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Dental injuries in sports: patterns, risk factors, and management – a literature review

Authors:

Kadłubowska Karolina

0009-0006-5588-1329

karolina.kadlubowskaa@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Sikorski Adam

0009-0006-8463-3957

adam.sikorski515@gmail.com

Medical University of Gdańsk, M. Skłodowskiej-Curie Street 3a, 80-210 Gdańsk, Poland

Chojnowska Natalia

0009-0004-8714-1726

nataliachojnowska@poczta.fm

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Rytel Jan

0009-0006-0831-9990

janryt@poczta.fm

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Szaryński Mikołaj

0009-0001-7344-8020

mikolaj.szarynski@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Jakubowska Paulina

0009-0007-6376-3135

paula.bialystok@wp.pl

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Jakubowska Martyna

0009-0008-7234-5178

m.jakubowska2003@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Bursztyn Michał

0009-0004-7566-6859

bursztyn82@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Bursztyn Tomasz

0009-0003-1862-1155

tomasz.bursztyn03@gmail.com

Medical University of Rzeszów, al. Tadeusza Rejtana 16c, 35-959 Rzeszów

Gólcz Adrian

0009-0009-8831-7398

adriangolcz@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Gólcz Julia

0009-0009-3424-4082

golczjulia@gmail.com

Medical University of Białystok, ul. Jana Kilińskiego 1, 15-089 Białystok, Poland

Abstract

Introduction and purpose: The head and face, due to their prominent positions, are at risk of intentional and unintentional injuries in the majority of competitive sports. Maxillofacial injuries represent a significant medical concern in both contact and non-contact sports.

State of knowledge : Current research focuses on the classification and management of the most common types of trauma, including abrasions, lacerations, hematomas, nasal fractures, jaw fractures, zygomatic and orbital fractures, as well as dental injuries such as tooth avulsion and fractures. The literature highlights the importance of both conservative and surgical treatment. Recommendations are based on current guidelines, including those issued by the American Heart Association and the Centers for Disease Control and Prevention, particularly in relation to infection prevention and tetanus immunization.

Summary: Maxillofacial injuries pose a significant clinical challenge. Early recognition and appropriate management are vital to avoid serious complications, disfigurement, and loss of function. Sports medicine practitioners must possess detailed knowledge of the injury types, underlying mechanisms, natural progression, anatomical factors, and treatment modalities. Moreover, future efforts should focus on advancing preventive measures to reduce the incidence of maxillofacial trauma.

Keywords: dental trauma, maxillofacial injuries, soft tissue injuries, sports medicine

Introduction:

According to available data, up to 12% of facial trauma cases treated in major trauma centers are directly related to sports activities.[1] Despite advancements in protective equipment and modifications to game rules, the incidence of such injuries remains unacceptably high. Scientific literature reports that 6–8% of all bodily trauma involves the face and jaws, while as many as 39% of dental injuries are sports-related.[2]

This article provides an overview of the most common maxillofacial traumas associated with athletic activity, emphasizing contemporary methods of diagnosis and treatment. Injuries most frequently affect the anterior teeth, particularly the upper central incisors, while lateral incisors and lower anterior teeth are less commonly involved. The types of trauma range from minor enamel cracks to more severe cases such as avulsions, root fractures, soft tissue injuries, and fractures of the jawbones.[3] Crown fractures and tooth loss are especially

prevalent and often result in costly dental care, interrupted training schedules, and, in some cases, exclusion from athletic events.[4]

The aim of this article is to review the most common types of sports-related maxillofacial trauma and to provide an overview of current diagnostic and treatment approaches.

Materials and Methods

This article presents a narrative review of the scientific literature concerning dentofacial injuries related to sports activities. The aim of this study was to analyze current data on the incidence of such injuries, their clinical characteristics, classification, diagnostic and therapeutic management, as well as general principles of prevention.

The source material was collected through a systematic search of international databases, including PubMed, Scopus, and Google Scholar. The search process covered the period from 1990 to 2023 and was conducted using relevant keywords such as: “dental trauma”, “maxillofacial injuries”, “soft tissue injuries”, “sports medicine”. Additionally, a manual review of the reference lists of preliminarily selected articles was performed, allowing for the identification of further relevant sources. Only scientific publications written in English or Polish were included in the analysis, provided they directly addressed dentofacial injuries resulting from physical or sports activities. The selection encompassed original research articles,

literature reviews, clinical reports, comprehensive reviews, and relevant textbook chapters focused on the diagnostic and therapeutic approach to the discussed injuries. Publications that did not relate to sports as an etiological factor, lacked full-text access, or failed to meet basic methodological or content-related standards were excluded. The initial screening of publications was based on titles and abstracts, followed by full-text analysis of selected works. The selection and content evaluation process was conducted independently by two reviewers to minimize the risk of bias or error. The information extracted from the included studies was categorized thematically and grouped according to major areas of interest, such as the epidemiology of injuries, mechanisms of trauma, the most commonly observed lesions (including facial bone fractures, tooth displacement or avulsion, and soft tissue injuries), diagnostic methods, and both conservative and surgical treatment strategies. This methodology made it possible to obtain a broad and comprehensive overview of the issue of dentofacial sports injuries, taking into account both clinical and practical aspects. The gathered material provides a solid foundation for further analysis and interpretation of data, with the ultimate goal of improving our understanding of these injuries and enhancing standards of care for athletes at risk.

Discussion

Maxillofacial injuries are complex and often require a multidisciplinary diagnostic and therapeutic approach. Orofacial traumas, which commonly occur during physical activities, sports, or accidents, can present in various clinical forms.[3-4] In the medical and dental literature, these injuries are generally classified into the following main categories:

1. **Soft tissue injuries** – including abrasions, contusions, and lacerations involving the lips, cheeks, gums, and oral mucosa;

2. **Fractures of the facial bones** – affecting structures such as the mandible, maxilla, nasal bones, zygomatic bones, and orbital region;

3. **Dental injuries**, which include:

- crown fractures (ranging from enamel only to those involving dentin and pulp),

- root fractures (in the apical, middle, or cervical third),
- tooth displacement (luxation, intrusion, extrusion),
- complete tooth avulsion.

This classification facilitates a better understanding of injury mechanisms, accurate diagnosis, and appropriate treatment planning. Since injuries within the oral cavity often coexist with damage to other maxillofacial structures, a comprehensive clinical evaluation is essential to ensure optimal patient care.

Dental Trauma

Although dental injuries in sports make up a relatively small proportion of all accidents—ranging between 2% and 33%—the associated treatment costs are disproportionately high compared to the number of incidents Greenberg and Springer [5] categorized dental trauma into two types: direct and indirect. Direct trauma typically occurs from a blunt impact with sports equipment or an opponent, often resulting in fractures of the upper front teeth. Injuries to the lips can reduce the force to the teeth but increase the chance of tooth avulsion (complete displacement). [6]

Indirect dental trauma happens due to an upward force on the lower jaw. Contact sports like hockey, football, and lacrosse increase the risk of this type of injury. In such cases, the lower teeth are forcefully driven upward against the upper teeth. Teeth that have been structurally weakened by large fillings or root canal treatments are more susceptible to fractures. Any dental injury should prompt the examiner to check for other related injuries to the face and jaw area.

Dental trauma frequently occurs as a result of facial impacts, particularly during athletic activities. Among these injuries, crown fractures are the most prevalent type affecting the front permanent teeth. [6] these can be categorized based on depth and severity:

- **Fractures limited to enamel** are typically painless and often go unnoticed. They are not urgent and can usually be resolved by smoothing the sharp edges. [7]
- **Fractures involving both enamel and dentin** can cause sensitivity to temperature or air exposure. If the broken fragment is found, it should be stored in a suitable medium like

milk and taken to the dentist for potential reattachment. Temporary protection can be applied to reduce sensitivity until definitive treatment is provided. [7]

- **Fractures that reach the pulp** require more complex management. The treatment depends on the condition of the pulp and the developmental stage of the tooth. For teeth with living pulp and fully developed roots, pulp capping followed by restoration is recommended. In teeth with immature roots, procedures to encourage natural root development (apexogenesis) are preferred. If the pulp is necrotic, either root canal treatment or apexification is necessary, depending on the root status. [7-8]

In addition to damage to the crown, root fractures may also occur and are classified according to their position:

- Fractures in the apical third tend to have a positive prognosis, especially if tooth segments remain stable and vital. These may only be identified through radiographs.[9]

- Middle third root fractures benefit from early repositioning and stabilization. If addressed quickly, the outcomes are often successful.[9]

- Cervical third fractures, near the gumline, carry a worse outlook. In such cases, extraction may be required, followed by restorative procedures such as dental implants.[9]

Proper diagnosis and timely intervention are crucial for preserving tooth vitality, restoring function, and achieving aesthetic outcomes. These injuries, though sometimes overlooked, demand attention due to their potential long-term consequences.[10-11]

Mandibular Trauma

Mandibular trauma constitutes approximately 10% of all sports-related maxillofacial injuries [12]. The most frequently affected area is the alveolar (tooth-bearing) portion of the mandible, where injuries can range from individual tooth fractures or avulsions to mobility of an entire bone segment. When two or more teeth move together as a unit, it strongly suggests a fracture involving the alveolar bone. Intraoral soft-tissue lacerations often occur simultaneously due to the close relationship between gingival tissues and the underlying bone. [13]

Fractures may also involve other regions of the mandible, including the condyle, symphysis, body, and angle. Each of these presents distinct clinical features:

- Alveolar fractures typically manifest with displaced teeth and sometimes segmental mobility within the dental arch.

- Condylar fractures may be unilateral or bilateral. In unilateral cases, the mandible tends to deviate toward the affected side during mouth opening. Bilateral condylar fractures often lead to an anterior open bite, with lack of contact between the front teeth.

- Symphyseal fractures involve the midline of the mandible and often result in displacement of the lower incisors and a noticeable disruption of the arch. The fracture may allow manual separation of the bone segments.

- Fractures in the body or angle of the mandible may lead to visible facial asymmetry, swelling, bruising, and difficulty in jaw movement or speaking.

Dislocation of the mandible occurs when the mandibular condyle is displaced anteriorly out of the glenoid fossa, often due to a forceful depression of the jaw. [14] This condition is typically maintained by muscle spasm, resulting in jaw deviation to the opposite side and difficulty achieving proper occlusion. In some cases, subcondylar trauma may lead to inflammation within the temporomandibular joint (TMJ), which can cause localized pain, swelling, and limited range of motion. Repetitive trauma to the TMJ may contribute to the development of TMJ dysfunction, which can include chronic unilateral pain, joint noises such as clicking, episodes of jaw locking, and pain radiating to the ear, jaw, or neck. Physical signs may include muscle tenderness (particularly in the masseter, temporalis, and pterygoid muscles) and facial asymmetry during jaw movement. [12-14]

Maxillary Trauma

Maxillary fractures are categorized into Le Fort types I, II, and III, usually caused by high-speed impacts to the midface region.

- Le Fort I fractures involve the separation of the maxilla from the nasal septum and pterygoid plates. These fractures are clinically recognized when the entire maxilla moves independently as one piece.[12]

- Le Fort II fractures cause separation of the maxilla and nasal complex from the orbital and zygomatic bones. Upon examination, the maxilla and nose move together as a single unit.[12]

- Le Fort III fractures result in the detachment of the maxillary, zygomatic, nasal, and orbital bones from the skull base.[12]

Le Fort I and II fractures often present with a sunken midface appearance, breathing difficulties, poor dental alignment, intraoral bleeding, and swelling. Radiographic imaging is essential to identify the fracture locations and assess the extent of deformity. [14]

Zygomatic Fractures

Zygomatic fractures, often referred to as “tripod fractures,” arise from blunt force trauma to the cheek area and represent about 10% of all maxillofacial injuries in sports. They are named for the three fracture points where the zygoma connects to the temporal, frontal, and maxillary bones. Clinical assessment includes checking for asymmetry and inward displacement of the fractured bone. Edema may obscure these signs. Palpation can reveal step-offs at the frontozygomatic suture and the lower orbital rim. Damage to the infraorbital nerve typically causes numbness in the cheek region. [15]

Frontal Sinus Fractures

Frontal sinus fractures usually happen due to blunt or sharp injuries to the forehead and can involve either the anterior or posterior sinus walls. Common signs include forehead pain and swelling. Any inward deformity of the forehead may be hidden by swelling. Nosebleeds are a frequent symptom, and clear nasal discharge may indicate leakage of cerebrospinal fluid, which suggests fractures of the posterior frontal sinus wall or the cribriform plate. Upright posterior-lateral and lateral X-rays are necessary to evaluate the injury. [16-17]

Maxillary and Ethmoid Sinus Fractures

Fractures of the maxillary sinus may occur alone or alongside other midfacial fractures such as zygomatic or orbital blowout fractures. Palpable crepitus is often detected over the fracture area. Ethmoid sinus fractures are less common from direct trauma due to their protected location and usually result from indirect forces transmitted through adjacent facial bones. Signs include swelling and a palpable crackling sensation in the medial orbit area.The severity of adjacent tissue damage influences the nature and complexity of fractures involving the frontal, maxillary, and ethmoid sinuses. [16-17]

Orbital Trauma

Orbital fractures are divided into two main types: those affecting only the orbital walls and those involving the bony orbital rim. About one-third of these fractures result from sports injuries. [18] Common signs of orbital trauma include swelling (periorbital edema), bruising, eye protrusion (proptosis), and irregularities along the orbital rim. Early eye examination is vital since swelling can worsen quickly, making further checks difficult.Injury history should include the cause, any loss of consciousness, vision changes, and pain level. Basic eye exams use a visual acuity chart and ophthalmoscope to assess vision and nerve function without applying pressure to the eye. Symptoms such as double vision in one eye, light sensitivity, limited eye movement, corneal injuries, or blood in the eye suggest serious ocular damage. Pain, proptosis, or retinal artery pulsation may indicate orbital bleeding, while vision loss or a non-reactive pupil can mean optic nerve injury, requiring urgent referral. [19-20] Jaw pain when opening may indicate lateral wall fractures; numbness in the cheek area (V2 nerve) often points to orbital floor fractures. Allergic or infectious causes of swelling should also be considered, with close monitoring for possible severe allergic reactions. [21]

CT scans are the preferred method to identify and locate orbital fractures. Blowout fractures happen when blunt force compresses the eye, breaking the thin orbital floor. Many athletes return to sports with protective gear about six weeks after injury. Double vision after trauma usually improves as swelling decreases. Most superficial foreign bodies on the cornea can be removed easily; deeper ones require eye protection and specialist care. [17]

Nasal Trauma

Nosebleeds (epistaxis) are the most frequent consequence of blunt nasal trauma in sports. [22] The most common bleeding site is Kiesselbach's plexus in the anterior nasal septum. Hemostasis is usually achieved by applying direct pressure at the base of the nasal bones with the head in a neutral position Return to sport is generally permitted once bleeding stops and no other complications are present. Nasal fractures represent over 50% of all sports-related maxillofacial fractures. [22-23] While trauma may cause bruising or swelling, most fractures present with visible nasal deformity. However, swelling may mask structural irregularities. Evaluation should consider the direction and force of impact, and include inspection of the septum with a nasal speculum to assess bleeding and septal integrity. [24-25]

Inferior trauma to the lower nasal cartilages commonly causes septal fractures or dislocations, whereas lateral blows tend to displace the upper nasal bones. Moderate lateral force may cause a unilateral depressed fracture, while severe impact can shift the entire nasal pyramid. High-velocity frontal trauma, such as being struck by a ball, may fracture the nasoethmoid complex and flatten the nasal bridge. In extreme cases, the injury may involve the cribriform plate and lead to cerebrospinal fluid leakage. [22-23]

Significant nasal trauma requires referral to an otolaryngologist. When fractures are uncertain, imaging—such as lateral, basal, or Water's view X-rays—may help clarify the diagnosis. Initial conservative treatment includes ice, head elevation, topical decongestants, and follow-up within 1–2 days. Repeated topical decongestant use every 10–30 minutes is preferred over nasal packing to control bleeding. If needed, gentle fracture reduction may be attempted with external and septal manipulation. Optimal timing for ENT referral is within 5–10 days, once swelling subsides but before fibrotic changes prevent realignment. Closed reductions are successful in 70–80% of cases both functionally and cosmetically. [26]

Soft Tissue Injuries

Soft tissue injuries are among the most common types of trauma experienced by athletes, especially in high-contact or high-speed sports. These injuries can affect the face, scalp, mouth, and ears, and often involve multiple tissue layers. The most frequent types include abrasions, contusions, hematomas, lacerations, avulsions, and puncture wounds. [27]

Abrasions typically result from friction between the skin and a rough surface, such as artificial turf or another player's equipment. Although these injuries are usually superficial, they can be quite painful due to the high density of nerve endings in the facial area. If not thoroughly cleaned, small debris may remain embedded in the skin, increasing the risk of long-term discoloration or scarring. [28-29]

Contusions, or bruises, occur when blunt force trauma damages underlying tissues without breaking the skin. These injuries are characterized by swelling, tenderness, and discoloration that usually resolves within one to two weeks. In some cases, deeper trauma may lead to hematoma formation — a localized collection of blood that can cause pressure and discomfort. [30]

Auricular hematomas, for example, are common in sports like wrestling and boxing and involve bleeding between the cartilage and overlying tissue of the ear. If untreated, the disrupted blood supply can lead to permanent deformity, commonly referred to as “cauliflower ear.” Timely drainage and compression are essential to preserve ear structure and function. Lacerations are another frequent concern in athletic settings. [31-32] These injuries, which involve the tearing of skin and deeper tissues, can vary widely in severity. Facial lacerations in particular require careful wound closure to restore anatomical alignment and minimize cosmetic defects. Intraoral lacerations, such as those caused by accidental bites, are usually treated conservatively unless they are large or pass through the cheek, in which case layered closure is necessary to protect internal structures. [32] Scalp injuries often result from direct impact and may penetrate deeply, sometimes reaching the galea aponeurotica — a connective tissue layer covering the skull. [33] Deep scalp wounds require layered sutures to achieve proper healing and prevent the spread of infection. In cases of traumatic avulsion, where skin or soft tissue is torn away, prompt management is critical. Preserving detached tissue and referring for microsurgical repair can help restore appearance and function. [33-34] Though less common, puncture wounds also occur in sports, often due to sharp equipment or accidental bites. These injuries are particularly concerning when there is a risk of embedded foreign bodies or bacterial contamination. Human bites, in particular, carry a high risk of infection and may transmit serious illnesses, including hepatitis B and HIV, making careful wound evaluation and prophylactic treatment essential. [34]

Despite the variety in appearance and severity, soft tissue injuries share a common need for early recognition, appropriate hygiene, and thoughtful management to prevent complications

and support a full recovery. In the athletic population, these principles are especially important to ensure not only proper healing, but also a safe and timely return to sport. [35]

Summary and conclusions

The article provides an overview of the most common dental injuries in athletes, describing the types and causes of these injuries in the context of various sports disciplines. It highlights the increasing risk of dental trauma associated with sports activities and emphasizes the importance of prevention and oral protection during athletic participation. Recent studies show that more people are engaging in sports activities, which leads to a higher chance of injuries, including those affecting the teeth. It is important not only to have a team dentist available for urgent care and follow-up treatment but also to ensure athletes receive custom-fitted mouthguards to help prevent many dental injuries during sports. The types of injuries discussed include soft tissue injuries such as abrasions, contusions, lacerations, hematomas, avulsions, and puncture wounds affecting the face, lips, gums, oral mucosa, scalp, and ears. Dental trauma involves crown fractures, ranging from minor enamel cracks to severe fractures involving dentin and pulp, root fractures located in different parts of the tooth root, tooth displacement such as luxation, intrusion, and extrusion, as well as complete tooth avulsion. Mandibular injuries include fractures of the alveolar bone, condyle, symphysis, body, and angle of the mandible, and dislocations. Maxillary fractures are classified as Le Fort I, II, and III types, involving varying degrees of separation of the maxilla from surrounding bones. Other common injuries include zygomatic (cheekbone) fractures, frontal and maxillary sinus fractures, orbital fractures including blowout fractures, and nasal fractures, which are among the most frequent maxillofacial injuries in sports. In summary, a comprehensive understanding of these injury types and timely, appropriate management are essential to minimize long-term complications and help athletes safely return to their sport. Preventive measures, including the use of protective equipment and education, remain key factors in reducing the incidence and severity of maxillofacial sports injuries.

Disclosure

Author's contribution

Conceptualization: Karolina Kadłubowska,
Methodology: Karolina Kadłubowska Adam Sikorski
Formal analysis:

Investigation:

Writing-rough preparation: Karolina Kadłubowska

Writing-review and editing: Adam Sikorski

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