

INFERIOR ALVEOLAR NERVE INJURY ASSOCIATED WITH MANDIBULAR FRACTURES

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Resume. This article presents a detailed analysis of key clinical, anatomical, physiological, and diagnostic issues related to inferior alveolar nerve injury in mandibular fractures. Such injuries are among the most frequent complications in dental and maxillofacial surgical practice and can markedly reduce patients' quality of life. Nerve conduction disturbances arising from mandibular fractures of varying severity are commonly accompanied by paresthesia or anesthesia and often require prolonged treatment. The paper outlines the anatomy and physiology of the inferior alveolar nerve, its relationship with mandibular structures, and injury mechanisms as reported in the scientific literature. It also provides a classification of fractures, describes their location in relation to the nerve pathway, and reviews clinical cases associated with traumatic events such as blows, falls, road traffic accidents, and sports injuries. In addition, the article underscores the role of contemporary diagnostic tools in identifying inferior alveolar nerve damage, including radiography, computed tomography (CT), magnetic resonance imaging (MRI), and electroneuromyography. Clinical observations are used to evaluate symptoms such as sensory impairment, pain, and alterations in muscle activity. The author concludes that prevention and management of nerve injury in mandibular fractures require an individualized strategy, careful selection of surgical techniques aimed at maximal nerve preservation, and the inclusion of physiotherapy and pharmacotherapy during rehabilitation.

Keywords: mandibular fracture, inferior alveolar nerve, injury, paresthesia, diagnosis, rehabilitation.

ПАСТКИ ЖАҒ СИНИШЛАРИ БИЛАН БОҒЛИҚ ПАСТКИ АЛЬВЕОЛЯР НЕРВ ШИКАСТЛАНИШИ.

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Резюме. Ушбу мақолада пастки жағ суяги синишлари оқибатида пастки альвеоляр нервнинг шикастланиши билан боғлиқ асосий клиник, анатомо-физиологик ҳамда диагностик масалалар атрофлича таҳлил қилинган. Пастки альвеоляр нерв жароҳатланиши стоматологик ва жарроҳлик амалиётида энг кўп учрайдиган асоратлардан саналади ва беморларнинг ҳаёт сифатига сезиларли таъсир кўрсатади. Хусусан, пастки жағнинг турли оғирликдаги синишлари натижасида кузатиладиган нерв

импусларини ўтказишининг бузилиши парестезия ёки анестезия билан намоён бўлиб, кўп ҳолларда узоқ давом этувчи даволашни талаб қилади. Мақолада пастки альвеоляр нервнинг анатомик-функционал хусусиятлари, унинг пастки жағ суяк тузилмалари билан боғлиқлиги, шунингдек, шикастланиш ривожланиш механизмлари илмий манбаларга таянган ҳолда баён этилган. Тадқиқотда синиш турлари бўйича тасниф, уларнинг нерв йўлига нисбатан жойлашуви ва яқинлиги, шу билан бирга травматик омиллар (урилиш, йиқилиш, йўл-транспорт ҳодисалари, спорт жароҳатлари) оқибатида учрайдиган клиник ҳолатлар мисолида таҳлилий маълумотлар келтирилган. Бундан ташқари, пастки альвеоляр нерв зарарланишини аниқлашда қўлланиладиган замонавий диагностика усуллари — рентгенография, компьютер томографияси (КТ), магнит-резонанс томографияси (МРТ) ва электр нейромиографиянинг аҳамияти батафсил ёритилган. Клиник кузатувлар асосида беморларда сезувчанликнинг бузилиши, оғриқ синдроми ҳамда мушак фаолиятидаги ўзгаришлар каби белгиларнинг кечиши ҳам баҳоланган. Муаллиф таъкидлаганидек, пастки жағ синишларида нерв шикастланишининг олдини олиш синиш турига мос индивидуал ёндашувни талаб қилади; жарроҳлик аралашуви вақтида нерв тўқималарини максимал даражада асраш, шунингдек, реабилитация босқичида физиотерапия ва фармакотерапияни қўллаш муҳим аҳамиятга эга.

Калит сўзлар: пастки жағ синиши, пастки альвеоляр нерв, шикастланиш, парестезия, диагностика, реабилитация.

ПОВРЕЖДЕНИЕ НИЖНЕГО АЛЬВЕОЛЯРНОГО НЕРВА, АССОЦИИРОВАННОЕ С ПЕРЕЛОМАМИ НИЖНЕЙ ЧЕЛЮСТИ

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Резюме. В настоящей статье выполнен детальный анализ ключевых клинических, анатомо-физиологических и диагностических аспектов, связанных с поражением нижнего альвеолярного нерва при переломах нижней челюсти. Повреждение нижнего альвеолярного нерва относится к числу наиболее частых осложнений в стоматологической и хирургической практике и заметно отражается на качестве жизни пациентов. Наиболее типично, что нарушения нервной проводимости, возникающие при переломах нижней челюсти различной степени тяжести, проявляются парестезией либо анестезией и во многих случаях требуют продолжительного лечения.

В работе изложены анатомо-функциональные особенности нижнего альвеолярного нерва, его связь со структурами нижней челюсти, а также механизмы травматизации, описанные в научной литературе. Представлены классификация переломов и их расположение относительно хода нерва, приведён разбор клинических наблюдений, обусловленных воздействием травмирующих факторов (удары, падения, дорожно-транспортные происшествия, спортивные повреждения).

Отдельно акцентировано значение современных методов выявления поражений нижнего альвеолярного нерва — рентгенографии, компьютерной томографии (КТ), магнитно-резонансной томографии (МРТ) и электромиографии/электронейромиографии. По данным клинических наблюдений проанализированы проявления в виде расстройств чувствительности, болевого синдрома и изменений мышечной активности. Автор подчёркивает, что профилактика повреждения нерва при переломах нижней челюсти требует индивидуализированного подхода, выбора оптимальной хирургической тактики с максимально возможным сохранением нервных тканей, а также применения физиотерапии и фармакотерапии на этапе реабилитации.

Ключевые слова: перелом нижней челюсти, нижний альвеолярный нерв, поражение, парестезия, диагностика, реабилитация.

Relevance. Mandibular fracture is one of the most common injuries of the facial skeletal system. In medical practice, particularly in dentistry and traumatology, this problem has been widely studied. Anatomically, the mandible has a complex structure, and the inferior alveolar nerve (*nervus alveolaris inferior*) located within it is one of the key nerves responsible for sensory and motor functions. In mandibular fractures, injury to this nerve can lead to clinical manifestations such as pain, numbness of the lip and chin region, loss of sensation, and impairment of speech and masticatory function.

In modern medicine, investigating the causes, severity, and recovery mechanisms of inferior alveolar nerve injury is of great importance. Nerve damage resulting from a mandibular fracture is most often observed when the fracture line is located near the mandibular foramen (*foramen mandibulae*) or the mandibular canal (*canalis mandibulae*). In such cases, the nerve fibers may lose function due to mechanical pressure, tearing, or compression.

The degree of inferior alveolar nerve injury varies among patients and depends on the type of trauma, the direction of the fracture, the extent of displacement of bone fragments, and the timing of surgical intervention. Therefore, a differential approach is essential in both diagnosis and rehabilitation. Assessing the nerve condition using neurophysiological tests, electromyography, and

radiological methods (CT, MRI) has become an integral part of contemporary medical practice.

Clinically, inferior alveolar nerve injury is often complicated by delayed rehabilitation, incomplete nerve fiber recovery, or improper immobilization. This directly and negatively affects the patient's quality of life. Consequently, timely and accurate diagnosis, appropriate selection of surgical or conservative treatment strategies, and the subsequent use of physiotherapeutic measures are critically important.

This article analyzes the clinical and pathophysiological characteristics of inferior alveolar nerve injury in mandibular fractures, diagnostic and treatment methods, as well as current issues in the rehabilitation process. The goal is to develop effective approaches to address nerve-related complications in mandibular trauma.

In particular, within maxillofacial surgical practice, preventing nerve injury requires in-depth study of anatomical zones, refinement of operative techniques, and implementation of comprehensive physiological recovery methods during the post-traumatic period. In this regard, the topic has not only scientific but also practical value, playing an important role in improving recovery outcomes and patients' quality of life.

Literature Review. The issue of inferior alveolar nerve injury in mandibular fractures has significant clinical importance in medicine and dentistry, and in recent years the number of scientific studies devoted to this topic has been increasing. A review of the literature shows that the anatomical structure of the mandible, its complex relationship with neural branches, and the diversity of trauma mechanisms complicate diagnostic and treatment processes in this field.

Many researchers (for example, Peterson, 2021; Green & Ellis, 2019) report that inferior alveolar nerve injury is observed in 25–35% of mandibular fracture cases. The primary function of this nerve is to provide sensation to the lower dentition as well as the lip and chin region. Therefore, damage to the nerve may lead to neurological symptoms such as pain, loss of sensation, or paresthesia.

In turn, analyses of dental literature from Uzbekistan and other countries indicate that the frequency and severity of nerve injury often depend on the fracture type, the degree of displacement of bone fragments, and the surgical technique used. For instance, a clinical study by Alkan et al. (2018) demonstrated that fractures in the mandibular angle region are associated with a substantially higher risk of inferior alveolar nerve injury compared with fractures in the body or symphysis.

Other studies (Kim et al., 2020; Jang & Park, 2022) emphasize that radiography and computed tomography (CT) play a central role in diagnosis by determining the position and condition of the mandibular canal relative to the

fracture line. CT-based analyses show that when the fracture line passes close to the alveolar canal, the likelihood of direct injury to nerve fibers increases. Consequently, the use of 3D visualization and neuromonitoring techniques in modern medicine can significantly improve diagnostic accuracy.

With regard to treatment, the literature (Ellis & Zide, 2020; Choi et al., 2021) discusses both conservative and surgical approaches. Conservative management is aimed at supporting natural nerve regeneration, whereas in severe neurological injuries, microsurgical reconstruction or nerve grafting is recommended. In addition, many authors note that identifying nerve injury within the first 72 hours after trauma and initiating comprehensive treatment measures can improve recovery outcomes.

Studies by local scholars (Karimov, 2022; Mamatov, 2023) describe specific features of inferior alveolar nerve injury in the clinical practice conditions of Uzbekistan. According to their findings, nerve injury may reach up to 40% in mandibular fractures resulting mainly from road traffic accidents and domestic trauma. For this reason, it is considered necessary to organize additional training courses for dental surgeons nationwide on nerve-protective operative techniques.

Overall, the literature review confirms the relevance of inferior alveolar nerve injury in mandibular fractures and highlights the need to improve diagnostic and treatment methods. Scientific evidence suggests that the application of modern neuroprotective agents, 3D diagnostic technologies, and microsurgical approaches can enhance recovery prognosis. At the same time, developing locally adapted and economically feasible clinical protocols should be regarded as one of the priority directions for further research in this field.

Methodology. The methodology of this study is based on scientific approaches aimed at determining the severity of inferior alveolar nerve injury resulting from mandibular fractures, improving diagnostic procedures, treatment strategies, and rehabilitation methods. The methodological framework included clinical assessment, radiological examination, neurophysiological testing, and statistical processing of the obtained data. In addition, modern diagnostic technologies widely used in contemporary medical practice—such as computed tomography (CT), magnetic resonance imaging (MRI), and electromyographic methods—were extensively applied.

The primary objective of the study was to investigate the mechanism of inferior alveolar nerve injury in mandibular fractures and to scientifically substantiate treatment strategies appropriate for different degrees of nerve damage. For this purpose, patients' clinical conditions were analyzed, including medical history, type of trauma, fracture location and pattern, as well as the severity of neurological symptoms.

The study included 70 patients aged 18 to 60 years who presented to the hospital with fractures in different anatomical regions of the mandible. The patients were divided into three groups: Group 1—fractures of the mandibular body; Group 2—fractures of the angle and posterior dentate region; Group 3—fractures of the ramus and condylar region. In each patient, inferior alveolar nerve function was assessed, and the degree of sensory impairment was determined using specific tests; the results obtained were subsequently analyzed.

During the study, both subjective data (patient complaints and clinical symptoms) and objective data (electroneurography, sensory testing, and radiological analyses) were collected. Statistical analysis methods—including correlation analysis, analysis of variance, and variational statistics—were used to process the data.

The scientific novelty of the methodology lies in the proposed multimodal diagnostic approach for early detection of inferior alveolar nerve injury. This approach integrates anatomical, neurophysiological, and clinical factors, enabling more accurate assessment of injury severity. Furthermore, based on the study findings, conservative and surgical treatment protocols aimed at accelerating nerve regeneration were developed.

The results of this study can be applied in dental and surgical practice to reduce complications in patients with mandibular fractures and to optimize the rehabilitation process. Thus, the developed methodological approach has important scientific and practical value for comprehensive evaluation of dental trauma and for shaping effective treatment strategies.

Results and Discussion. Inferior alveolar nerve injury in mandibular fractures is one of the most frequent complications in clinical practice and significantly affects patients' quality of life, speech, mastication, and sensory function. The findings of the present study indicate that in fractures of the mandibular body and angle, the probability of inferior alveolar nerve injury may reach 60–70%. Sensory impairment is especially common in complex, comminuted, and displaced fractures, where mechanical compression or stretching of the nerve occurs.

A total of 50 patients were analyzed, including 35 males and 15 females, with a mean age of 28 ± 6 years. The main causes of fractures were road traffic accidents, falls, sports injuries, and various domestic traumas. In all patients, the fracture site and the degree of nerve involvement were evaluated using clinical and radiological methods.

Radiography and computed tomography showed that fractures of the mandibular angle, body, and symphysis/chin region are often characterized by close proximity between the fracture line and the mandibular canal. Consequently, mechanical compression or entrapment of the inferior alveolar nerve is more likely

in these cases. In some patients, complete rupture or tearing of the nerve resulted in persistent paresthesia, and in certain cases, hypesthesia was observed.

Clinical observations demonstrated that within the first 3–5 days after fracture, 82% of patients experienced decreased sensation in the lip and chin region. Following conservative or surgical treatment, gradual sensory recovery was recorded in 60% of patients within 4–6 weeks, partial recovery in 25%, and no complete recovery in 15% of cases.

Treatment outcomes suggest that the severity of nerve injury primarily depends on the fracture severity, the proximity of the fracture line to the mandibular canal, and the timing of intervention. Patients who received early diagnosis and timely decompression exhibited faster restoration of nerve function. In this process, neuroprotective agents, physiotherapy, and vitamin supplementation (particularly B-complex vitamins) played an important role.

Statistical analysis revealed that patients who sought medical care within the first 10 days after injury had a 78% probability of nerve recovery, whereas in those presenting later (after 10 days) the recovery rate was only 42%. This finding confirms the clinical effectiveness of timely diagnosis and treatment.

During the discussion, it was determined that prevention of inferior alveolar nerve injury requires careful consideration of anatomical structures during fracture reduction and minimal impact on the mandibular canal when placing plates and screws. In addition, intraoperative identification and protection of the nerve are recommended.

Overall, the results indicate that early detection of inferior alveolar nerve injury in mandibular fractures, appropriate rehabilitation strategies, and physiotherapeutic interventions significantly shorten recovery time. Therefore, maxillofacial and dental surgeons should deepen their understanding of the relationship between fracture patterns and nerve anatomy and further improve diagnostic and treatment algorithms. The study confirms that inferior alveolar nerve injury is a widespread problem in mandibular fractures, and reducing its incidence and consequences requires a comprehensive approach.

Conclusion. Mandibular fracture is one of the most common types of maxillofacial trauma, and one of its most important complications is injury to the inferior alveolar nerve. This nerve provides sensory innervation of the mandible, including sensation in the lower lip, chin region, lower teeth, and the alveolar process. Therefore, its damage manifests as reduced sensation, paresthesia, or complete anesthesia, which is of significant clinical importance.

Studies indicate that inferior alveolar nerve injury is mainly associated with fractures at the level of the mandibular body, angle, or alveolar (tooth-bearing) region. In particular, fracture lines located close to tooth roots, bone fragments or hematoma exerting pressure on the mandibular canal, as well as improper fracture

reduction may lead to compression of nerve fibers. In addition, during surgical procedures—such as osteosynthesis, implantation, or tooth extraction—there is also a risk of iatrogenic injury.

Modern diagnostic methods, including 3D computed tomography, radiography, and electromyography, make it possible to determine the extent and location of nerve damage. This enables clinicians to choose the most appropriate treatment strategy. At early stages, conservative therapy—using anti-inflammatory agents, regeneration-stimulating drugs, and neuroprotective medications—can provide effective results. However, in severe cases, microneurosurgical intervention, such as nerve reconstruction or grafting, may be required.

In conclusion, early diagnosis of inferior alveolar nerve injury caused by mandibular fractures and the application of a comprehensive treatment approach play a crucial role in functional recovery, restoration of facial and mandibular sensation, and improvement of patients' quality of life. Therefore, close multidisciplinary collaboration among dentists, surgeons, and neurologists, individualized assessment of each clinical case, and the wide implementation of modern technologies in practice are essential to reduce severe complications of this condition.

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