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POSTTRAUMATIC OSTEOMYELITIS OF THE MANDIBLE: ETIOLOGY, PATHOGENESIS AND MODERN APPROACHES TO SURGICAL MANAGEMENT

Annotation. *Posttraumatic osteomyelitis of the mandible is a chronic bone infection developing after fractures or trauma, often in patients with systemic comorbidities or local risk factors, and requires combined surgical and antibiotic management tailored to bone vascularity, biofilm biology and host status (Baur et al., 2015; Spellberg & Lipsky, 2011; Hudson et al., 2017; Giordano et al., 1982; Sood et al., 2019; Masters et al., 2019).*

Keywords. *Posttraumatic osteomyelitis; mandibular fractures; jaw osteomyelitis; chronic bone infection; surgical debridement; decortication; systemic antibiotics; biofilm; immunocompromised patients; quality of life.*

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ПОСТТРАВМАТИЧЕСКИЙ ОСТЕОМИЕЛИТ НИЖНЕЙ ЧЕЛЮСТИ: ЭТИОЛОГИЯ, ПАТОГЕНЕЗ И СОВРЕМЕННЫЕ МЕТОДЫ ЛЕЧЕНИЯ

Аннотация. *Посттравматический остеомиелит нижней челюсти представляет собой хроническую инфекцию костной ткани, развивающуюся после переломов или травм, чаще у пациентов с системными сопутствующими заболеваниями или локальными факторами риска. Лечение требует комплексного подхода, включающего хирургическое вмешательство и антибактериальную терапию, с учетом васкуляризации костной ткани, биологии биопленок и иммунного статуса пациента (Baur et al., 2015; Spellberg & Lipsky, 2011; Hudson et al., 2017; Giordano et al., 1982; Sood et al., 2019; Masters et al., 2019).*

Ключевые слова. *Посттравматический остеомиелит; переломы нижней челюсти; остеомиелит челюсти; хроническая костная инфекция; хирургическая санация; декортикация; системные антибиотики; биопленка; иммунокомпрометированные пациенты; качество жизни.*

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PASTKI JAG‘NING POSTTRAVMATIK OSTEOMIYELITI: ETIOLOGIYASI, PATOGENEZI VA ZAMONAVIY DAVOLASH USULLARI

Annotatsiya. *Pastki jag‘ning posttravmatik osteomiyeliti — bu suyak to‘qimasining surunkali infeksiyasi bo‘lib, odatda jag‘ sinishlari yoki boshqa travmalar natijasida rivojlanadi. Ushbu kasallik ko‘pincha tizimli hamroh kasalliklari yoki mahalliy xavf omillari mavjud bo‘lgan bemorlarda uchraydi. Davolash suyak to‘qimasining qon bilan ta’minlanishi, biofilm biologiyasi hamda bemorning immun holatini hisobga olgan holda jarrohlik va antibakterial terapiyani o‘z ichiga olgan kompleks yondashuvni talab qiladi (Baur et al., 2015; Spellberg & Lipsky, 2011; Hudson et al., 2017; Giordano et al., 1982; Sood et al., 2019; Masters et al., 2019).*

Kalit so‘zlar. *Posttravmatik osteomiyelit; pastki jag‘ sinishlari; jag‘ osteomiyeliti; surunkali suyak infeksiyasi; jarrohlik debridment; dekortikatsiya; tizimli antibiotiklar; biofilm; immuniteti pasaygan bemorlar; hayot sifati.*

Abstract. Posttraumatic osteomyelitis is a severe complication of mandibular fractures and other maxillofacial injuries, driven by microbial colonization of devitalized bone and biofilm formation in poorly vascularized tissues.[5 8 12] Retrospective series show that chronic mandibular osteomyelitis is relatively uncommon but requires aggressive combined therapy, including debridement or decortication and prolonged culture-directed antibiotics, to achieve stable remission and primary wound closure.[1 7 8] Systemic reviews of osteomyelitis therapy indicate that 4–6 weeks of systemic antibiotics, often feasible orally when bioavailable agents are used, achieve cure rates comparable to parenteral regimens, especially when surgical source control is adequate.[5] Newer concepts emphasize distinct bacterial reservoirs (soft-tissue abscesses, biofilm on hardware and necrotic bone, and colonization of the osteocyte–lacuno–canalicular network), explaining high reinfection rates and the need for meticulous debridement and, where indicated, local antibiotic strategies.[12] Demographic data from maxillofacial

cohorts highlight the strong association between jaw osteomyelitis, systemic disease, and substance abuse, underlining the importance of comprehensive medical optimization in posttraumatic cases.[11] This thesis aims to synthesize current evidence on risk factors, pathogenesis, classification, and outcomes of surgical and antibiotic strategies in posttraumatic mandibular osteomyelitis, and to frame them within evolving biofilm-based concepts to guide individualized, function-preserving treatment.[1 5 7 8 11 12]

Objectives.

To evaluate contemporary concepts and clinical outcomes of combined surgical and antibiotic treatment of posttraumatic osteomyelitis of the mandible, with specific objectives to:

1.Describe epidemiology and risk factors (mandibular fractures, systemic comorbidities, substance abuse) in jaw osteomyelitis cohorts.[8 11]

2.Summarize evidence on systemic antibiotic regimens, routes and durations for chronic osteomyelitis in adults.[2 5]

3.Compare surgical strategies—debridement, decortication with periosteal disruption, marginal/segmental resection—and their impact on infection control and function.[1 3 7 8]

4.Integrate emerging biofilm and immune-proteome concepts to propose a rational treatment algorithm for posttraumatic mandibular osteomyelitis.[12]

Materials and Methods

Literature component

- **Design:** Narrative/scope review focused on posttraumatic and mandibular osteomyelitis.
- **Sources:** PubMed, Scopus and Web of Science; keywords such as “posttraumatic osteomyelitis”, “mandibular fracture infection”, “chronic mandibular osteomyelitis”, “systemic antibiotic therapy chronic osteomyelitis”, “biofilm bone infection”.[2 5 8 12]
- **Inclusion criteria:**
  - Human studies, adults ≥18 years.
  - Posttraumatic or fracture-related mandibular or maxillofacial osteomyelitis, or general adult chronic osteomyelitis where treatment principles are applicable.[1 5 7 8 11]
  - Reports of surgical procedure, antibiotic regimen and outcomes with ≥6 months follow-up where possible.[1 4 5 8]
- **Data extraction:**
  - Demographics, etiology (fracture, odontogenic, other trauma), comorbidities and substance abuse.[8 11]
  - Surgical method (irrigation–suction debridement, decortication with periosteal disruption, marginal vs segmental resection, hardware management).[1 3 7 8]
  - Systemic antibiotic type, route, duration; adjuncts (rifampin, local antibiotic devices).[2 5 12]
  - Outcomes: infection resolution, recurrence, complications, need for reoperation, quality of life.[1 3 5 7 8]

Clinical component

- **Design:** Retrospective cohort of all patients treated for posttraumatic mandibular osteomyelitis at your department over a defined period, mirroring previous retrospective studies.[1 7 8 11]
- **Inclusion criteria:**
  - History of mandibular fracture or maxillofacial trauma with subsequent clinical and radiologic diagnosis of chronic osteomyelitis (pain, fistula, sequestra, non-healing fracture).[1 7 8]
- **Variables:**
  - Trauma mechanism, fracture site and fixation method.[8]
  - Time from trauma to infection; prior surgeries and antibiotic courses.
  - Systemic comorbidities (e.g. diabetes, immunosuppression), substance abuse, vascular risk factors.[8 11]
  - Operative details: type/extent of debridement, decortication, periosteal disruption, suction–irrigation, local antibiotics, preservation of mandibular continuity and inferior alveolar nerve.[1 7 8]
  - Antimicrobial therapy: empiric vs culture-directed, IV and/or oral, total duration (target 4–6 weeks or more as clinically indicated).[2 5]
- **Outcomes:**
  - Primary: clinical and radiologic resolution of infection without further surgery.[1 5 7 8]
  - Secondary: recurrence, non-union, segmental resection or reconstruction, patient-reported function/quality of life.[3]

Core Treatment Concepts

Table 1.

Key management principles for posttraumatic mandibular osteomyelitis

Aspect	Key Points (applied to posttraumatic mandibular osteomyelitis)	Citations
Frequency & risk factors	Uncommon after fractures; strongly linked to comorbidities, substances	8,11
Surgical principles	Debridement/decortication, restore blood supply, remove necrotic bone	1,7,8
Antibiotic strategy	4–6 weeks systemic therapy; oral bioavailable agents often adequate	2,5
Biofilm & reinfection	Multiple bacterial reservoirs; explains chronicity and high recurrence	12,5

Results.

Posttraumatic mandibular osteomyelitis is rare among fracture patients (8 of 350 in one series) but more frequent in individuals with systemic disease or substance abuse, and the mandible is affected more often than the maxilla.[8 11] Conservative marginal resections alone show higher rates of persistent symptoms than more radical segmental resections in chronic mandibular osteomyelitis.[1] Decortication with deliberate periosteal disruption plus at least 6 weeks of targeted intravenous antibiotics produced complete radiologic resolution while preserving mandibular continuity.[7] Suction–irrigation systems after debridement improved infection control and allowed primary closure in post-fracture cases.[8]

Across adult chronic osteomyelitis, cure rates of roughly 60–90% are reported with 4–6 weeks of systemic therapy, with similar effectiveness between oral and parenteral regimens when bone-penetrating drugs are used for susceptible organisms, and there is no evidence that treatment beyond 6 weeks improves outcomes.[5] Quality-of-life data from mandibulectomy cohorts indicate that resection involving the symphysis has a greater negative impact than the choice between marginal and segmental resection, underscoring the need to balance infection control with functional preservation.[3]

Conclusion.

Posttraumatic osteomyelitis of the mandible is an uncommon but serious complication of facial trauma and fractures. Evidence supports a combined strategy of meticulous surgical debridement or decortication to remove necrotic, poorly vascularized bone and restore blood supply, together with 4–6 weeks of culture-directed systemic antibiotics with good bone penetration.[1 5 7 8] Adjunctive measures such as suction–irrigation systems and selected local antibiotic delivery help manage dead space and residual biofilm.[8 12] Outcomes improve when systemic comorbidities and substance abuse are treated and when surgery consciously preserves mandibular continuity and critical functional segments to maintain quality of life.[1 3 7 11] Evolving biofilm-focused and local antimicrobial strategies offer promising avenues to reduce recurrence and should be integrated into future treatment algorithms for posttraumatic mandibular osteomyelitis.[12]

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