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Temporomandibular joint injuries in boxers and combat sport athletes – diagnostics and therapeutic Management

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Abstract

Temporomandibular joint (TMJ) injuries represent a significant yet frequently underestimated issue among boxers and combat sport athletes. The TMJ, a complex biomechanical structure essential for chewing, speaking, and breathing, is highly susceptible to both acute trauma and chronic overload. Combat sports expose athletes to repetitive direct blows to the mandible, increased muscular tension, and stress-related clenching, all of which elevate the risk of intra-articular and muscular dysfunctions. These injuries often remain

undiagnosed, contributing to chronic pain, restricted jaw mobility, joint noises, headaches and long-term functional impairment.

This paper provides an overview of TMJ anatomy and biomechanics, highlighting the joint's vulnerability to trauma and microtrauma. It examines the epidemiology and mechanisms of injury in combat sports, emphasizing the prevalence of disc displacement, capsular damage, degenerative changes and muscle-related disorders in this population. The clinical presentation commonly includes joint pain, clicking, limited mouth opening and muscle tenderness. Diagnostic procedures are based on standardized DC/TMD protocols, physical examination and imaging methods such as MRI and CBCT, which enable precise identification of structural and functional abnormalities.

Therapeutic management focuses primarily on conservative treatment, including patient education, physiotherapy, manual therapy and pharmacotherapy with NSAIDs and muscle relaxants. When symptoms persist, minimally invasive techniques, such as intra-articular hyaluronic acid injections, botulinum toxin administration, arthrocentesis, and arthroscopy may be implemented. In severe therapy-resistant cases surgical intervention is considered. The paper underscores the importance of comprehensive, individualized treatment strategies and highlights preventive measures such as custom mouthguards, proper technique training, and early symptom assessment. Interdisciplinary collaboration is essential for effective diagnosis, management and prevention of TMJ injuries in combat sport athletes.

Key words: Temporomandibular disorders; Temporomandibular joint; Combat sports; Boxing; Maxillofacial injuries; Conservative treatment.

Introduction

The temporomandibular joint (TMJ) is one of the most complex articular structures in the human body. Its proper function enables essential life activities such as chewing, speaking, swallowing and breathing. Due to its anatomical structure and constant exposure to dynamic mechanical loads, the TMJ is prone to numerous dysfunctions, both overload-related and traumatic. Injuries to this joint may lead to significant functional limitations, chronic pain and even permanent anatomical changes that affect a patient's quality of life.[1] Although temporomandibular disorders occur relatively frequently in the general population, athletes participating in contact sports, especially boxers and combat sport fighters, constitute a particularly high-risk group. Frequent blows to the face, teeth clenching during exertion, and increased muscle tension resulting from intensive training and competitive stress, significantly increase the likelihood of TMJ injuries in this population. [2] Nevertheless, TMJ problems often remain undiagnosed or underestimated, promoting chronicity and worsening symptoms. The aim of this article is to provide a comprehensive analysis of temporomandibular joint injuries in combat sport athletes, with particular emphasis on anatomical aspects, epidemiology, injury mechanisms, clinical presentation, diagnostic methods and modern treatment strategies. This work seeks to raise awareness among specialists in sports medicine, dentistry and physiotherapy regarding the role of the TMJ in the health and performance of contact-sport athletes, as well as to indicate possible avenues for prevention and effective therapy of this complex clinical condition.[3]

Anatomy and Biomechanics of the TMJ

The temporomandibular joint is a symmetrical, bicondylar, ginglymoarthrodial joint that combines rotational and translational movements within a single structure, allowing for

complex mandibular motions. The articular surfaces consist of the mandibular head (condyle) and the mandibular fossa of the temporal bone, complemented by the articular eminence. These surfaces are covered with fibrocartilage rather than typical hyaline cartilage.[4] Between the bones lies the articular disc, composed of dense fibroblastic fibrous tissue, which divides the joint cavity into an upper and lower compartment lined with synovial membrane. The disc is biconcave, thicker at the periphery (particularly posteriorly), while the central zone is thin and avascular, relying on synovial fluid for nutrition. It is enclosed by the joint capsule, to which it is attached.[5] External reinforcements include the temporomandibular ligament and two accessory ligaments, the stylomandibular and sphenomandibular, which stabilize extreme joint movements. The TMJ functions as a paired system of joints working simultaneously, movement on one side influences the other. The lower compartment enables rotational movements, whereas the upper compartment is responsible for translation, allowing full mouth opening.[6]

The articular disc serves both a shock-absorbing function which distributes forces over a larger contact area to protect articular surface sand a stabilizing function, as its thickened periphery helps prevent displacement during movement, while the posterior band protects soft tissues during jaw closure. The disc is shaped by forces acting on the mandibular head, the central portion is compressed between the condyle and the articular eminence, resulting in central thinning and peripheral thickening.[7] This prevents disc displacement during opening and closing. Additionally, the biomechanical properties of joint components, such as the elasticity of the disc and cartilage, influence their deformation under load and tissue adaptation in response to daily mechanical stresses related to chewing or tooth grinding (bruxism).[8]

Epidemiology and Injury Mechanisms in Combat Sports

Combat sports such as boxing, MMA, wrestling and karate are associated with a high risk of craniofacial injuries, including injuries to temporomandibular joint structures. Direct blows to the mandible and repetitive microtrauma to the facial region may lead to acute or chronic overload-related changes within the TMJ. In contact sports, TMJ dysfunction symptoms occur significantly more often than in the general population, with the most common being joint pain, clicking, limited jaw mobility, and sensations of locking.[9] These changes may

be structural (e.g., disc displacement) or functional (e.g., masticatory muscle dysfunction and tension-type headaches).

TMJ injuries in combat sports may result from a single strong traumatic event (macrotrauma) or long-lasting overload (microtrauma). Direct blows to the mandible can cause displacement or injury of the articular disc, capsular tears or condylar fractures.[10] Such injuries may not be apparent on standard radiographs, requiring MRI or arthroscopy to evaluate structural damage. Indirect injuries include overload from prolonged tooth clenching, bruxism and psychological stress related to sports competition. These factors promote degenerative changes even in the absence of direct trauma.[11]

Risk factors for TMJ injuries include the athlete's level (professionals are more exposed than recreational practitioners), training frequency and intensity, fighting style (e.g., full-contact striking techniques) and lack of custom-fitted mouthguards. Some fighters present with persistent overload changes leading to chronic dysfunction, manifested by pain during eating, speech difficulties, chronic headaches and reduced jaw mobility.[12] In combat sports, TMJ injuries are often underdiagnosed or disregarded, increasing the risk of permanent functional impairment. Therefore, implementing effective post-traumatic treatment and preventive measures including athlete and coach education, proper mouthguard use and early assessment of seemingly minor symptoms is essential.[13]

Clinical Presentation and Diagnostics

Patients with temporomandibular disorders often report joint pain radiating to the ear, temple, neck or teeth. Clicking, popping, or joint noises during mouth opening and closing may occur, as well as reduced range of motion (trismus), difficulty fully opening the mouth and sensations of jaw catching or locking.[14] Symptoms may include tension-type headaches, the feeling of an unstable bite and discomfort during chewing. Physical examination often reveals tenderness of the masticatory muscles, joint tenderness (especially on pressure near the external auditory meatus) and the presence of crepitus or clicks. An interincisal distance below approximately 35 mm indicates restricted function and lateral deviations during opening may suggest pathological movement patterns.[15]

Diagnostics begin with a detailed interview based on the DC/TMD protocol, which considers pain history, joint noises, functional limitations, psychosocial stress and behavioral factors.

Clinical assessment includes jaw motion evaluation, auscultation of joint sounds, palpation of muscles and joint structures, and occlusal assessment. DC/TMD enables standardized classification of muscle-related and intra-articular disorders, integrating physical and psychosocial factors.[16]

Imaging is indicated when disc displacement, osteoarthritis, bone structural changes or unexplained clinical symptoms are suspected. Cone-beam CT provides detailed assessment of bone changes including erosions, osteophytes and sclerosis, while MRI is indispensable for evaluating disc displacement, capsular injuries or post-traumatic hemarthrosis.[17] MRI demonstrates high sensitivity in detecting degenerative joint changes, although specificity for certain bone lesions may be lower and interobserver agreement moderate, emphasizing the need for combined clinical and radiologic interpretation.[18]

In selected cases, diagnostic arthroscopy can reveal ligament tears, capsular adhesions, cartilage fragments or occult hemarthrosis, influencing the treatment plan. Differentiating TMD from conditions such as trigeminal neuralgia, otitis, parotid disorders or cervical muscle pain requires complete ENT, neurological and dental evaluation. Common symptoms such as joint pain, limited jaw function, clicking, and muscle tenderness carry prognostic significance. For instance, reduced maximal mouth opening correlates with non-reducing disc displacement and degenerative features, requiring more intensive treatment. Joint clicking may occur with multiple types of disc displacement and is not a strong indicator of degeneration. Therefore, a comprehensive diagnostic approach integrating clinical findings, psychosocial assessment, and imaging is essential for selecting appropriate therapy and predicting functional recovery.[19]

Therapeutic Management

Therapeutic management of TMJ injuries in boxers and combat sport athletes should be multimodal, beginning with conservative approaches and progressing to invasive interventions when necessary. The first step includes patient education and implementation of self-care strategies, such as proper chewing habits and relaxation techniques. Gentle, non-invasive interventions such as physiotherapy (manual therapy, stretching and strengthening exercises of masticatory muscles) and therapeutic electrotherapy show moderate evidence for reducing pain and improving mouth opening. Reducing muscle tension and improving jaw mobility significantly enhances comfort and function.[20]

Pharmacotherapy complements conservative treatment: NSAIDs, often combined with proton pump inhibitors, along with muscle relaxants constitute first-line therapy for pain and acute post-traumatic symptoms. Their effectiveness is particularly evident in inflammatory and muscle-related injuries.[21]

For dysfunctions resistant to conservative therapy, minimally invasive procedures may be considered. Intra-articular hyaluronic acid (HA) injections have proven effective in increasing jaw mobility and reducing pain. Controlled studies show that HA significantly improves mandibular range of motion (abduction and protrusion), outperforming platelet-rich plasma (PRP), which did not yield significant improvements in these parameters. HA also exhibits anti-inflammatory effects through CD44 receptor interaction, reducing intra-articular friction and supporting tissue regeneration.[22]

Botulinum toxin (BTX-A) injections, primarily administered to the lateral pterygoid muscle or other masticatory muscles, may provide relief in chronic, therapy-resistant cases. BTX reduces muscle tension, decreasing pain and improving joint function, although its effectiveness in purely intra-articular disorders (e.g., disc displacement) is limited. These injections are typically used as an adjunct to physiotherapy and HA supplementation.[23]

When conservative treatment and injections fail-and adhesions, disc displacement, or persistent hemarthrosis are present-arthroscopy or arthrocentesis may be performed. These procedures allow joint lavage, adhesion release and introduction of therapeutic agents without open surgery. In select cases of structural or degenerative changes, surgical intervention may be considered, though it should remain a last resort for chronic, severely limiting conditions.[24]

A multimodal treatment strategy also includes various physiotherapeutic modalities: low-level laser therapy, ultrasound and TENS, which support tissue repair aa well as provide analgesic and anti-inflammatory effects. Research shows that laser therapy significantly reduces pain, enhances muscle relaxation and improves joint mobility.[25]

Therapeutic approaches must always be individualized, considering the type of dysfunction (muscular vs. articular), stage (acute vs. chronic), level of athletic activity and personal preferences. A comprehensive strategy, combining education, manual therapy,

physiotherapy, pharmacotherapy and, when needed, minimally invasive interventions offers the best chance for full functional recovery and return to sport.[26]

Conclusions

Temporomandibular joint (TMJ) injuries among boxers and combat sport athletes represent a serious yet often underestimated clinical problem affecting both mastication and overall quality of life. Despite the high prevalence of symptoms such as joint pain, limited mobility, clicking, jaw locking and chronic headaches, TMJ injuries in this athlete group are still not routinely diagnosed or adequately monitored. Direct blows to the mandible, muscular overload, stress-induced clenching and lack of mouthguard use significantly increase the risk of TMJ injuries. In many cases, TMJ trauma is not associated with visible fractures, which may lead to misinterpretation of the clinical situation and failure to implement proper treatment.

Accurate diagnosis requires not only thorough history taking and functional assessment but also modern imaging tools such as MRI and CBCT. These techniques allow the detection of disc displacement, inflammatory changes, bone injuries and other clinically occult pathologies. Standardized diagnostic protocols such as DC/TMD support accurate diagnosis and enable assessment of psychosocial factors that may significantly influence treatment outcomes.

Treatment should be comprehensive and tailored to the type of injury, severity of symptoms and the athlete's expectations regarding function and return to sport. Conservative methods including manual therapy, movement exercises, pharmacotherapy and stabilization splints are effective in most cases. When symptoms persist, intra-articular injections of hyaluronic acid or botulinum toxin may be implemented, as well as consideration of arthroscopy for joint lavage or adhesion release. Surgery should remain a last resort reserved for chronic, therapy-resistant cases.

From a sports medicine perspective, prevention is equally important as treatment. Regular TMJ function assessment, use of custom mouthguards, proper striking technique training and education of athletes and coaches can significantly reduce the risk of chronic dysfunction. Early intervention, comprehensive diagnostics and interdisciplinary collaboration among

physicians, dentists, physiotherapists and sports psychologists are essential for effective management of TMJ injuries in athletes.

Disclosure

Author's contribution

Conceptualization: Tomasz Bursztyn,

Methodology: Tomasz Bursztyn, Michał Bursztyn,

Formal analysis:

Investigation:

Writing-rough preparation: Tomasz Bursztyn,

Writing-review and editing: Michał Bursztyn,

Supervision:

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