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Novel Transoral Endoscopic Assisted Minimally Invasive Method for Mandibular Condyle Fractures in Croatia: A Case Presentation and Literature Review

Nova minimalno invazivna transoralna endoskopski asistirana metoda za liječenje prijeloma kondila mandibule u Hrvatskoj: prikaz slučaja i pregled literature

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Abstract

Mandibular fractures, particularly condylar process fractures, are common in maxillofacial surgery and require effective treatment methods that minimize complications while ensuring functional and esthetic recovery. **Objectives:** This paper presents two cases of mandibular condylar process fractures treated using a transoral endoscopically assisted technique (EATA), thus marking the first documented application of this approach in Croatia. The aim was to evaluate the efficacy of this minimally invasive method compared to traditional extraoral approaches, which often carry risks such as visible scarring, facial nerve injury, and prolonged postoperative recovery. **Methods:** A 30° rigid endoscope and specialized angled instruments were utilized in both cases to achieve precise visualization, reduction, and fixation of the fractures. The first case involved a young male with a double mandibular fracture, while the second case addressed an isolated condylar fracture in an older female with comorbidities. **Results:** Both patients were successfully treated without complications, including facial nerve injury, hematomas, or salivary fistulas. Hospitalization periods were shorter compared to traditional approaches, and recovery included restored temporomandibular joint function (TMJ), stable occlusion, and the absence of visible scars. The EATA method proved to be safe and effective, offering numerous advantages such as reduced morbidity, minimal soft tissue trauma, and superior aesthetic outcomes. Despite requiring specialized equipment and additional surgical training, EATA has significant potential to become a standard treatment modality for mandibular fractures. **Conclusion:** The findings of this study contribute to the growing body of evidence supporting the clinical benefits of this minimally invasive technique.

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Introduction

Mandibular fractures account for 2 to 2.5% of all trauma cases in the United States, according to the National Trauma Data Bank (1). These fractures are among the most common facial injuries and often require hospitalization and surgical intervention. Mandibular fractures are significantly more common in men, accounting for between 74% and 90% of cases (2, 3, 4). They are most common in individuals aged 18 to 54 years, with the highest incidence observed in

Uvod

Prema podatcima Nacionalne banke trauma, prijelomi donje čeljusti čine između 2 i 2,5 % svih trauma u Sjedinjenim Američkim Državama (1). Te su frakture među najčešćim ozljedama lica te često zahtijevaju hospitalizaciju i kiruršku intervenciju. Znatno su češće kod muškaraca – čine između 74 % i 90 % svih slučajeva (2, 3, 4). Najveća učestalost prijeloma mandibule zabilježena je u populaciji između 18 i 54 godine, pri čemu je najveća incidencija u trećem de-

the third decade of life. Approximately one third of all mandibular fractures involve the condylar process, with condylar base being the most common type (54% of condylar process fractures) (5).

Condylar fractures can be managed either through conservative treatment, typically involving closed reduction with mandibulomaxillary fixation, or through surgical intervention using open reduction and internal fixation (ORIF). Both methods can lead to satisfactory results, but open reduction often offers better functional results, especially in complex fractures. The choice of treatment should be based on the characteristics of the fracture and individual needs of the patient (6, 7, 8).

Extraoral surgical approaches, such as preauricular, retroauricular, submandibular and retromandibular, run a certain risk of complications. The most common complication is facial nerve paresis, which occurs in around 12% of patients, with the majority (95%) making a full recovery, while 5% of them may suffer permanent paralysis. Other complications include hematomas (1.7%), wound infections ($\geq 2.9\%$), Frey syndrome (1.1%), sialoceles (2.6%), salivary fistulas ($\geq 4.8\%$), sensory disturbances of the greater auricular nerve (7.9%) and esthetically unsightly scars ($\geq 1.6\%$) (9).

The endoscopic approach is a modern, minimally invasive method for the treatment of condylar process fractures. This technique allows for precise reduction and fixation while reducing the risk of facial nerve damage and visible scarring. Despite its proven benefits, its routine use remains limited due to the technical complexity and prolonged learning curve associated with the procedure. Endoscopically assisted surgery is particularly beneficial for displaced fractures of the condylar neck and subcondylar fractures, as it allows for precise anatomical reduction while minimizing esthetic and functional complications. In addition, this approach enables faster recovery of temporomandibular joint (TMJ) function and restoration of pre-traumatic occlusion (10, 11, 12).

The Department of Maxillofacial and Oral Surgery of the Dubrava University Hospital is the leading national center for the treatment of mandibular fractures as the Reference Center for Maxillofacial Traumatology of the Ministry of Health of the Republic of Croatia. We present the application of a minimally invasive surgical technique for the treatment of condylar fractures via transoral approach with endoscopic support in two patients. These are the first documented cases of the application of this technique in Croatia.

Case presentations

Case report 1

An 18-year-old male patient was referred to our Department from an external institution after sustaining a fall from a bicycle. The fall resulted in a direct impact to the chin. On clinical examination, there was evidence of mandibular mobility between teeth 31 and 41, as well as pathological mobility of the right TMJ. The patient reported hypoesthe-

setljeću života. Otprilike jedna trećina svih prijeloma mandibule zahvaća kondilarni nastavak, a najčešće je puknuće baze kondilarnog nastavka koji čini 54 % svih prijeloma zglobnog nastavka (5).

Prijelomi kondila mogu se liječiti konzervativnim pristupom, što najčešće uključuje zatvorenu repoziciju i intermaksilarnu fiksaciju (IMF), ili kirurškim zahvatom otvorene repozicije i unutarnje fiksacije (engl. ORIF – *open reduction and internal fixation*). Oba pristupa mogu rezultirati zadovoljavajućim ishodima, no otvorenom repozicijom često se postižu bolji funkcionalni rezultati, osobito kod složenijih prijeloma. Odabir metode liječenja treba biti individualiziran i temeljiti se na karakteristikama prijeloma i potrebama pacijenta (6, 7, 8).

Ekstraoralni kirurški pristupi, poput preaurikularnoga, retroaurikularnoga, submandibularnoga i retromandibularnoga, nose određeni rizik od komplikacija. Najčešća je pareza facijalnoga živca koja se pojavljuje kod oko 12 % pacijenata, pri čemu se kod većine (95 %) funkcija živca potpuno oporavi, a kod njih 5 % može nastati trajna paraliza. Ostale komplikacije uključuju hematome (1,7 %), infekcije rane ($\geq 2,9\%$), Freyinov sindrom (1,1 %), sialokele (2,6 %), salivarne fistule ($\geq 4,8\%$), senzorne poremećaje velikoga aurikularnoga živca (7,9 %) i neestetske postoperativne ožiljke ($\geq 1,6\%$) (9).

Endoskopski asistirani pristup moderna je, minimalno invazivna metoda u liječenju prijeloma kondilarnog nastavka. Ta tehnika omogućuje preciznu repoziciju i fiksaciju prijeloma uz smanjenje rizika od ozljede facijalnoga živca i izbjegavanje vidljivih ožiljaka. Unatoč dokazanim prednostima, njegova rutinska primjena i dalje je ograničena zbog tehničke složenosti i dugog procesa usavršavanja operacijske tehnike. Endoskopski asistirane operacije osobito su korisne u slučaju dislociranih prijeloma vrata kondila i subkondilarnih prijeloma jer omogućuju preciznu anatomsku redukciju uz smanjenje estetskih i funkcionalnih komplikacija. Taj pristup također pridonosi bržem oporavku funkcije temporomandibularnoga zgloba (TMZ) te ranijem vraćanju normalne okluzije (10, 11, 12).

Klinika za kirurgiju lica, čeljusti i usta Kliničke bolnice Dubrava vodeći je nacionalni centar za liječenje prijeloma donje čeljusti te djeluje kao Referentni centar za maksilofacijalnu traumatologiju Ministarstva zdravstva Republike Hrvatske. U ovom radu prikazujemo primjenu minimalno invazivne kirurške tehnike u liječenju prijeloma kondila transoralnim pristupom uz endoskopsku asistenciju kod dvaju pacijenata. To su prvi dokumentirani slučajevi primjene ove tehnike u Hrvatskoj.

Prikazi slučajeva

Prikaz slučaja 1

Osamnaestogodišnji muškarac upućen je u našu kliniku iz vanjske ustanove nakon pada s bicikla, pri čemu je zadio izravni udarac u bradu. Kliničkim pregledom ustanovljena je patološka pokretljivost donje čeljusti u području između zuba 31 i 41 te patološka pokretljivost desnoga TMZ-a. Pacijent je prijavio hipoesteziju u području lijevoga mental-

sia in the region of the left mental nerve. Mouth opening was limited to 15 mm and was associated with significant pain in the right TMJ. There was also a vertical linear displacement of the chin measuring 20 mm, along with an open bite and disturbed occlusion. Also, the patient had 25 x 5 mm wound of the chin. Multislice computed tomography (MSCT) demonstrated the presence of a double mandibular fracture (Figure 1.A). The right condylar process was medially angulated by more than 45 degrees, and there was a parasymphyseal fracture on the left side (Figure 1.B). The patient was treated surgically under general anesthesia. Intermaxillary fixation (IMF) was initially established using self-tapping screws. Transoral incisions were made in the lower vestibule, one medially and one posteriorly on the right side. The parasymphyseal fracture was reduced through the transoral approach. Fixation was achieved using two 2.0 mm titanium plates. The fracture of the right condylar process was addressed using a novel combination of endoscopic-assisted transoral visualization and specialized angled instruments. Using a flexible angled borer, the fracture site was carefully accessed, ensuring minimal disruption to surrounding tissues. Following reduction, fixation was achieved with a 2.0 mm titanium plate featuring four holes and four 5 mm screws, strategically placed to secure the posterior fragment edge. The first two screws were inserted on the fragment after alignment, and the next two screws were inserted on the lower part of mandible immediately after reduction to stabilize the alignment. Additionally, a 2.0 mm titanium plate with three holes and three screws was placed anteriorly to provide supplemental support. Throughout the procedure, endoscopic guidance allowed precise visualization of the fracture site, thus ensuring an accurate placement of fixation hardware. The use of an angled screwdriver facilitated the insertion of screws in challenging anatomical regions, particularly along the medially displaced condylar fragment. To further stabilize the dentition, a wire-composite splint was applied across teeth 33 to 43. The patient's postoperative recovery was uneventful. He remained in the hospital for three days, during which a control MSCT confirmed satisfactory fracture alignment and fixation (Figure 1.C). Occlusion was restored to its pre-injury state while the IMF was in place. The patient experienced no deficits of the facial nerve, and there were no reports of pain, hematoma or swelling. At the first follow-up visit on the tenth postoperative day, the sutures were removed, and panoramic imaging demonstrated satisfactory findings. Four days later, the IMF screws and wires were removed, with soft food diet for 6 weeks total. At the three-month follow-up visit, the control orthopantomograph showed normal bone healing with no dislocation. There were no sensory or motor deficits, and occlusion remained stable. The patient was able to open his mouth to 50 mm without discomfort or limitations. The surgical management of the double mandibular fracture, involving the right condylar process and left parasymphyseal region, was successfully performed using advanced transoral surgical approaches and endoscopic assistance. The patient made a full recovery, with restored occlusion, normal function, and no residual complications.

nog živca. Otvaranje usta bilo je ograničeno na 15 mm i povezano s jakim boli u desnome TMZ-u. Također je uočena vertikalna linearna dislokacija brade od 20 mm, otvoreni za-griz i narušena okluzija. Uz to pacijent je na bradi imao ranu veličine 25 x 5 mm. Multislojna kompjutorizirana tomografija (MSCT) potvrdila je dvostruki prijelom mandibule (slika 1.A.). Desni kondilarni nastavak bio je medijalno anguliran za više od 45 stupnjeva, a također je dijagnosticiran parasimfzni prijelom s lijeve strane (slika 1.B.). Pacijent je operiran u općoj anesteziji. Na početku je postavljen IMF s pomoću samoureznih vijaka. Transoralni rezovi učinjeni su u donjem vestibulumu, jedan medijalno, a drugi posteriorno s desne strane. Prijelom parasimfize reduciran je transoralnim pristupom i fiksiran dvjema titanijskim pločicama promjera 2,0 mm. Prijelom desnoga kondilarnog nastavka liječen je kombinacijom endoskopski asistirane transoralne vizualizacije i specijalnih kutnih instrumenata. Fleksibilnim kutnim svrdlom pažljivo je pristupljeno mjestu prijeloma uz minimalnu traumu okolnih tkiva. Nakon redukcije fiksacija je obavljena korištenjem titanijske pločice debljine 2,0 mm s četirima vijcima duljine 5 mm strateški postavljenih tako da se osigura stabilnost stražnjeg fragmenta. Prva dva vijka postavljena su u fragment nakon poravnanja, a sljedeća dva umetnuta su u donji dio mandibule odmah nakon redukcije kako bi se osigurala stabilnost položaja. Za dodatnu stabilizaciju, prednja potporna pločica (2,0 mm) s trima vijcima postavljena je u području kondilarnog nastavka. Tijekom cijelog zahvata endoskopska vizualizacija omogućila je precizno pozicioniranje i stabilizaciju fragmenata, a kutni odvijač olakšao je umetanje vijaka u anatomske zahtjevna područja, osobito duž medijalno dislociranoga kondilarnog fragmenta. Za daljnju stabilizaciju zuba od 33 do 43 primijenjen je žičano-kompozitna udloga (splint). Postoperativni oporavak bio je uredan. Pacijent je bio hospitaliziran tri dana tijekom kojih je kontrolni MSCT potvrdio zadovoljavajuću redukciju i fiksaciju prijeloma (slika 1.C.). Okluzija je vraćena u stanje prije ozljede, a IMF je ostao postavljen privremeno. Pacijent nije imao funkcionalne deficite facijalnoga živca, niti su zabilježene komplikacije poput hematoma, boli ili otekline. Desetoga postoperativnoga dana uklonjeni su šavovi, a ortopantomografska snimka pokazala je zadovoljavajuće nalaze. Četiri dana poslije uklonjeni su IMF vijci i žice, uz preporuku da šest tjedana jede mekanu hranu. Na tromjesečnom kontrolnom pregledu novi ortopantomogram pokazao je normalno cijeljenje kosti bez znakova dislokacije. Nisu uočeni senzorni ili motorički deficiti, a okluzija je ostala stabilna. Pacijent je mogao otvoriti usta do 50 mm bez boli ili ograničenja. Kirurško liječenje dvostrukoga prijeloma mandibule, koji je zahvatio desni kondilarni nastavak i lijevu parasimfznu regiju, uspješno je provedeno naprednim transoralnim kirurškim pristupima uz endoskopsku asistenciju. Pacijent je potpuno funkcionalno i estetski oporavljen bez ikakvih komplikacija.

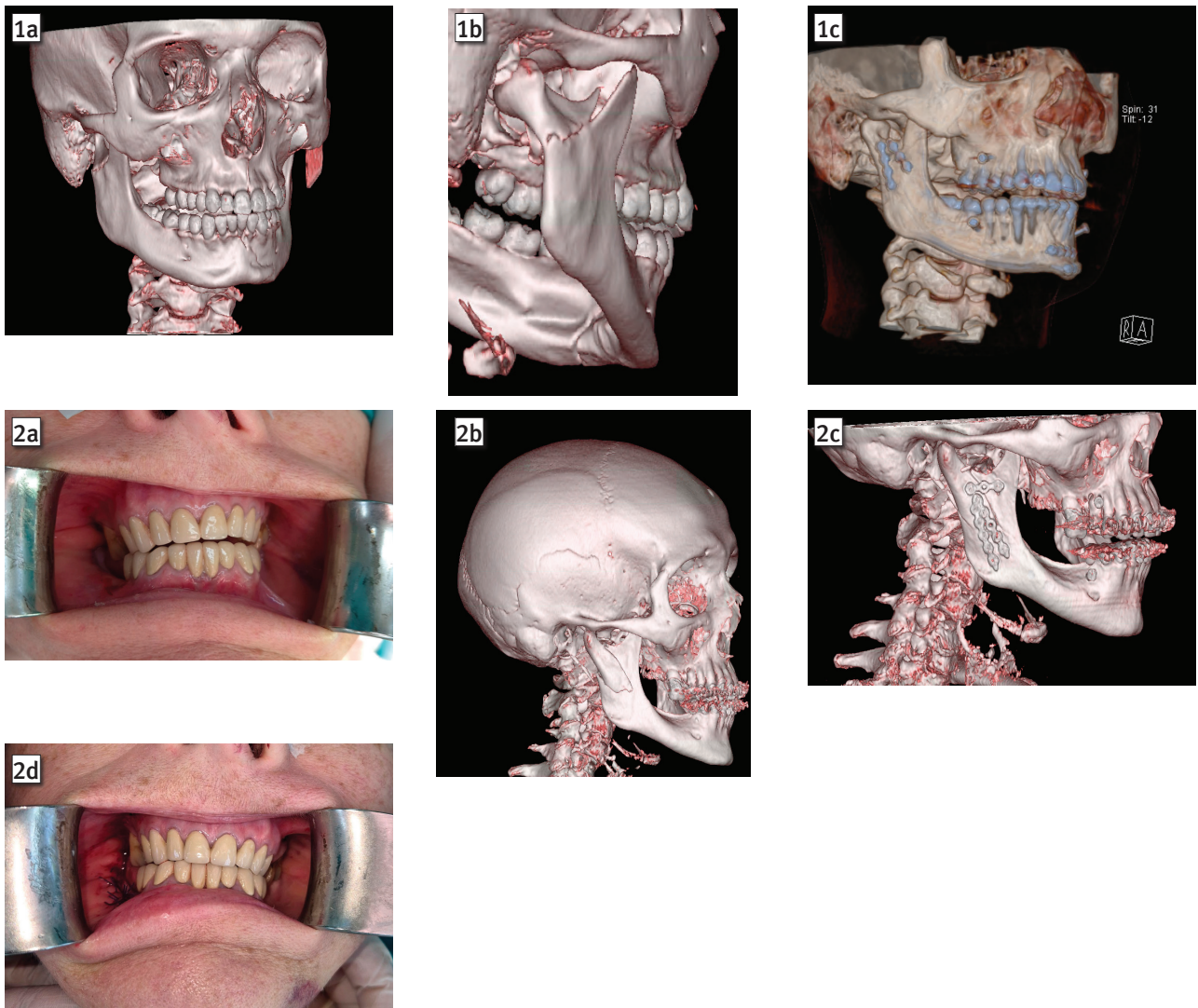


Figure 1 Case report 1 • Slika 1. Prikaz slučaja 1.

Figure 1A CT 3D reconstruction of a double mandibular fracture with a parasymphiseal fracture and a fracture of the right condylar base. Occlusion is disturbed, with an open bite and midline deviation to the right.

Slika 1.A CT 3D rekonstrukcija dvostrukoga prijeloma mandibule s parasimfiznim prijelomom i prijelomom baze desnoga kondilarnog nastavka; okluzija je poremećena, prisutan je otvoreni zagriz i devijacija središnje linije udesno

Figure 1B Posterior view of the CT 3D reconstruction showing a subcondylar fracture with angulation of the condylar process exceeding 45 degrees.

Slika 1.B Stražnji prikaz CT 3D rekonstrukcije koji prikazuje subkondilarni prijelom s angulacijom kondilarnoga nastavka većom od 45 stupnjeva

Figure 1C CT 3D reconstruction demonstrating postoperative outcomes with fixation of the mandibular fractures using titanium plates and screws, along with four screws placed for IMF. The left parasymphiseal fracture and right condylar process are shown with fragments satisfactorily reduced and anatomically aligned.

Slika 1.C CT 3D rekonstrukcija koja prikazuje postoperativni ishod s fiksacijom prijeloma mandibule s pomoću titanijskih pločica i vijaka, uz dodatna četiri vijka postavljena za IMF; prikazani su lijevi parasimfizni prijelom i desni kondilarni nastavak sa zadovoljavajuće reduciranim i anatomski poravnanim fragmentima

Figure 2 Case report 2 • Slika 2. Prikaz slučaja 2.

Figure 2A Intraoperative photograph showing disturbed occlusion at the beginning of the surgical procedure, with an open bite on the left side and premature molar contact on the right side.

Slika 2.A Intraoperativna fotografija koja prikazuje poremećenu okluziju na početku kirurškog zahvata, s otvorenim zagrizom na lijevoj strani i prijevremenim kontaktom molara na desnoj strani

Figure 2B CT 3D reconstruction showing an irregular subcondylar fracture of the right condylar process with lateral displacement of the fragments and shortening of the right mandibular ramus.

Slika 2.B CT 3D rekonstrukcija prikazuje nepravilni subkondilarni prijelom desnoga kondilarnog nastavka s lateralnom dislokacijom fragmenata i skraćanjem desnoga ramusa mandibule

Figure 2C CT 3D reconstruction showing satisfactory reduction and fixation of the fracture using three titanium plates, along with four screws for IMF. According to established principles, at least two plates should be placed to ensure stability.

Slika 2.C CT 3D rekonstrukcija prikazuje zadovoljavajuću redukciju i fiksaciju prijeloma s pomoću triju titanijskih pločica, uz četiri vijka za IMF; prema ustaljenim principima, za osiguranje stabilnosti potrebno je postaviti najmanje dvije pločice

Figure 2D Intraoperative photograph showing habitual occlusion achieved at the end of the surgical procedure.

Slika 2.D Intraoperativna fotografija prikazuje uspostavljenu habitualnu okluziju na kraju kirurškoga zahvata

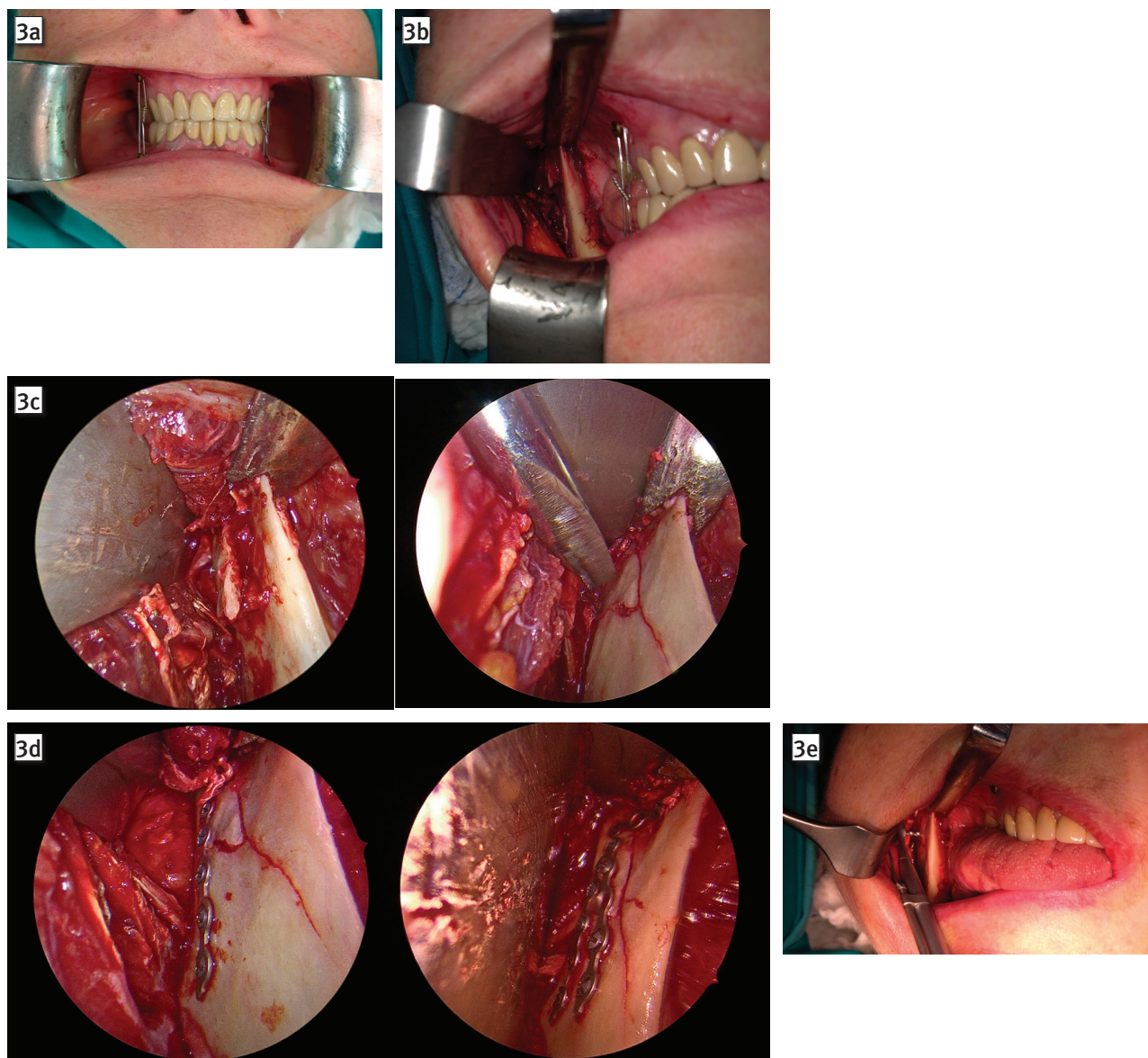


Figure 3 Surgical Procedure • Slika 3. Kirurški postupak

Figure 3.A Intraoperative photograph demonstrating the placement of rigid IMF to establish habitual occlusion.

Slika 3.A Intraoperativna fotografija prikazuje postavljanje rigidnoga IMF-a radi uspostavljanja habitualne okluzije

Figure 3B Intraoperative photograph demonstrating exposure of the fracture site after subperiosteal dissection during a transoral approach.

Slika 3.B Intraoperativna fotografija prikazuje eksponiranje mjesta prijeloma nakon subperiostalne disekcije tijekom transoralnoga pristupa

Figure 3C Endoscopic views of the condylar process fracture with lateral fragment displacement. The left image shows the fracture site, while the right image demonstrates fragment reduction using instruments and manual downward traction of the mandible.

Slika 3.C Endoskopski prikaz prijeloma kondilarnog nastavka s lateralnom dislokacijom fragmenta; lijeva slika prikazuje mjesto prijeloma, a desna redukciju fragmenta s pomoću instrumenata i manualne trakcije mandibule prema dolje

Figure 3D Endoscopic intraoperative views. The left image shows fixation with the first 2.0-mm titanium plate and 5-mm screws placed along the posterior border of the mandible. The right image demonstrates the addition of two more titanium plates toward the mandibular notch for improved stabilization of the fracture.

Slika 3.D Endoskopski intraoperativni prikaz; lijeva slika prikazuje fiksaciju prvom titanijskom pločicom debljine 2,0 mm i vijcima duljine 5 mm duž stražnjega ruba mandibule; desna slika prikazuje dodatne dvije titanijske pločice postavljene prema mandibularnoj incizuri radi bolje stabilizacije prijeloma

Figure 3E Use of specialized 90° angled instruments for the transoral approach during the surgical procedure.

Slika 3.E Primjena specijaliziranih kutnih instrumenata od 90° tijekom transoralnoga pristupa u kirurškome zahvatu

Case report 2

A 72-year-old female patient with a history of arterial hypertension and Parkinson's disease was referred to our Department after tripping and falling, resulting in a direct impact to the chin. Additionally, the fall caused a dislocation of the left shoulder, which was managed by an orthopedic team. On clinical examination, the patient presented with mandibular mobility localized to the right TMJ. Mouth opening was limited to 20 mm and associated with significant pain in the right TMJ. Occlusion was disturbed with an open bite (Figure 2.A). Also, the patient had 35x5 mm full thickness wound of the chin. MSCT revealed an isolated fracture of the right mandibular condylar process with a lateral dislocation (Figure 2.B). There were no additional fractures identified in the parasymphyseal or other regions. The patient was treated surgically under general anesthesia. IMF was established using self-tapping screws to stabilize the occlusion temporarily. A transoral approach was utilized to access the fracture site of the right condylar process.

Fixation was achieved using three 2.0 mm titanium miniplates. The first plate was vertically oriented along the posterior edge of the condyle, featuring four holes secured with four 5 mm screws. A similar plate was placed towards the anterior aspect, also with four holes and four 5 mm screws. To enhance stability, an additional horizontal titanium plate with three holes was applied at the fracture site, secured with two screws toward the bifurcation of the mandible. Endoscopic assistance was employed to ensure precise reduction and placement of the fixation hardware. Specialized angled instruments, including an angled screwdriver and borer, were used to navigate the anatomical complexities of the condylar fragment, which was medially angulated by more than 45 degrees, while minimizing soft tissue disruption. The patient's postoperative recovery was uneventful. She remained in the hospital for seven days due to her underlying conditions and was managed in consultation with the orthopedic team for the dislocated left shoulder. Control MSCT confirmed satisfactory alignment and fixation of the fracture (Figure 2.C). Occlusion was restored to its pre-injury state, and the IMF remained in place during hospitalization (Figure 2.D). There were no facial nerve deficits, and pain was well-controlled. At the first follow-up visit, 7 days postoperatively, the sutures were removed. Orthopantomographic imaging demonstrated satisfactory alignment and fixation. The IMF screws were removed on the last day of hospitalization, and soft food diet was implemented for 6 weeks. At the three-month follow-up visit, the patient reported no sensory or motor deficits, and occlusion remained stable. She could open her mouth to 45 mm without discomfort or limitations and had no functional or esthetic deficit. The fixation with two vertical titanium plates and an additional horizontal plate provided robust stability. The incorporation of advanced angled instruments facilitated precise reduction and secure fixation. Despite her complex medical history, the patient achieved full recovery in, with restored occlusion, normal function, and no residual complications.

Prikaz slučaja 2

Pacijentica, 72-godišnja žena s anamnezom arterijske hipertenzije i Parkinsonove bolesti, upućena je u naš odjel nakon što se spotaknula i pala, pri čemu je zadobila izravni udarac u bradu. Osim toga, pad je prouzročio dislokaciju lijevog ramena koju je zbrinuo ortopedski tim. Kliničkim pregledom utvrđena je pokretljivost mandibule lokalizirana na desni TMZ. Otvaranje usta bilo je ograničeno na 20 mm, uz izraženu bol u desnome TMZ-u. Okluzija je bila poremećena, s otvorenim zagrizom (slika 2.A). Pacijentica je također imala ranu na bradi pune debljine kože dimenzija 35 × 5 mm. MSCT-om je verificiran izolirani prijelom desnoga kondilarnog nastavka mandibule s lateralnom dislokacijom (slika 2.B). Nisu uočeni dodatni prijelomi parasimfize ili regija mandibule. Pacijentica je liječena kirurški u općoj anesteziji. IMF je uspostavljen s pomoću samoureznih vijaka radi privremene stabilizacije okluzije. Transoralni pristup korišten je za pristup prijelomu desnoga kondilarnog nastavka. Fiksacija je postignuta korištenjem triju titanijskih mini-pločica debljine 2,0 mm. Prva je bila vertikalno postavljena duž stražnjega ruba kondila, s četirima otvorima i osigurana četirima vijcima duljine 5 mm. Slična pločica postavljena je na prednji aspekt, također s četirima otvorima i četirima vijcima duljine 5 mm. Za dodatnu stabilnost, dodatna horizontalna titanijska pločica s trima otvorima postavljena je na mjestu prijeloma i pričvršćena dvama vijcima prema incizuri mandibule. Kako bi se osigurala precizna redukcija i pravilan položaj fiksacijskog materijala, primijenjena je endoskopska asistencija. Specijalni kutni instrumenti, uključujući kutni odvijač i svrdlo, korišteni su za navigaciju kroz anatomske strukture kondilarnog fragmenta koji je bio medijalno anguliran za više od 45 stupnjeva, uz istodobno minimalno narušavanje mekih tkiva. Postoperativni oporavak pacijentice protekao je bez komplikacija. Ostala je u bolnici sedam dana zbog svojih pridruženih stanja, a njezino liječenje provedeno je u suradnji s ortopedskim timom zbog dislokacije lijevog ramena. Kontrolni MSCT potvrdio je zadovoljavajuće poravnanje i fiksaciju prijeloma (slika 2.C). Okluzija je vraćena u stanje prije ozljede, a IMF je ostao na mjestu tijekom hospitalizacije (slika 2.D). Nisu zabilježeni deficiti facijalnoga živca, a bol je bila dobro kontrolirana. Na prvome postoperativnom kontrolnom pregledu, sedmog dana poslije operacije, uklonjeni su šavovi. Ortopantomografska snimka pokazala je zadovoljavajuće poravnanje i fiksaciju. IMF vijci uklonjeni su posljednjeg dana hospitalizacije, a pacijentici je preporučena mekana prehrana tijekom šest tjedana. Na tromjesečnom kontrolnom pregledu pacijentica nije prijavila nikakve senzorne ili motoričke deficite, a okluzija je ostala stabilna. Mogla je otvoriti usta do 45 mm bez nelagode ili ograničenja te nije imala ni funkcionalnih, ni estetskih deficita. Fiksacija dvjema vertikalnim titanijskim pločicama i dodatnom horizontalnom pločicom osigurala je čvrstu stabilnost. Primjena naprednih kutnih instrumenata omogućila je preciznu redukciju i sigurnu fiksaciju. Unatoč složenoj medicinskoj anamnezi, pacijentica se potpuno funkcionalno oporavila, uz vraćenu okluziju, normalnu funkciju i bez ikakvih komplikacija.

Surgical Procedure

The surgical procedures for both patients followed a standardized protocol with case-specific adaptations. Three surgeons participated in each procedure: one lead surgeon and two assistants. Endoscopic assistance was provided by the first assistant to ensure optimal visualization of the surgical field for the lead surgeon. Under general anesthesia, four self-tapping screws were inserted to establish IMF and achieve habitual occlusion (Figure 3.A). A local anesthetic, consisting of 1% lidocaine with epinephrine in a 1:100,000 ratios, was administered into the surgical field to enhance hemostasis and improve visibility during the procedure. A 2 cm vestibular incision was made along the external oblique ridge, thus allowing access to the fractured area. Subperiosteal dissection was carefully performed to expose the lateral surface of the ramus and the fractured condylar segment (Figure 3.B). During dissection of the posterior border of the mandible, particular attention was paid to avoid injury to the retromandibular vein and facial nerve. Coagulation or forceful traction in this region was avoided to minimize the risk of nerve damage. To ensure optimal visualization, a rigid 4 mm, 30° angled endoscope (Karl Storz, Tuttlingen, Germany) was inserted. Reduction of the proximal condylar fragment was achieved by manually pulling the mandible downward and/or using a mandibular angle retractor to assist in aligning the fracture (Figure 3.C). This technique allowed proper alignment of the fracture line while minimizing manipulation of the surrounding tissues. The fixation of the condylar fracture involved the sequential application of two 2.0 mm titanium plates and at the fracture site. The first screw was inserted into the proximal condylar fragment near the fracture line to secure the alignment. A second screw was also inserted into the proximal condylar fragment to ensure stable fixation. Following this, the third and fourth screws were placed in the distal fragment of the ramus, thereby completing the fixation of the first plate. The second plate was then positioned toward the anterior border of the mandible and extended toward the mandibular notch (incisura). As with the first plate, the screws were inserted in a precise sequence. The first and second screws were placed in the proximal condylar fragment, followed by the insertion of the third and fourth screws into the distal fragment of the ramus (Figure 3.D). This step ensured robust stabilization and proper anatomical alignment of the fractured condylar segment. The sequential placement of screws, starting with the proximal condylar fragment for both plates, was essential to achieve and maintain alignment while minimizing the risk of fragment displacement during the procedure. The use of endoscopic guidance throughout the fixation process allowed precise placement of plates and screws and minimized disruption to the surrounding soft tissues. Specialized instruments were employed to address the anatomical challenges of the medially displaced condylar fragments. A 90° angled screwdriver and a flexible angled borer (KLS Martin, Tuttlingen, Germany) were utilized to facilitate the placement of screws in anatomically challenging regions, particularly along the posterior and anterior borders of the mandible.

Kirurški postupak

Kirurški zahvati kod obaju pacijenata učinjeni su prema standardiziranom protokolu s prilagodbama specifičnima za svaki slučaj. U svakom zahvatu sudjelovala su tri kirurga: jedan glavni operater i dva asistenta. Endoskopska asistencija bila je zadatak prvoga asistenta kako bi se glavnome operateru omogućila optimalna vizualizacija operacijskoga polja. Pod općom anestezijom postavljena su četiri samourezna vijka radi uspostavljanja IMF-a i postizanja habitualne okluzije (slika 3.A). U kirurško polje infiltriran je lokalni anestetik – 1-postotni lidokain s epinefrinom u omjeru 1 : 100 000 da bi se poboljšala hemostaza i postigla bolja vidljivost tijekom zahvata. Učinjen je vestibularni rez duž vanjskoga kosoga grebena duljine 2 cm, čime je osiguran pristup ozljeđenom području. Subperiostealna disekcija pažljivo je obavljena kako bi se izložila lateralna površina ramusa i prijelomni segment kondila (slika 3.B). Pri disekciji stražnjega ruba mandibule, posebna pozornost posvećena je izbjegavanju ozljede retromandibularne vene i facijalnoga živca. Koagulacija ili snažna trakcija u tom su području izbjegnute kako bi se smanjio rizik od oštećenja živca. Za optimalnu vizualizaciju korišten je rigidni endoskop promjera 4 mm s kutom od 30° (Karl Storz, Tuttlingen, Njemačka). Redukcija proksimalnoga kondilarnoga fragmenta postignuta je ručnim povlačenjem mandibule prema dolje i/ili uporabom retraktora kuta mandibule za pomoć pri usklađivanju prijeloma (slika 3.C). Ta tehnika omogućila je precizno poravnanje linije prijeloma uz minimalnu manipulaciju okolnoga tkiva. Fiksacija prijeloma kondila uključivala je sekvencijalnu primjenu dviju titanijskih pločica debljine 2,0 mm na mjestu prijeloma. Prvi vijak umetnut je u proksimalni kondilarni fragment blizu linije prijeloma da bi se osiguralo poravnanje. Drugi vijak također je postavljen u proksimalni kondilarni fragment radi dodatne stabilizacije. Nakon toga, treći i četvrti vijak umetnuti su u distalni fragment ramusa, čime je dovršena fiksacija prve pločice. Druga pločica postavljena je uz prednji rub mandibule i protezala se prema mandibularnom urezu (incisura). Kao i kod prve pločice, vijci su umetnuti preciznim redoslijedom. Prvi i drugi vijak postavljeni su u proksimalni kondilarni fragment, nakon čega su treći i četvrti vijak umetnuti u distalni fragment ramusa (slika 3.D). Taj postupak osigurao je čvrstu stabilizaciju i pravilno anatomsko poravnanje puknutoga kondilarnog segmenta. Sekvencijalno postavljanje vijaka, započevši s proksimalnim kondilarnim fragmentom za obje pločice, bilo je ključno za postizanje i održavanje poravnanja te za minimizaciju rizika od dislokacije fragmenata tijekom zahvata. Primjena endoskopske navigacije tijekom cijelog procesa fiksacije omogućila je precizno postavljanje pločica i vijaka te smanjenje traume okolnih mekih tkiva. Specijalni instrumenti korišteni su za prevladavanje anatomskih izazovnih medijalno dislociranih kondilarnih fragmenata. Kutni odvijač od 90° i fleksibilno kutno svrdlo (KLS Martin, Tuttlingen, Njemačka) omogućili su precizno postavljanje vijaka u anatomske zahtjevnije regije, posebice duž stražnjega i prednjega ruba mandibule (slika 3.E). Nakon potvrde stabilnosti fiksacije i pravilnoga poravnanja okluzije, operacijsko polje zatvoreno je Vicryl 3-0

ble (Figure 3.E). After confirming the stability of the fixation and the proper alignment of occlusion, the surgical site was closed with Vicryl 3-0 sutures. A light, flexible IMF was applied a few hours postoperatively to maintain stability during the early healing phase. Both patients were instructed to follow a soft food diet for six weeks to facilitate bone healing and minimize strain on the mandible during recovery.

Discussion

The cases presented illustrate the effectiveness of a novel transoral endoscopically assisted transoral approach (EATA) in managing mandibular condylar process fractures. These are the first recorded applications of this technique in Croatia, underscoring its potential for broader clinical adoption to reduce postoperative complications associated with traditional extraoral approaches. EATA is gaining recognition as a minimally invasive surgical option with significant advantages in treating complex mandibular fractures.

While Silverman first mentioned an intraoral approach for condylar fractures in 1925, the first successful implementation of EATA was reported by Jacovitzet and colleagues in 1998, highlighting its minimally invasive nature (13, 14). A key advancement for intraoral surgery occurred when Fritzeimer and Bechthold introduced the 90-degree angular screwdriver (15). In 2021, Chen et al. conducted a systematic review and meta-analysis that provided strong evidence of EATA's benefits over traditional extraoral methods. Their analysis of seven studies, comprising 318 patients, revealed significant reductions in operative time (by an average of 5.56 minutes), intraoperative blood loss (by 89.02 ml), postoperative hospitalization (by 2.44 days), and drainage volume (by 32.97 ml). Additionally, complication rates were notably lower, with an odds ratio (OR) of 0.30 compared to extraoral techniques (16).

EATA not only reduces morbidity but also offers esthetic benefits by eliminating visible scars, which are commonly associated with external approaches. This technique enables precise visualization of the fracture site with minimal disruption to adjacent tissues, thereby reducing the risk of facial nerve damage and other complications. Systematic evaluations confirm that EATA is a safe and effective method that supports faster recovery and delivers superior esthetic outcomes, crucial for patient satisfaction and long-term treatment success (17, 18). While various surgical techniques have been developed to optimize the reduction and fixation of condylar fractures, some approaches remain more invasive. Kim et al. introduced an innovative method for internal stabilization using intracorporeal reduction following vertical ramus osteotomy. Their technique allows for precise anatomical reconstruction while preserving blood supply to the condylar fragment. However, unlike our minimally invasive approach, it requires an additional osteotomy, thus increasing surgical invasiveness, potentially prolonging recovery, and introducing additional technical challenges during the procedure. This highlights the advantage of EATA in achieving effective fracture stabilization while minimizing surgical trauma and associated risks (19).

šavovima. Nekoliko sati postoperativno postavljena je lagana, fleksibilna IMF fiksacija kako bi se održala stabilnost tijekom rane faze cijeljenja. Oba pacijenta dobila su upute da šest tjedana konzumiraju mekanu hranu kako bi se omogućilo adekvatno cijeljenje kosti i smanjilo opterećenje mandibule tijekom oporavka.

Rasprava

Prikazani slučajevi ilustriraju učinkovitost novoga transoralnoga endoskopski asistiranoga pristupa (EATA) u liječenju prijeloma kondilarnog nastavka mandibule. Ovo su prvi zabilježeni slučajevi primjene te tehnike u Hrvatskoj, što ističe njezin potencijal za širu kliničku primjenu u svrhu smanjenja postoperativnih komplikacija povezanih s tradicionalnim ekstraoralnim pristupima. EATA se sve češće prihvaća kao minimalno invazivna kirurška opcija s mnogobrojnim prednostima u liječenju složenih prijeloma mandibule.

Iako je Silverman još 1925. godine prvi spomenuo intraoralni pristup u liječenju prijeloma kondilarnog nastavka, prva uspješna primjena metode EATA-e zabilježena je tek 1998. u radu Jacovitzeta i suradnika koji su istaknuli minimalno invazivnu prirodu toga pristupa (13, 14). Ključni napredak u intraoralnoj kirurgiji dogodio se kada su Fritzeimer i Bechthold uveli kutni odvijač od 90 stupnjeva (15). Godine 2021. Chen i suradnici proveli su sustavni pregled i metaanalizu koja je pružila snažne dokaze o prednostima tehnike EATA-e u odnosu na tradicionalne ekstraoralne metode. Njihova analiza sedam studija s ukupno 318 pacijenata pokazala je značajno smanjenje operacijskoga vremena (u prosjeku za 5,56 minuta), intraoperativnoga gubitka krvi (za 89,02 mL), postoperativne hospitalizacije (za 2,44 dana) te volumena drenaže (za 32,97 mL). I stopa komplikacija bila je znatno niža, s omjerom izgleda (OR) od 0,30 u usporedbi s ekstraoralnim tehnikama (16).

EATA ne samo da smanjuje morbiditet, nego pruža i estetske prednosti jer eliminira vidljive ožiljke koji su često povezani s vanjskim pristupima. Ta tehnika omogućuje preciznu vizualizaciju mjesta prijeloma uz minimalno narušavanje okolnih tkiva, čime se smanjuje rizik od ozljede facijalnoga živca i drugih komplikacija. Sustavne analize potvrđuju da je EATA sigurna i učinkovita metoda koja omogućuje brži oporavak te osigurava superiorne estetske ishode, što je ključno za zadovoljstvo pacijenata i dugoročni uspjeh liječenja (17, 18). Iako su razvijene različite kirurške tehnike za optimizaciju redukcije i fiksacije prijeloma kondilarnoga nastavka, neki pristupi ostaju invazivniji. Kim i suradnici predstavili su inovativnu metodu za unutarnju stabilizaciju prijeloma primjenom intrakorporealne redukcije nakon vertikalne osteotomije ramusa. Njihova tehnika omogućuje preciznu anatomsku rekonstrukciju uz očuvanje opskrbe krvlju kondilarnog fragmenta. No za razliku od našega minimalno invazivnog pristupa, zahtijeva dodatnu osteotomiju, čime se povećava kirurška invazivnost, potencijalno produljuje oporavak i uvode dodatni tehnički izazovi tijekom zahvata. To dodatno ističe prednost metode EATA-e u postizanju učinkovite stabilizacije prijeloma uz istodobno smanjenje kirurške traume i pridruženih rizika (19).

Although our surgeries were more time consuming than conventional procedures, primarily due to the learning curve for this technique, the results affirmed the advantages of the endoscopically assisted transoral approach. Importantly, these were the first such operations performed in Croatia, conducted by a surgical team of three highly trained surgeons, thus highlighting the necessity of specialized knowledge and coordinated efforts. Regarding hospitalization, our patients spent less time in the hospital compared to traditional approaches: three days for the first patient and seven days for the second. The extended stay of the second patient was related to comorbidities rather than the surgical procedure itself. This shortened hospital stays further support the literature findings on quicker recovery and reduced postoperative monitoring needs for EATA-treated patients (9).

The present study demonstrated that neither of the two patients experienced pain associated with facial nerve injuries nor any complications such as hematomas, sialoceles, or salivary fistulas. Endoscopic visualization allowed precise fracture access and fixation with minimal disruption to surrounding tissues, thereby reducing the risk of functional and esthetic complications. The absence of visible facial scars is especially significant, as esthetic outcomes are often a priority for patients with such injuries. Furthermore, neither patient reported notable postoperative pain, reflecting the minimally invasive nature of the procedure and reduced soft tissue trauma. These findings reinforce that EATA not only ensures functional and esthetic advantages but also contributes to a better overall postoperative experience for patients.

Specialized instruments, such as angled drills and screwdrivers, are also essential for accurate fragment repositioning and fixation through an intraoral approach. This reduces the risk of injury to the facial nerve and inferior alveolar nerve while ensuring better functional and esthetic outcomes (20,21). This approach has proven effective in both a younger, otherwise healthy patient and an older patient with multiple comorbidities, demonstrating its versatility across patient demographics.

Although it presents specific challenges, endoscopic management of mandibular condylar process fractures represents a minimally invasive alternative to conventional surgical methods, (Table 1.). One notable risk is potential transient facial nerve weakness (3,4%), which, although reduced compared to extraoral methods, remains a concern in cases of complex dislocations or comminuted fractures (22,23). Sanati-Mehrizy et al. conducted a systematic review of endoscopic repair of mandibular fractures and analyzed data from 22 studies involving 509 patients. The study found an incidence of occlusal complications of 6.5, mainly malocclusion (4.4%) and anterior open bite (2.1%). In addition, intraoperative bleeding requiring conversion to open surgery was observed in 6.4% of cases, bony nonunion occurred in 8.3% of cases, postoperative infection in 3.0% of cases, screw loosening in 2.8% and permanent facial nerve injury (facial nerve palsy) in 0.2% of cases (24). Limited visibility and access can also complicate cases requiring extensive manipulation of fragments (25). Additionally, the technical complexity of EATA demands specialized equipment, including angled en-

Iako su naši operacijski postupci zahtijevali nešto više vremena u usporedbi s konvencionalnima, ponajprije zbog procesa učenja te tehnike, rezultati su potvrdili prednosti endoskopski asistiranoga transoralnog pristupa. Važno je istaknuti da su to bile prve operacije takve vrste učinjene u Hrvatskoj, a obavila ih je kirurška ekipa sastavljena od tri visokospecijalizirana kirurga, što ističe potrebu za specijaliziranim znanjem i koordiniranim radom tima. Kad je riječ o hospitalizaciji, naši pacijenti proveli su manje vremena u bolnici u odnosu prema pacijentima liječenima tradicionalnim metodama: prvi pacijent bio je hospitaliziran tri dana, a drugi sedam. Produženi boravak drugog pacijenta bio je posljedica komorbiditeta, a ne same kirurške procedure. Smanjeno trajanje hospitalizacije dodatno potvrđuje nalaze iz literature o bržem oporavku i smanjenim postoperativnim zahtjevima kad je riječ o praćenju pacijenata liječenih metodom EATA-e (9).

Ni jedan pacijent nije imao ozljedu facijalnoga živca, ni komplikacije poput hematoma, sialokele ili salivarnih fistula. Endoskopska vizualizacija omogućila je precizan pristup mjestu prijeloma i fiksaciju uz minimalno narušavanje okolnih tkiva, čime je smanjen rizik od funkcionalnih i estetskih komplikacija. Odsutnost vidljivih ožiljaka na licu posebno je značajna, zato što su estetski ishodi često prioritet pacijenata s takvim ozljedama. Nadalje, ni jedan pacijent nije prijavio značajnu postoperativnu bol, što dodatno ističe minimalno invazivnu prirodu postupka i smanjenu traumu mekih tkiva. Ti nalazi potvrđuju da EATA ne samo da osigurava funkcionalne i estetske prednosti, nego i pridonosi boljemu ukupnom postoperativnom iskustvu pacijenata.

Specijalni instrumenti, poput kutnih svrdla i odvijača, također su ključni za precizno repozicioniranje i fiksaciju fragmenata intraoralnim pristupom. To smanjuje rizik od ozljede facijalnoga i donjega alveolarnoga živca te osigurava bolje funkcionalne i estetske ishode (20, 21). Taj pristup pokazao se učinkovitim kod mladoga, zdravoga pacijenta, kao i kod starijega s mnogobrojnim komorbiditetima, što upućuje na njegovu primjenjivost u različitim populacijama pacijenata.

Endoskopsko liječenje prijeloma kondilarnog nastavka mandibule minimalno je invazivna alternativa konvencionalnim kirurškim metodama, premda postoje i određeni izazovi (tablica 1.). Jedan od potencijalnih rizika je prolazna slabost facijalnoga živca (3,4 %), koja je, iako smanjena u usporedbi s ekstraoralnim metodama, i dalje prisutna kod složenih dislokacija ili kominutivnih prijeloma (22, 23). Sanati-Mehrizy i suradnici proveli su sustavni pregled endoskopske sanacije prijeloma mandibule te analizirali podatke iz 22 studije koje su obuhvaćale 509 pacijenata. Istraživanje je pokazalo incidenciju okluzijskih komplikacija od 6,5 %, pri čemu su najčešći problemi bili malokluzija (4,4 %) i anteriorni otvoreni zagriz (2,1 %). Uz to, intraoperativno krvarenje koje je zahtijevalo konverziju u otvorenu kirurgiju zabilježeno je u 6,4 % slučajeva, koštana pseudoartroza u 8,3 %, postoperativna infekcija u 3,0 %, popuštanje vijaka u 2,8 %, a trajna ozljeda facijalnoga živca u 0,2 % slučajeva (24). Ograničena vidljivost i pristup mogu također otežati zahvate koji zahtijevaju opsežnu manipulaciju fragmenata (25). Dodatno, tehnička složenost metode EATA-e zahtijeva specijalnu opremu, uključujući kutne endoskope i instrumente,

Table 1 Comparison of Extraoral and Transoral Approaches in the Treatment of Mandibular Condylar Process Fractures
Tablica 1. Usporedba ekstraoralnih i transoralnih pristupa u liječenju prijeloma kondilarnog nastavka mandibule

Aspect • Pristup	Extraoral Approach • Ekstraoralni pristup	Transoral Approach • Transoralni pristup
Esthetic Outcome • Estetski ishod	Visible scars are possible, impacting facial aesthetics • Mogući vidljivi ožiljci koji mogu utjecati na estetiku lica	No visible scars, offering a superior aesthetic result • Nema vidljivih ožiljaka, osigurava superiorni estetski rezultat
Risk of Facial Nerve Injury • Rizik od ozljede facijalnog živca	Higher risk due to the proximity and potential damage to the facial nerve branches • Veći rizik zbog blizine i mogućeg oštećenja grana facijalnog živca	Reduced risk as the approach avoids external facial nerve branches • Smanjeni rizik jer pristup izbjegava vanjske grane facijalnog živca
Surgical Field Visibility • Vidljivost kirurškog polja	Provides a broad and clear field of view for complex and multi-fragment fractures • Omogućuje široko i jasno vidno polje za složene i višefragmentne prijelome	Limited visibility, reliant on endoscopic technology and expertise • Ograničena vidljivost, ovisi o endoskopskoj tehnologiji i stručnosti
Postoperative Recovery • Postoperativni oporavak	Typically associated with a longer recovery period • Obično povezan s duljim razdobljem oporavka	Shorter recovery time due to minimal invasiveness • Kraće vrijeme oporavka zbog minimalne invazivnosti
Invasiveness • Invazivnost	Involves external incisions, making it a more invasive approach • Podrazumijeva vanjske incizije, što ga čini invazivnijim pristupom	No external incisions, making it a minimally invasive technique • Bez vanjskih incizija, minimalno invazivna tehnika
Complication Risk • Rizik od komplikacija	Higher likelihood of hematoma, infection, and wound healing complications • Veća vjerojatnost hem atoma, infekcije i problema s cijeljenjem rane	Lower risk of complications such as hematoma and infection • Manji rizik od komplikacija poput hematoma i infekcije
Suitability for Severe Displacement • Prikladnost za teške dislokacije	Preferred method for addressing severe displacements or fractures requiring complex reconstruction • Preferirana metoda za teške dislokacije ili prijelome koji zahtijevaju složenu rekonstrukciju	Not ideal for complex, severely displaced fractures requiring extensive access • Nije idealna za složene, teško dislocirane prijelome koji zahtijevaju opsežan pristup
Technical Demand • Tehnička zahtjevnost	Moderate technical demand; requires general maxillofacial surgical expertise • Umjerena tehnička zahtjevnost; zahtijeva opću maksilofacijalnu kiruršku stručnost	High technical demand; requires specific training and use of specialized instruments • Visoka tehnička zahtjevnost; zahtijeva specifičnu edukaciju i korištenje specijalnih instrumenata
Hospital Stay Duration • Trajanje hospitalizacije	Longer hospital stays compared to transoral approach • Dulji boravak u bolnici u usporedbi s transoralnim pristupom	Shorter hospital stays due to reduced surgical trauma • Kraći boravak u bolnici zbog smanjenoga kirurškog traumatizma
Risk of Salivary Fistulas and Sialoceles • Rizik od salivarnih fistula i sijalokela	Moderate risk due to external incisions near salivary glands • Umjereni rizik zbog vanjskih incizija u blizini žlijezda slinovnica	Low risk as no external incisions are near salivary glands • Mali rizik jer nema vanjskih incizija u blizini žlijezda slinovnica

doscopes and instruments, as well as highly trained surgeons who have undergone specialized training. While EATA reduces visible scarring, esthetic outcomes may occasionally be compromised in cases requiring additional incisions due to anatomical complexities or technical limitations (25, 26,27). Furthermore, achieving optimal fragment repositioning can be challenging in complex fractures, necessitating careful planning and experience. Despite these challenges, EATA offers significant benefits in appropriate cases, particularly in terms of reduced invasiveness and improved esthetics.

The Department of Oral and Maxillofacial Surgery at University Hospital Dubrava, a reference center for maxillofacial traumatology under the Ministry of Health of the Republic of Croatia, has a rich history spanning 85 years in managing complex facial and jaw fractures. Over the years, it has gained international recognition as a center for education and innovation in maxillofacial surgery, particularly in the treatment of mandibular fractures. Annually, the department manages approximately 100 patients with mandibular fractures, one-third of whom are referred due to the complexity of their cases. The department utilizes advanced 3D technology for surgical planning and execution, enabling precise fragment reduction and individualized care for each patient. By integrating new technologies and innovative surgical methods, the Department of Maxillofacial and Oral Surgery continues to elevate standards in mandibular fracture treatment, thus ensuring excellent functional and aesthetic outcomes for its patients.

te visoko educirane kirurge s posebnim stručnim usavršavanjem. Iako EATA smanjuje vidljivost postoperativnih ožiljaka, estetski ishodi mogu biti kompromitirani u slučajevima koji zahtijevaju dodatne incizije zbog anatomskih složenosti ili tehničkih ograničenja (25, 26, 27). Nadalje, postizanje optimalne repozicije fragmenata može biti izazov kod složenih prijeloma, što zahtijeva pažljivo planiranje i iskustvo kirurga. Unatoč tim izazovima, EATA ima značajne prednosti u odabranim slučajevima, osobito kad je riječ o smanjenoj invazivnosti i poboljšanim estetskim rezultatima.

Klinika za kirurgiju lica, čeljusti i usta Kliničke bolnice Dubrava, Referentni centar za maksilofacijalnu traumatologiju Ministarstva zdravstva Republike Hrvatske, ima dugu povijest od 85 godina u liječenju složenih prijeloma lica i čeljusti. Tijekom godina stekla je međunarodno priznanje kao centar za edukaciju i inovacije u maksilofacijalnoj kirurgiji, osobito u liječenju prijeloma mandibule. Na godinu se u klinici liječi oko 100 pacijenata s prijelomima mandibule, od kojih je jedna trećina upućena zbog složenosti slučaja. Liječnici se koriste naprednom 3D tehnologijom za kirurško planiranje i izvedbu zahvata i tako omogućuju preciznu redukciju fragmenata i individualiziranu skrb za svakog pacijenta. Integracijom novih tehnologija i inovativnih kirurških metoda klinika kontinuirano podiže standarde u liječenju prijeloma mandibule i tako osigurava izvrsne funkcionalne i estetske ishode za svoje pacijente.

Conclusion

The transoral endoscopically assisted technique (EATA) for mandibular condylar fractures represents a significant advance in minimally invasive maxillofacial surgery, offering reduced morbidity and improved esthetic outcomes. Our results confirm the existing literature demonstrating the safety and efficacy of the technique with a low incidence of complications, including facial nerve injury. This study is the first documented application of EATA in Croatia and highlights its potential to improve national surgical protocols and expand treatment modalities. By minimizing surgical trauma and optimizing functional recovery, this approach may contribute to improved patient outcomes. Despite the inherent technical challenges and specialized training required, EATA holds promise for broader clinical application in the treatment of maxillofacial trauma.

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Zaključak

EATA je značajan napredak u minimalno invazivnoj maksilofacijalnoj kirurgiji zato što omogućuje smanjeni morbiditet i poboljšane estetske ishode. Naši rezultati potvrđuju postojeće podatke iz literature koji ističu sigurnost i učinkovitost te metode uz nisku incidenciju komplikacija, uključujući ozljede facijalnoga živca. U ovom istraživanju predstavljeni su i dokumentirani prvi slučajevi primjene metode EATA-e u Hrvatskoj te se ističe njezin potencijal za unapređenje nacionalnih kirurških protokola i proširenje terapijskih mogućnosti. Smanjenjem kirurške traume i optimizacijom funkcionalnog oporavka, taj pristup može pridonijeti boljim ishodima liječenja pacijenata. Unatoč tehničkim izazovima i potrebi za posebnom edukacijom, EATA pokazuje velik potencijal za širu kliničku primjenu u liječenju maksilofacijalnih trauma.

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Doprinos autora: I. Č. i M. T. – istraživanje; I. Č., M. T. i I. L. – metodologija; I. Č. i M. T. – vizualizacija; I. Č., M. T. i I. L. – pisanje prvog nacrt teksta; I. Č. i M. T. – konceptualizacija; I. Č. i M. T. – upravljanje projektom; I. L. – nadzor te izrada nacrti i kritička revizija teksta. Svi navedeni autori odobrili su tekst, uključujući redoslijed i popis autora.

Sažetak

Frakture mandibule, osobito one kondilarnog nastavka, česte su u maksilofacijalnoj kirurgiji i zahtijevaju učinkovite metode liječenja koje minimiziraju komplikacije, a istodobno osiguravaju funkcionalni i estetski oporavak. U ovom radu predstavljena su dva slučaja prijeloma kondilarnog nastavka mandibule liječenih transoralnom endoskopski asistiranom tehnikom (EATA), što je prvo dokumentirano primijenjeno korištenje toga pristupa u Hrvatskoj. Cilj: Cilj je bio procijeniti učinkovitost te minimalno invazivne metode u usporedbi s tradicionalnim ekstraoralnim pristupima koji su često rizični zbog vidljivih ožiljaka, ozljeda facijalnoga živca i produljenoga postoperativnog oporavka. **Metode:** U oba slučaja korišten je 30° kruti endoskopski specijalni kutni instrument za postizanje precizne vizualizacije, redukcije i fiksacije fraktura. Prvi slučaj uključivao je mladog muškarca s dvostrukom frakturom mandibule, a u drugom slučaju riječ je o izoliranoj frakturi kondilarnog procesa kod starije žene s komorbiditetima. Oba pacijenta uspješno su liječena bez komplikacija, uključujući ozljedu facijalnog živca, hematome ili salivarne fistule. **Rezultati:** Vrijeme hospitalizacije bilo je kraće u usporedbi s tradicionalnim pristupima, a oporavak je uključivao obnovljenu funkciju temporomandibularnoga zgloba (TMJ), stabilnu okluziju i odsutnost vidljivih ožiljaka. Metoda EATA pokazala se sigurnom i učinkovitom s mnogobrojnim prednostima poput smanjene morbidnosti, minimalne traume mekih tkiva i superiornih estetskih rezultata. Iako zahtijeva specijalnu opremu i dodatnu kiruršku izobrazbu, EATA ima znatan potencijal da postane standardni modalitet liječenja za frakture mandibule. **Zaključak:** Nalazi u ovom istraživanju pridonose sve brojnijim dokazima koji podržavaju kliničke prednosti ove minimalno invazivne tehnike.

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