljna medicinska i stomatološka anamneza.

Veličina uzorka izračunata je s pomoću G-Power softwara, uz interval pouzdanosti 95 %, 80 % snage te veličine učinka 80 % (22), a potrebna veličina uzorka bila je 80 osoba.

Kriterij za uključivanje bile su zdrave osobe obaju spolova (ASA I), bez poznatih alergija na lijekove primjenjivane tijekom istraživanja. Svi su ispitanici morali biti bez znakova upale ili simptoma boli u operacijskom području. Upotreba farmakoloških agensa koji mogu utjecati na postoperativno razdoblje bila je zabranjena sedam dana prije zahvata.

Kriteriji za isključivanje bili su trudnoća, dojenje, pušenje te korištenje opojnih sredstava.

Za svakog ispitanika radiografski je ortopantomogramom utvrđeno da su donji treći kutnjaci u istom položaju u kosti te iste koštane angulacije. Svi kirurški uklonjeni treći kutnjaci donje čeljusti pripadali su ljestvici Parant III (ljestvica za predviđanje poteškoća pri uklanjanju trećih kutnjaka).

### Operacijski zahvat

Prije operacije svi su pacijenti ispirali usnu šupljinu jednu minutu s 15 mL 0,12-postotnoga klorheksidina (Miradent, Mouth Rinse paraguard chx, Hager Pharma GmbH, Duisburg, Njemačka). Poslije toga aplicirana im je provodna

performed under local anaesthesia of inferior alveolar nerve block with a 1ml injection suspension containing 40mg of articainchloridum and 0.005mg of adrenaline in the form of adrenalinchloridium (Ubistesin-articaine, 3M ESPE, Neuss, Germany). All treatments were performed by the same surgical team, with the same equipment and by taking the same surgical approach.

Triangular flap design was performed with scalpel blade No: 15 (Carl Martin GmbH, 42657 Solingen, Germany). The incision was performed from the mandibular ramus the distobuccal part of the first lower molar. Elevation of a full-thickness mucoperiosteal flap was performed by Willinger periosteal elevator (Carl Martin GmbH, 42657 Solingen, Germany). To provide a better visibility of the surgical field, Stenberg lip retractor (Carl Martin GmbH, 42657 Solingen, Germany) was used. Straight handpiece (Ti-Max X-SG65L, NSK Europe GmbH Eschborn, Germany) and steel bone cutters (REF: H141104023, H267104016, H141104010, Komet Dental, Bras seller Gmbh & Co, Lemgo, Germany) with maximum speed 40000 rpm and cooling aqueous irrigation were used for bone removal and tooth separation. Depending on the situation, extracting forceps, root elevators, and luxating instruments were used. Extraction wounds were closed with 3-0 silk simple interrupted sutures which were removed 7 days after the surgical procedure. Postoperative instructions were the same for all participants. The analgesics that they were allowed to take as needed in the postoperative period were only ibuprofen tablets (Neofen Forte 400 mg, Belupo, Koprivnica, Croatia). All participants who used other analgesics, other pharmacological agents than those allowed were excluded from this clinical study. Given that there are conflicting studies on the results of using ice packs (cryotherapy ), and because there was a possibility that some subjects would use ice packs and other patients would not, a cryotherapy of the surgical area was not allowed.

Postoperative control, observation and all postoperative measurements of the study were done by the surgeon who performed surgical procedures.

### Assessment of BMI, swelling, pain and trismus

Depending on BMI, which was calculated by the ratio between weight and height, participants were divided into 4 groups: 1-underweight ≤ 18,5, 2-normal weight- 18,6-24,9, 3-pre-obesity 30-34,9,4-obesity->30.

A four grade descriptive scale was used to measure the degree of swelling on the first, second and third postoperative day after the removal of the mandibular third molar: 0-none (no swelling), 1- light (intraoral, localized to the surgical field), 2- moderate (extraoral swelling localized to the surgical field), and 3- severe (extraoral swelling extending beyond the surgical field) (23).

A pain assessment was performed by patients who were marking the pain level on the VAS scale (10-cm long line with marked "no pain" on the far-left side of the scale (0 cm) and "unbearable pain" on the far-right side of the scale (10 cm)), 2, 4, 6, 12, 24, 48 and 72 hours after the removal of the mandibular third molar.

mandibularna anestezija – blok donjega alveolarnoga živca s 1 mL injekcijske suspenzije koja sadržava 40 mg artikainklorida i 0,005 mg adrenalina u obliku adrenalinklorida (Ubistesin-articaine, 3M ESPE, Neuss, Njemačka).

Sve zahvate obavio je isti kirurški tim s istom opremom i kirurškim pristupom.

Zahvat je počeo sukularnom incizijom skalpelom broj 15 (Carl Martin GmbH, 42657 Solingen, Njemačka) od početnoga dijela uzlaznoga kraka donje čeljusti do distalne plohe drugoga donjega molara. Formirani režanj odignut je u punoj debljini elevatorom prema Wilingeru (Carl Martin GmbH, 42657 Solingen, Njemačka). Veća preglednost i pristupačnost operacijskome polju osigurana je razmicanjem tkiva retraktorom prema Stendbergu (Carl Martin GmbH, 42657 Solingen, Njemačka).

Za osteotomiju i presijecanje zuba korišteni su kirurški nasadnik (Ti-Max X-SG65L, NSK Europe GmbH Eschborn, Njemačka) i čelična svrdla (REF: H141104023, H267104016, H141104010, Komet Dental,Brasseler Gmbh & Co, Lemgo, Njemačka) s maksimalnom brzinom 40 000 o/min uz obvezno vodeno hlađenje. Za ekstrakciju zuba korišteni su različiti instrumenti (kliješta, luksatori te apeksni elevatori), a birani su ovisno o kirurškoj situaciji. Režanj je repozicioniran i pričvršćen u početni položaj s pomoću jednostavnih pojedinačnih šavova od svile 3 – 0 (Johnson i Johnson Medical Ltd Simpson Parkway, Krikton Campus, Livingston, Engleska). Šavovi su uklonjeni sedmi dan postoperativno. Postoperativne upute bile su jednake za sve sudionike. Analgetike koje su smjeli uzimati prema potrebi bile su tablete ibuprofena (Neofen Forte 400 mg, Belupo, Koprivnica, Hrvatska). Svi oni koji su se koristili drugim analgeticima ili drugim farmakološkim sredstvima od onih dopuštenih, isključeni su iz ove kliničke studije. S obzirom na to da postoje oprečne studije o krioterapiji (korištenje hladnih obloga) te mogućnost da se neki sudionici koriste oblozima, a drugi ne, njihova upotreba tijekom ovog istraživanja nije bila dopuštena.

Postoperativne kontrole, promatranja i sva postoperativna mjerenja obavio je kirurg koji je i operirao pacijente.

### Procjena BMI-ja, boli, otekline i trizmusa

Ispitanici su podijeljeni u četiri različite kategorije s obzirom na izračunati BMI: 1 – pothranjenost (< 18,5); 2 – normalna tjelesna težina (18,5 – 24,9), 3 – prekomjerna tjelesna težina (25,0 – 29,9) te 4 – pretilost (> 30,0).

Mjerenje stupnja otekline provodilo se opisnom ljestvicom prvoga, drugoga i trećega postoperativnoga dana: 0 – nema otekline, 1 – oteklina u usnoj šupljini u području operacijskoga zahvata, 2 – oteklina izvan usne šupljine u području operacijskoga zahvata, 3 – oteklina izvan usne šupljine i izvan operacijskoga područja (23).

Razina boli mjerena je s pomoću VAS ljestvice i to 2, 4, 6, 12, 24, 48 i 72 sata poslije zahvata. Ljestvica je oblikovana kao linija duga 10 centimetara na kojoj je krajnje lijevo (0 cm) naznaka „bez boli", a krajnje desno (10 cm) naznaka „neizdrživa bol".

Ograničeno otvaranje usta ili trizmus izmjereno je udaljenošću između incizalnih površina mandibularnoga i mak-

Trismus was measured by the distance between the incisal surfaces of the mandibular and maxillar central incisor using TheraBite scale (Atos Medical UK, Nottingham, England) before the operative procedure on the first, second and third postoperative day (24).

### Statistical analysis

The SPSS software (Version 25.0. Armonk, NY: IBM Corp.Armonk, NY, USA) was used for statistical analysis. Data was tested by one-way analysis of variance (Welch's ANOVA). The assessment of data normality was conducted by the Kolmogorov-Smirnov test. The differences were tested intragroup using the Games-Howell test. The level of significance was set at 0.05.

## Results

Eighty-four patients met the criteria and participated in the present study. Sociodemographic characteristics of participants are present in Table 1. Participants were divided into 4 groups according to the calculated body mass index. The group of underweight (BMI ≤ 18.5) consisted of seven, the group of normal body weight (BMI 18.6 – 24.9) fourty eight, the group of overweight (BMI 25.0 – 29.9) twenty four, and the group of obese (BMI ≥ 30.0) five respondents.

The level of postoperative pain measured by the VAS scale and the statistical differences between BMI groups are shown in Table 2. The results showed that there was a statistically significant difference in the level of postoperative pain within the first 24 postoperative hours: 4 hours (p = 0.014), 6 hours (p = 0.034, p = 0.049), 12 hours (p = 0.00. P = 0.023), and 24 hours (p = 0.010) after the surgery.

The results of the level of postoperative swelling and the ability of mouth opening between BMI groups are shown in Table 3. According to Games-Howell post hoc test, there was

silarnoga središnjega sjekutića s pomoću ljestvice TheraBite (Atos Medical UK, Nottingham, Engleska) prije operacije te prvi, drugi i treći postoperativni dan (24).

### Statistička analiza

Za statističku obradu podataka korišten je programski paket SPSS ( Version 25.0. Armonk, NY: IBM Corp.Armonk, NY, SAD). Procjena distribucije podataka učinjena je Kolmogorov-Smirnovim testom. Za provjeru razlike između ispitivanih skupina korištena je jednosmjerna analiza varijance (Welch's ANOVA) uz Games-Howelov *post hoc* test. Razina statističke značajnosti postavljena je na $p < 0,05$.

## Rezultati

Osamdeset i četiri ispitanika zadovoljila su kriterije i bili su uključeni u istraživanje (45 muškaraca, 39 žena) (tablica 1.).

Bili su podijeljeni u četiri skupine s obzirom na izračunati BMI. Skupinu pothranjenih (BMI ≤ 18,5) činilo je sedam ispitanika, skupinu s normalnom tjelesnom težinom (BMI 18,6 – 24,9) četrdeset i osam, skupinu s prekomjernom tjelesnom težinom (BMI 25,0 – 29,9) dvadeset i četiri te skupinu pretilih (BMI ≥ 30,0) pet sudionika.

Razina postoperativne boli mjerena je s pomoću VAS ljestvice te su u tablici 2. prikazane statistički značajne razlike između ispitivanih BMI skupina. Rezultati su pokazali statistički značajne razlike između skupina u prva 24 sata postoperativno: 4 sata ($p = 0,014$), 6 sati ($p = 0,034$, $p = 0,049$), 12 sati ($p = 0,00$; $p = 0,023$) i 24 sata ($p = 0,010$) poslije operacijskoga zahvata.

Rezultati stupnja otekline te trizmusa između različitih BMI skupina nalaze se u tablici 3. Prema rezultatima Games-

**Table 1.** Sociodemographic characteristics of the participants
**Tablica 1.** Sociodemografske karakteristike ispitanika između skupina

| BMI | Age (years) | Male | Female |
|---|---|---|---|
| ≤ 18.5 | 24.71±3.65 | 4 | 3 |
| 18.6 – 24.9 | 23.56±3.09 | 25 | 23 |
| 25.0 – 29.9 | 24.63±3.39 | 14 | 10 |
| ≥ 30.0 | 27.80±2.64 | 2 | 3 |
| | | TOTAL: N=84 | |

**Table 2.** Pain level (VAS scale) between BMI groups
**Tablica 2.** Razina boli (VAS skala) između BMI skupina

| PAIN (VAS scale) | BMI GROUPS | | | |
|---|---|---|---|---|
| | ≤ 18.5 | 18.6 – 24.9 | 25.0 – 29.9 | ≥ 30.0 |
| **2 h** | 2.43 ± 1.81 | 2.34 ± 1.91 | 3.58 ± 2.92 | 3.80 ± 2.68 |
| **4 h** | 3.57 ± 1.99 | 3.71 ± 2.2[a] | 5.29 ± 1.9[a] | 5.4 ± 3.36 |
| **6 h** | 2.86 ± 1.77[b] | 3.56 ± 2.13[c] | 4.75 ± 2.13 | 5.8 ± 1.30[bc] |
| **12h** | 2.14 ± 1.07[d] | 3.45 ± 2.26[e] | 5.17 ± 2.33[de] | 4.6 ± 1.67 |
| **24 h** | 2.43 ± 1.27[f] | 3.58 ± 2.48 | 4.92 ± 2.54[f] | 4.00 ± 1.87 |
| **48 h** | 3.00 ± 1.91 | 3.49 ± 2.36 | 4.21 ± 2.80 | 3.6 ± 0.55 |
| **72 h** | 2.57 ± 1.51 | 3.05 ± 2.42 | 3.9 ± 2.68 | 3.2 ± 0.45 |

a = 0.014; b = 0.034; c = 0.049; d = 0.000; e = 0.023; f = 0.010

**Table 3.** Level of postoperative swelling. duration of operation, first and total analgetics consumation and the ability of mouth opening between BMI groups
**Tablica 3.** Razina postoperativne otekline, trajanje operacije, prvi konzumirani analgetik, ukupna konzumacija analgetika i mogućnost otvaranja usta između BMI grupa

| | BMI GROUPS | | | |
|---|---|---|---|---|
| | **≤ 18.5** | **18.6 – 24.9** | **25.0 – 29.9** | **≥ 30.0** |
| **Duration of operation (min.)** | 23.0 ± 9.04 | 19.79 ± 6.30 | 20.17 ± 5.80 | 23.60 ± 8.96 |
| Pain Caused by Anesthetic Application (VAS scale) | 2.71 ± 0.95 | 2.62 ± 1.68 | 4.04 ± 2.65 | 4.20 ± 1.92 |
| Personal Experience of the Operation | 6.14 ± 3.76 | 7.63 ± 2.40 | 8.21 ± 1.35 | 6.60 ± 1.52 |
| Duration of Anesthesia (min) | 299.14 ± 140.98 | 264.29 ± 55.36 | 263.50 ± 53.21 | 233.00 ± 49.95 |
| Swelling | | | | |
| 1st day | 2.71 ± 0.49 | 2.77 ± 0.81 | 2.75 ± 0.53 | 2.40 ± 0.89 |
| 2nd day | 2.86 ± 0.69 | 2.88 ± 0.76 | 2.79 ± 0.83 | 3.00 ± 1.00 |
| 3rd day | 2.71 ± 0.49 | 2.73 ± 0.92 | 2.71 ± 0.96 | 3.2 ± 0.84 |
| Trismus | | | | |
| 1st day | 29.86 ± 5.01[ab] | 37.60 ± 10.07[a] | 38.96 ± 9.23[b] | 40.8 ± 14.22 |
| 2nd day | 31.00 ± 4.58 | 36.08 ± 9.52 | 36.38 ± 8.01 | 28.00 ± 11.51 |
| 3rd day | 33.00 ± 6.40 | 38.13 ± 11.11 | 35.83 ± 12.00 | 34.00 ± 6.52 |
| First analgetic (min. postoperative) | 271.00 ± 98.46 | 374.4 ± 457.07 | 213.00 ± 84.56 | 157.60 ± 53.99 |
| Analgetic consumption | | | | |
| 1st day | 2.14 ± 0.69 | 2.13 ± 1.32 | 2.17 ± 0.96 | 2.20 ± 0.45 |
| 2nd day | 1.86 ± 1.07 | 2.08 ± 1.86 | 1.96 ± 1.65 | 2.4 ± 0.55 |
| 3rd day | 1.14 ± 1.07 | 1.6 ± 1.74[c] | 1.63 ± 1.56 | 1.6 ± 0.89[c] |
| a = 0.026; b = 0.014; c = 0.026 | | | | |

no statistical difference for the level of postoperative swelling in all tested times. Also, the test showed there was no statistical difference for the mouth opening among the BMI groups with the exception of the first postoperative day when statistically significant differences between underweight and normal weight groups (p=0.026), also underweight and overweight groups (p=0.014) were found.

In addition to the above mentioned observations, a statistically significant difference was also found for the consumption of analgesics during the first postoperative day between normal weight and overweight groups (p=0.026).

## Discussion

The purpose of this study is to evaluate the correlation between body mass index and the occurrence of the most common postoperative complications after surgical removal of the lower third molar: trismus, pain and swelling. To the best of our knowledge, the literature on this specific topic is very scarce and there are only a few papers about this correlation. Also, this is the first clinical trial which studies this correlation in patients who were statistically approximately of equal ages, had identical tooth position, degree of bone impaction and the same Parant class in the surgical removal of the lower third molars.

Previous research has shown that obesity significantly affects health and the occurrence of operative and postoperative complications (25). However, the association between BMI and operational outcomes is still considered controversial. According to the available literature, the association be-

Howellova *post hoc* testa ne postoji statistički značajna razlika u stupnju otekline između ispitivanih skupina u svim testiranim vremenima. Test je također pokazao da nema statistički značajne razlike u ograničenosti otvaranja usta između skupina, s iznimkom prvoga dana postoperativno kada postoji statistički značajna razlika između skupine pothranjenih i onih normalne tjelesne težine ($p$ = 0,026) te onih prekomjerne tjelesne težine ($p$ = 0,014).

Osim navedenih zapažanja, statistički značajna razlika prikazana je i za konzumaciju prvoga analgetika tijekom prvoga postoperativnoga dana između skupina normalne tjelesne težine i pretilih ispitanika (p = 0,026).

## Rasprava

Svrha ovog istraživanja bila je procijeniti povezanost indeksa tjelesne mase i pojave najčešćih postoperativnih komplikacija poslije uklanjanja donjega trećega molara, poput trizmusa, boli i otekline. Prema našim spoznajama, dostupna literatura o ovoj specifičnoj temi poprilično je oskudna te postoji samo nekoliko radova koji se bave spomenutom povezanošću. Ovo je također prvo kliničko ispitivanje koje je proučavalo tu povezanost kod pacijenata koji su bili statistički približno jednake dobi, imali identičan položaj zuba, stupanj koštane impakcije te istu Parantovu klasu kirurškoga uklanjanja donjega trećeg kutnjaka.

Dosadašnja istraživanja pokazala su da pretilost znatno utječe na zdravlje i pojavu operacijskih i poslijeoperacijskih komplikacija (25). Međutim, i danas se smatra kontroverznom povezanost BMI-ja i operacijskih ishoda. Prema dostupnoj literaturi, povezanost BMI-ja i pojave komplikacija

tween the body mass index and the occurrence of complications varies considerably among different, and even in the same, surgical procedures (26). For instance, by reviewing the neurosurgical literature, it has been proven that there is an increased incidence, and prevalence, of postoperative complications such as infections in overweight patients undergoing spinal surgery due to degenerative diseases. On the other hand, obesity poses very little or no risk of adverse events in the field of general neurosurgery (27-29).

Although the incidence of complications following the surgical removal of the lower third molar is low and is mostly referred to minor complications, the approach to an obese person may pose particularly difficult challenges to the oral and maxillofacial surgeon (16, 30).

As previously mentioned, pain is the most common complication that the health workers encounter in oral surgery practice. According to the available literature, previous studies have not shown an association between BMI and postoperative pain levels, but neither BMI and trismus or swelling.

Moreover, Waisath et al. have studied the occurrence of postoperative infection, nerve damage, dry socket, oral antral (O / A) fistula, soft-tissue defect, temporomandibular joint dysfunction (TMD), during various dentoalveolar surgeries and obtained equal results, and found no associations between BMI and complications (31). Also, Matijević *et al.* stated that BMI has no effect on the duration and intensity of pain in the first seven postoperative days (25). Although in the present study the patients were not monitored for seven postoperative days, but for three (72 hours), conflicting results were obtained when compared to the aforementioned studies. The results showed that there was a statistically significant difference in the level of postoperative pain within the first 24 postoperative hours. Lower levels of postoperative pain intensity were observed in patients with the lowest BMI. After 4 hours, a significantly lower level of pain was observed in patients of normal body weight than the group of overweight patients (BMI 25.0 – 29.9) ($p = 0.014$). Furthermore, after 6 hours, a lower pain level was observed in underweight patients compared to normal-weight patients ($p = 0.034$) and in normal weight patients compared with obese patients ( $p = 0.049$). After 12 hours, a higher pain level was observed in the overweight patients compared to those underweight ($p \leq 0.001$) and normal weight ($p = 0.023$). Also, 24 hours after the surgery, the pain level was lower in underweight patients compared to overweight patients ($p = 0.010$) (Table 2.) It should be emphasized that a statistically significant difference has always been in favour of the group of overweight and obese patients. Unlike the previously mentioned studies, the advantage of this present study and the reliability of the results is that the surgery was performed by one surgical team, and each removed mandibular molar belonged to Parant scale 3. Therefore, the surgeon's experience, the position of the tooth and the approach to surgical procedure could not interfere with the results of this clinical study.

As in previous clinical studies to date, this trial has found no association between BMI and swelling (Table 3). The authors believe that this issue should be further investigated using more objective methods. For example, swelling can be evaluznatno varira između različitih, pa čak i jednakih kirurških zahvata (26). Primjerice, pregledom neurokirurške literature dokazano je da postoji povećana incidencija i prevalencija postoperativnih komplikacija, poput infekcije, kod pacijenata s prekomjernom tjelesnom težinom koji su podvrgnuti operaciji kralježnice zbog degenerativnih bolesti. S druge strane, pretilost je malen ili nikakav rizik kad je riječ o nuspojavama u području opće neurokirurgije (27 – 29).

Iako je incidencija komplikacija poslije kirurškoga uklanjanja donjega trećeg kutnjaka niska i uglavnom se odnosi na manje komplikacije, pristup pretiloj osobi donekle je izazov za oralnoga kirurga (16, 30).

Kao što je već spomenuto, bol je najčešća komplikacija s kojom se susreću oralni kirurzi. Trenutačno dostupna kliničke istraživanja nisu pokazala povezanost između BMI-ja i postoperativne boli, ali ni BMI-ja i trizmusa ili otekline.

Štoviše, Waisath i suradnici uključili su u svoje istraživanje i druge komplikacija poput infekcije, oštećenja živca, suhe alveole, oroantralne fistule, defekta mekoga tkiva i pogoršanja disfunkcije temporomandibularnoga zgloba (TMZ) tijekom različitih dentoalveolarnih operacija te su dobiveni jednaki rezultati, točnije nije pronađena povezanost BMI-ja s komplikacijama (31). Matijević i suradnici također dokazuju da BMI nema utjecaja na trajanje i intenzitet boli u prvih sedam postoperativnih dana (25). Iako u ovom istraživanju, u usporedbi s radom Matijevića i suradnika, pacijenti nisu praćeni sedam dana postoperativno, nego tri (72 sata), dobiveni su oprečni rezultati. Naime, statistički značajna razlika u razini postoperativne boli postoji unutar prva 24 sata. Niža razina postoperativne boli uočena je kod ispitanika s nižim BMI-jem. Poslije četiri sata značajnije manja razina boli uočena je kod pacijenata normalne tjelesne težine u usporedbi s onima prekomjerne tjelesne težine (BMI 25,0 – 29,9) ($p = 0,014$). Poslije šest sati, znatno veća razina boli bila je kod pretilih pacijenata u usporedbi s onima normalne tjelesne težine ($p = 0,034$) i pothranjenima ($p = 0,049$). Poslije 12 sati veća razina boli uočena je kod ispitanika prekomjerne tjelesne težine u usporedbi s pothranjenima ($p \leq 0,001$) i onima normalne tjelesne težine ($p = 0,023$). Također, 24 poslije operacije, razina postoperativne boli bila je niža kod pothranjenih pacijenata u odnosu prema onima s prekomjernom tjelesnom težinom ($p = 0,010$) (tablica 2.). Potrebno je istaknuti da je statistički značajna razlika uvijek u korist skupine pacijenata s prekomjernom tjelesnom težinom te pretilošću. Za razliku od već navedenih radova, objektivnost rezultata u ovom istraživanju jest u tome što je operacijske zahvate obavio jedan kirurški tim te je svaki uklonjeni kutnjak donje čeljusti pripadao Parantovoj 3. klasi. Zato iskustvo kirurga, položaj zuba i pristup kirurškome zahvatu nije mogao utjecati na rezultate ovoga kliničkoga istraživanja.

Kao i u dosadašnjim kliničkim istraživanjima, ovo istraživanje nije pronašlo povezanost BMI-ja i pojave otekline (tablica 3.). To pitanje potrebno je dodatno istražiti primjenom objektivnijih metoda, primjerice, mjerenjem udaljenosti točno definiranih (referentnih) točaka na licu. Za razliku od dostupne literature, ovo je istraživanje pokazalo da postoji statistički značajna razlika u sposobnosti otvaranja usta prvoga postoperativnoga dana između skupine s nedovoljnom tjele-

ated by measuring reference points on the subject's face. Contrary to the reviewed literature, this study showed that there was a statistically significant difference in the ability of mouth opening on the first postoperative day between the group of underweight and the group of normal weight (p = 0.026) and underweight and overweight patients (p = 0.014). The difference was in favor of the normal weight group which had 7.747 and overweight group which had 9.101 higher score.

The concept of extended procedure duration due to slightly different anatomical characteristics of overweight people is frequently mentioned in the literature. More precisely, such individuals very often have more pronounced and fuller cheeks, and thus the visibility of the operative field is reduced, which makes the procedure more difficult, prolonged and more challenging (16, 22, 32). Gbotolorun *et al.* stated that the duration of the procedure was statistically significantly prolonged by an increase in BMI (33). Similar results can also be found in the literature of other surgical fields. For example, Ri M *et al.* concluded that during cardiovascular and gastroenterological surgical procedures, the increase in BMI is associated with prolonged time of the procedure (26). Contrary to these findings and the same as the study by Obimakinde et al. (32), in this clinical trial, a statistically significant correlation between a patient's BMI and duration of surgical procedure was not found.

Akadiri *et al.* have mentioned that body weight and the body surface area are the factors that can make it difficult for a surgeon to perform the surgical removal of the lower third molar. However, they have emphasized that althought BMI is a total body weight, it does not necessarily reflect the size of oral tissue, which could explain why there are such contradictory results on duration of surgical procedure due to BMI. (34)

There are several limitations to the study that need to be considered. There is a small number of respondents in the group of underweight and obese patients, which can be justified by the fact that such groups generally include young and physically active individuals. Furthermore, BMI is a good indicator of a patient's nutritional status, but not ideal. Increased BMI does not necessarily mean an increased amount of adipose tissue in the body. Namely, an increased BMI can be seen in people with large muscle mass, e.g. athletes. Besides, BMI doesn't give information about a person's body constitution. For example, as we mentioned before, an increased BMI does not necessarily mean having a fuller cheek. Therefore, additional measurements such as waist-to-hip ratio, waist circumference, skinfold thickness and neck circumference should be used in further studies to make the results as accurate and reliable as possible (35).

## Conclusions

The null hypothesis of the study was rejected. The study showed that body weight above normal had an effect on pain levels within the first 24 hours of the procedure. On the first postoperative day, difficulty in opening the mouth is visible in normal and overweight patients compared with those malnourished.

snom težinom i one s normalnom ($p$ = 0,026) te onih s nedovoljnom tjelesnom težinom i prekomjernom ($p$ = 0,014). Razlika je bila u korist skupine normalne težine koja je imala 7,747 i skupine s prekomjernom težinom koja je imala 9,101 veći rezultat.

U literaturi se često spominje koncept produžena trajanja zahvata zbog nešto drukčijih anatomskih karakteristika osoba s prekomjernom tjelesnom težinom. Naime, takve osobe vrlo često imaju izraženije i punije obraze, čime se smanjuje vidljivost operacijskoga polja pa je postupak teži, dulji i izazovniji (16, 22, 32). Gbotolorun i suradnici dokazuju da je trajanje postupka statistički značajno produženo povećanjem BMI-ja (33). Takva se saznanja mogu pronaći i u drugim kirurškim granama. Primjerice, Ri. M. i suradnici zaključili su da je tijekom kardiovaskularnih i gastroenterološkiх zahvata povećanje BMI-ja povezano s produljenim vremenom zahvata (26). Suprotno tim nalazima, u ovom istraživanju, te u istraživanju Obimakinde i suradnika (32), nije pronađena statistički značajna povezanost između trajanja operacijskoga zahvata i BMI-ja.

Akadiri i suradnici spomenuli su da su, između ostaloga, tjelesna masa i površina tijela čimbenici koji otežavaju kirurško uklanjanje donjega trećega kutnjaka. No istaknuli su da je BMI ukupna tjelesna masa, no ne i nužno odraz veličine oralnoga tkiva (34). To bi moglo objasniti zašto postoje poprilično kontradiktorni rezultati spomenutih studija o trajanju kirurškoga zahvata i njegove povezanosti s BMI-jem.

U ovom istraživanju postoje neka ograničenja i nedostatci koje treba uzeti u obzir. Naime, mali broj ispitanika bio je u skupini pothranjenih i pretilih, što se može opravdati činjenicom da su ispitanici bili mlađe, tjelesno aktivne osobe. Važno je istaknuti da je BMI dobar pokazatelj statusa uhranjenosti pacijenata te se donekle smatra zlatnim standardom, no nije idealan. Povećani BMI ne znači nužno povećanu količinu masnoga tkiva u tijelu te se može vidjeti i kod zdravih osoba s visokom mišićnom masom poput sportaša. Uz to, BMI ne daje podatke o konstituciji osobe. Tako, primjerice, kao što je već spomenuto, povećani BMI ne znači nužno puniji i deblji obraz. U daljnjim istraživanjima trebala bi se koristiti neka dodatna, pomoćna mjerenja kao što je omjer struka i bokova, opseg struka, debljina nabora kože te opseg vrata kako bi rezultati bili točniji i pouzdaniji (35).

## Zaključak

Nulta hipoteza istraživanja je odbačena. Naime, pokazalo se da je tjelesna masa iznad normalnih vrijednosti povezana s razinom boli u prva 24 sata postoperativnog razdoblja. Također su prvoga dana postoperativno vidljive poteškoće u otvaranju usta kod pacijenata normalne i prekomjerne tjelesne težine u usporedbi s pothranjenima.

In conclusion, pathophysiological changes that occur with weight gain reduce the quality of the postoperative period, make recovery more difficult for the patient, thus making the procedure far more complex for the oral surgeon to perform. All things considered, the authors of the present study believe that good planning and a more careful performance are needed, particularly if we take into account the growing increase in the number of obese people in the world.

## Conflict of interest

The authors report no conflict of interest and the article is not funded or supported by any research grant.

**Authors' Contributions:** **D. J., M. C.** - the main researchers contributed to the conception and design of the study, and drafted manuscript; **A. T.** - contributed to the analysis of the results and critically revised the manuscript; **L. G.** - contributed to the interpretation of the results and drafted the manuscript; **K. J.** - contributed to acquisition and critically revised manuscript; **D. M.** - contributed to the conception of the study and critically revised the manuscript. All authors gave the final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

Zaključno, patofiziološke promjene koje se pojavljuju s povećanjem tjelesne težine smanjuju kvalitetu postoperativnoga razdoblja i otežavaju oporavak pacijenta, a oralnome kirurgu otežavaju obavljanje operacije. S obzirom na sve to smatra se da je potrebno temeljito planiranje i rad, posebice ako se uzme u obzir porast broja pretilih u svijetu.

## Sukob interesa

Autori nisu bili u sukobu interesa.

**Doprinos autora:** **D. J., M. C.** – glavni istraživači, pridonijeli osmišljavanju i oblikovanju studije te pisanju teksta; **A. T.** – pridonio analizi rezultata i kritički revidirao rukopis; **L. G.** – pridonio tumačenju rezultata i pisao tekst; **K. J.** – pridonio nabavi i kritički revidirao tekst; **D. M.** – pridonio osmišljavanju studije i kritički revidirao rukopis. Svi autori dali su konačno odobrenje i slažu se da će biti odgovorni za sve aspekte rada, osiguravajući integritet i točnost.

**Sažetak**

**Cilj:** Oteklina, bol i trizmus najčešće su, ali i očekivane, komplikacije nakon operacijskoga uklanjanja donjega trećeg kutnjaka. Cilj ovog istraživanja bio je procijeniti povezanost spomenutih postoperativnih komplikacija i BMI nakon kirurškoga uklanjanja donjih trećih kutnjaka. **Materijali i metode:** U ovo su istraživanje bila uključena 84 ispitanika kojima je bilo potrebno kirurški ukloniti donje treće kutnjake. Bili su podijeljeni u četiri skupine, ovisno o izračunatom BMI-ju. Za ispitivanje dobivenih rezultata korištena je jednosmjerna analiza varijance (Welchova ANOVA), a razlike između grupa testirane su Games-Howellovim testom. **Rezultati:** Učinak BMI-ja na bol dokazan je statistički značajnom razlikom unutar prva 24 postoperativna sata: 4 sata ($p = 0{,}014$), 6 sati ($p = 0{,}034$, $p = 0{,}049$), 12 sati ($p = 0{,}00$, $p = 0{,}023$) i 24 sata ($p = 0{,}010$). S druge strane, nije pronađena statistički značajna povezanost za oteklinu i trizmus, s iznimkom otežanoga otvaranja usta prvoga postoperativnoga dana kod skupine pothranjenih u usporedbi s ispitanicima s normalnom tjelesnom masom ($p = 0{,}026$) i prekomjernom tjelesnom masom ($p = 0{,}014$). **Zaključak:** BMI utječe na pacijentov rani postoperativni oporavak.

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**Adresa za dopisivanje**
Daniel Jerković
Klinički bolnički centar
Zavod za maksilofacijalnu kirurgiju
Spinčićeva 1, 21 000 Split, Hrvatska
tel: +385917559980
dajerkovic@kbsplit.hr

**MeSH pojmovi:** vađenje zuba; umnjak; poslijeoperativne komplikacije
**Autorske ključne riječi:** BMI; kirurško uklanjanje donjega trećeg kutnjaka; alveotomija; oteklina; bol; trizmus

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