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Risk, frequency, and prevention of facial and dental injuries in racket sports

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Abstract

Background: Racket sports are experiencing unprecedented global growth, encompassing traditional disciplines (e.g., tennis with 106 million players; squash showing a 47% growth from 2013–2018 and an upcoming debut in the 2028 Olympics) and rapidly expanding modern variants like padel. Supported by widespread club networks, participation now spans all demographics and fitness levels. While regular play delivers major cardiovascular, mental, and social health benefits, its high-intensity dynamic nature—characterized by rapid changes of direction and high-velocity impacts—has led to a surge in injuries, including musculoskeletal strains, dental trauma, and severe ocular injuries.

Aim: Assess the impact of racket sports on the occurrence of maxillofacial injuries. Analyze player awareness regarding the risks of these specific injuries. Evaluate the effectiveness of current protective measures in preventing long-term complications, such as vision loss or chronic dental issues.

Material and methods: This review article was based on scientific publications published in PubMed, Quality in Sport, and databases between 2012 and 2026, as well as one archival article from 1981, included to highlight the scale of the problem. The literature search focused on studies investigating the risk of injuries, especially head, eye, and dental injuries among recreational and professional racket sports players. Relevant original studies, observational studies, and review papers addressing the association between playing racquet sports and head injury complications were analyzed and summarized.

Keywords: racquet sports, head injury, dental injury, tennis, badminton, table tennis, squash, padel, eye injury, mouthguards

Introduction

The surge in global participation in racket sports has been substantial in recent years; for instance, squash participation increased by 47% between 2013 and 2018, while badminton and tennis have also reported steady growth (Mazarelo et al.). However, this popularity is accompanied by inherent physical risks, as these disciplines are classified as high-risk for

injuries to the head and face due to the use of rackets and the high velocity of balls and shuttlecocks (Mazarelo et al.). Because players often compete in proximity—particularly in doubles play—the time for a projectile to decelerate is minimal, significantly increasing the potential for high-impact trauma (Mazarelo et al.).

The face is a particularly vulnerable region, with racket sports accounting for an estimated 28% to 52% of all sports-related eye injuries (Mazarelo et al.). These injuries frequently involve blunt trauma, such as contusions, which are the primary diagnosis in 77% of sports-related ocular cases (Leivo et al.). Severe outcomes, including retinal detachment, hyphaema, and orbital fractures, can lead to permanent functional impairment or "facial disfigurement" (Mazarelo et al.). In squash, the risk is compounded by the ball's diameter, which allows it to fit directly into the anterior part of the orbit, delivering the full force of impact to the eye globe (Barrell et al.). Furthermore, orodental trauma remains a significant concern, constituting approximately 31% of all maxillofacial injuries in sports (Wojda & Wielgosz). Common dental injuries include tooth fractures—which account for up to 50% of cases—as well as avulsions and luxations (Pandey et al.). The clinical severity of these impacts is underscored by evidence suggesting that for every tooth injured, the odds of a concomitant traumatic brain injury increase by 45% (Mills & Fine).

Despite the availability of effective preventative equipment, such as custom-made mouthguards and ASTM-compliant polycarbonate eyewear, compliance remains alarmingly low. Research indicates that the median percentage of eye injuries occurring when no eyewear is worn is 93% (Mazarelo et al.). Similarly, orodental protection is often neglected; one study of high school athletes found that only 6% of boys and 2% of girls utilized mouthguards (Singh et al.). This safety gap is often attributed to physical discomfort, a perceived reduction in athletic performance, and a general lack of mandates from national governing bodies (Wojda & Wielgosz; Mazarelo et al.).

The objective of this paper is to analyze the epidemiological patterns and mechanisms of facial, ocular, and dental injuries across racket sports to highlight the specific risks associated with each discipline. By evaluating the severity of these injuries and the current lack of protective compliance, this research advocates for more robust safety protocols and mandatory protective equipment to prevent permanent sensory and aesthetic damage.

Discussion

Dental injuries occur in society.

Classification of Common Dental Injuries

The most widely acknowledged classification system for traumatic dental injuries (TDIs) is the Andreasen system, which has recently been integrated into the World Health Organization's ICD-11 under code **NA0D**. These injuries are categorized into two primary groups:

Table 1. Classification of common traumatic dental injuries.

Category	Injury Type	Description
Injuries to Hard Dental Tissues and the Pulp	Enamel Infraction	An incomplete fracture (crack) of the enamel without loss of tooth structure.
	Enamel and Enamel-Dentin Fractures	Chips or breaks involving only the outer layers of the tooth.
	Crown Fractures (Complicated/Uncomplicated)	Fractures involving the crown that may (complicated) or may not (uncomplicated) expose the dental pulp.
	Crown-Root and Root Fractures	More complex breaks that extend below the gum line into the root structure.
Injuries to Periodontal Tissues	Concussion and Subluxation	Injuries where the tooth is bumped but not displaced; subluxation involves increased mobility.

	Luxation (Extrusive, Lateral, Intrusive)	Displacement of the tooth within the socket. Intrusion is particularly damaging to the permanent tooth bud.
	Avulsion	The complete displacement of the tooth out of its bony socket.

[2]

Sports-Related Prevalence and Mechanisms

Dental trauma is recognized as a significant public health issue with high susceptibility among active populations. Individuals who engage in contact sports, swimming, soccer, or running are particularly at risk, as these activities often involve dental injuries. There are many mechanisms/factors, e.g., Physical Mechanisms: falls and collisions, hits from sports objects, or direct player-to-player contact. According to demographic and clinical statistics, males are significantly more vulnerable to dental trauma, facing 2.06 times the odds of sustaining a traumatic dental injury (TDI) compared to females. Anatomical factors also play a major role, as children with an overjet greater than 3.5 mm are 1.78 times more likely to suffer a dental injury. Furthermore, having inadequate lip coverage increases the risk of experiencing oral trauma by 2.57 times. When these injuries do occur, the maxillary central incisors, which are the upper front teeth, are the most frequently affected teeth in both primary and permanent dentitions. [1],[3]

Immediate Sideline Management & Emergency Care

Traumatic lesions are emergencies requiring immediate attention to prevent medical, aesthetic, and psychological consequences. The success of treating severe dental injuries, such as an avulsion, is highly time-dependent and relies on a crucial "golden window." While standard clinical practice recommends specific storage media like milk, the evidence emphasizes that immediate attention and post-traumatic therapy are the most critical factors for improving a patient's prognosis. Unfortunately, despite data showing that a high percentage of children require dental care after sports-related trauma, immediate emergency presentation remains uncommon, highlighting a significant unmet need in sports emergency management.

Furthermore, dental trauma in young children—specifically intrusion and avulsion of primary teeth—requires constant radiographic follow-up, as it can lead to long-term sequelae in permanent successor teeth, such as enamel hypoplasia or eruption disturbances. [1]

Head injury

Overview of Facial Skeleton and Head Trauma in Sports

Among common maxillofacial injuries, nasal fractures are identified as the most frequent facial injury overall, occurring in 30.1% to 55.8% of patients presenting at emergency departments, while mandibular fractures represent the most common type requiring surgical intervention, accounting for 41.6% to 75.2% of surgical cases. Other frequent injuries include midface and orbital rim fractures, such as zygomaticomaxillary complex (ZMC) and naso-orbito-ethmoid (NOE) fractures. Additionally, head and soft tissue trauma are highly prevalent, with sports injuries accounting for 4% to 18% of facial trauma—primarily presenting as soft tissue lacerations and dentoalveolar fractures—while frontal sinus fractures occur in approximately 1% to 9% of facial bone trauma cases. The primary mechanisms driving these injuries include direct object impact, such as hits from balls, which account for 34.1% of sports-related facial injuries, and player collisions, which constitute 24.5% of cases and often involve elbow-to-head or head-to-head impacts. Finally, high-energy forces, such as falls or high-velocity accidents, serve as the typical drivers for complex injuries like orbital roof or Le Fort fractures. [4],[6]

Ocular and Periorbital Injuries

Regarding the vulnerability of the eye area, the orbital walls—specifically the floor and medial wall—are thin and highly prone to "blowout" fractures when force is transmitted through the globe, with ocular injury occurring in approximately 25% of all orbital fracture cases. Common types of ocular trauma include these orbital blowout fractures, where the internal walls are disrupted while the orbital rim remains intact, as well as orbital roof fractures, which are less common at 1% to 9% of facial fractures but carry a high risk due to their proximity to the brain and superior extraocular muscles. Critical intraorbital conditions encompass globe rupture, which presents as the "flat tire" sign on CT scans, retrobulbar hematoma, hyphema involving blood in the anterior chamber, and traumatic optic neuropathy, while soft tissue sequelae like periorbital hematomas, ecchymosis, and edema serve as standard indicators of underlying skeletal damage. Furthermore, the risk in racket sports is particularly high due to high-velocity

projectiles like balls and shuttlecocks that generate significant energy upon impact with the small surface area of the eye. This risk is compounded by an anatomical mismatch, as objects like squash balls have a diameter that fits directly within the orbital rim, thereby bypassing the protective bony structure and transmitting the entire force of the impact directly to the eye globe. [4],[5]

Severity Markers and Clinical Considerations

Immediate emergency evaluation is required if key visual and ocular indicators are present, such as loss of visual acuity, which indicates potential globe rupture or optic nerve damage. Furthermore, the presence of diplopia and ophthalmoplegia—characterized by double vision or restricted eye movement, especially during vertical gaze—suggests extraocular muscle entrapment, such as the inferior rectus muscle in an orbital blowout fracture. Other critical ocular signs include enophthalmos or exophthalmos, where the eye globe becomes sunken or bulging due to sudden changes in orbital volume. In addition to these ocular indicators, neurological and structural signs serve as vital red flags; for instance, cerebrospinal fluid (CSF) leakage presenting as clear fluid from the nose or ears indicates a dural tear associated with cribriform plate or frontal sinus fractures. Similarly, altered sensation, such as anesthesia or hypoesthesia of the cheek, chin, or lip, points to damage of the infraorbital or inferior alveolar nerves, while a palpable step deformity along the orbital rim or supraorbital ridge reveals underlying structural displacement. [4],[5],[6]

Racquet sports injury influence on health

Prevalence and Injury Typology in Racket Sports

General prevalence of head and face injuries varies by racket sport discipline. While they represent a significant minority of total racket sport injuries, they account for approximately 7% of injuries in recreational tennis. In professional squash, they make up 15.03% of injuries, compared to 6.6% in nonprofessional collegiate table tennis and 2.6% in padel. [8],[12],[15],[17]

In squash specifically, trauma to the head and eyes is the leading cause of hospital presentation, comprising 48.7% of all emergency department visits related to the sport. [16]

Soft tissue trauma is the most frequent presentation across these sports. For example, a study of recreational tennis showed that 67.7% of head and face injuries were contusions or wounds.[8]

Structural damage is also common, which includes bone fractures and dental trauma. Common sites for bone fractures include the nose in tennis, the orbital walls in both tennis and squash, and more extensive craniofacial fractures like Le Fort II, frontal bone, and zygomatic arch fractures in squash. Furthermore, dental trauma is classified as a medium risk in squash. The most common dental injuries include crown fractures, complete avulsions, and dislocations." [8],[16]

Primary Mechanisms of Facial Trauma

High-Velocity Projectiles: Squash balls can travel up to 230 km/h, and because the ball's diameter fits precisely into the anterior orbit, it can bypass the protective orbital rim and deliver its full force directly to the eye globe. Similarly, shuttlecocks can reach speeds of 400 km/h during smash shots, with the hard base being responsible for most blunt ocular trauma. Additionally, racket strikes are a primary cause of head injuries in tennis, accounting for nearly half (15/31) of reported head and face cases in one recreational cohort. [8],[13],[15],[26]

Infrastructure and Player Collisions: In padel, a unique risk involves the racket rebounding off glass walls, which can lead to maxillofacial fractures or wounds. Squash players are also highly susceptible to severe injuries from colliding with the junction of the wall and floor. [16],[17],

Court Dynamics: The close proximity to other players, particularly in doubles badminton, significantly increases the risk of being hit by a partner's racket or a high-speed shuttlecock at close range. [13]

Anatomic Distribution of Trauma

The ocular region is extremely vulnerable in badminton and squash, with key injuries including hyphaema, which is bleeding in the eye found in 96% of audited badminton cases, angle recession at 74%, retinal tears, and lens subluxation. [13]

In the periorbital area, orbital blowout fractures occur when force is transmitted through the globe to the thin orbital floor. [16]

Regarding the maxillofacial and nasal regions, the nose is a frequent target for racket strikes in tennis, while more extensive trauma can involve the maxilla, zygoma, and frontal bone. [8],[16]

From a clinical perspective, while facial lacerations are common and highly visible, contusions to the globe itself are of much greater clinical concern due to the serious risk of permanent vision loss, secondary glaucoma, or retinal detachment. [13]

Eye injuries in racket sports

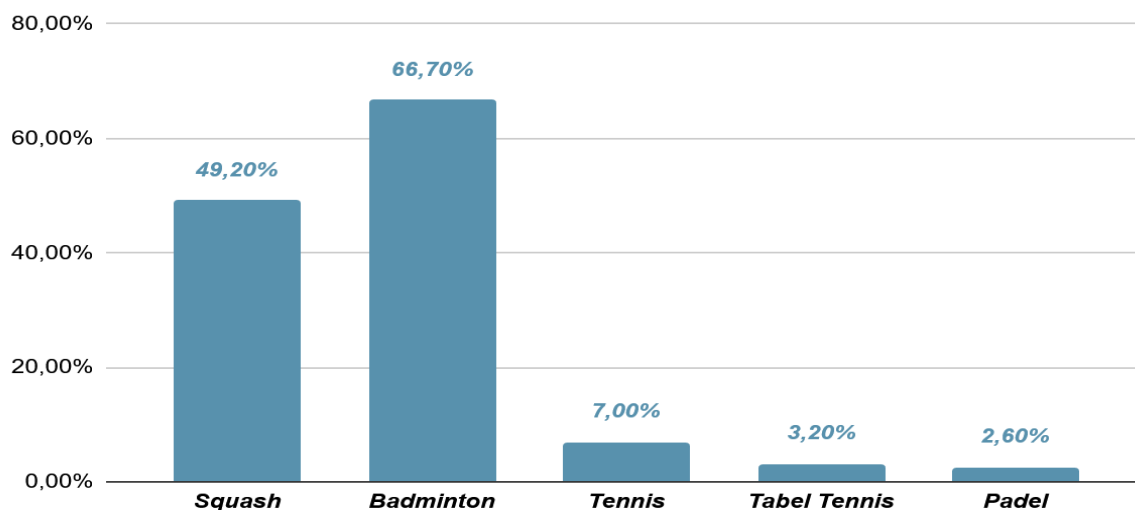


Figure 1. Percentage of presentations for intensive care due to eye injury among racket sport players.

Tennis injury influence on health

General Overview of Tennis Injuries

Tennis is a physically demanding sport involving repeated sprinting, jumping, and high-velocity stroke production, which places a significant mechanical load on the musculoskeletal system. Consequently, the majority of acute injuries occur in the lower extremities, ranging from 31% to 67%, followed by the upper extremities at 20% to 49%, and the trunk or head at 3% to 21%. [7],[8],[9]

Injury patterns also differ between recreational and professional populations. In recreational cohorts, ankle sprains are the most frequent serious acute injury, accounting for 11% of cases, while overuse injuries commonly affect the lower back, shoulders, and elbows. [8],[9]

Finally, regarding head injury prevalence, although orthopaedic injuries clearly predominate, trauma to the head and trunk still represents approximately 11% of acute injuries in recreational settings. [8]

Facial Soft-Tissue and Skeletal Injuries in Tennis

Soft-tissue trauma, specifically contusions and wounds, represents the most common manifestation of head and face trauma in tennis. Indeed, in a study of recreational players, head

and face contusions and wounds accounted for the majority of the 31 reported head-related cases. [8]

Skeletal fractures occur in approximately 12% of all acute tennis injuries, with 6% of these located specifically in the face. [8]

These injuries are primarily driven by three mechanisms. First, racquet hits are the most frequent cause of head injuries, accounting for 15 out of 31 cases, and they typically result in facial wounds, contusions, and nasal fractures. Second, ball hits from high-velocity tennis balls are responsible for eye contusions, periorbital hematomas, and orbital wall fractures. Finally, falls on the court frequently result in head and face contusions, wounds, and occasionally concussions. [8]

Ocular (Eye) Trauma

The eye and periorbital region are highly vulnerable and serve as significant targets for acute trauma, which is primarily caused by racquet and ball impacts. [8]

Among the common injury types, eye contusions are reported as a frequent outcome of both racquet hits and ball impacts, while periorbital hematomas are often associated specifically with ball hit mechanisms. Additionally, orbital wall fractures are structural injuries explicitly linked to direct ball hits. [8]

Regarding the physical mechanics, while the sources acknowledge the role of high-velocity ball impacts in causing orbital wall fractures and contusions, they do not provide specific clinical details concerning the ball's diameter relative to the orbital rim. However, they strongly emphasize that these ball hits act as a direct mechanism for both soft-tissue and skeletal ocular damage. [8]

Dental and Temporomandibular Trauma

While specific dental terminology such as "avulsion" or "subluxation" is not explicitly detailed in the provided clinical data, dental trauma is included under the broader categories of face contusions and wounds resulting from racquet and ball strikes. [8]

Preventive Recommendations

To mitigate general injury risk, players are advised to engage in dynamic warm-ups, static stretching, and proprioceptive or neuromuscular training. Furthermore, understanding common injury mechanisms, such as falls and equipment strikes, is essential for developing future preventive strategies. From an occupational standpoint, prevention programs for tennis coaches, who suffer from a high musculoskeletal burden—particularly in the lower back and shoulders—should explicitly address workload management and recovery practices. Finally, while knowing

which acute injuries occur can help focus future research on prevention, the effectiveness of some current unsupervised exercise programs remains questionable in reducing injury rates among recreational players. [8],[9]

Table tennis injury influence of health

General Overview of Table Tennis Injuries

Although table tennis is generally considered a low-risk sport compared to other disciplines, it involves unique physiological demands that can lead to various injuries. The most frequent injury types are tenosynovitis, benign muscle injuries, strains, and sprains. Anatomically, these injuries primarily affect the lower limbs—such as the ankle, knee, and foot—followed by the shoulder, spine, upper limbs, and trunk. Furthermore, long-term play is associated with chronic and overload risks, including a kyphotic body posture and significant morphological asymmetry in the trunk and limbs, which are considered potential risk factors for overload injuries and chronic back pain. Finally, while musculoskeletal injuries clearly predominate, head and neck injuries still account for approximately 6.6% of all injuries among nonprofessional collegiate athletes. [10],[11],[12]

Facial Soft-Tissue and Skeletal Injuries

Facial injuries are documented as the least common lesions among table tennis players. Trauma in the sport is typically nontraumatic, accounting for 94.6% of cases, such as strains, though direct traumatic injuries like contusions do occur in a minority of cases (5.4%) primarily through accidental contact. These direct impacts can result in soft-tissue injuries such as lacerations and contusions. Meanwhile, structural facial fractures are exceedingly rare; although a general fracture was noted in one Olympic study—comprising 5.2% of injuries—table tennis is consistently ranked alongside sailing and fencing as a discipline with very few serious traumatic events. [10],[12]

Ocular (Eye) Trauma in Table Tennis

Table tennis presents a risk of blunt eye trauma due to the high speed of the ball. However, compared to squash at 49.2% and badminton at 19.5%, table tennis accounts for a very low percentage of sports-related ocular lesions, ranging from 0.8% to 3.2% in various hospital case series. Regarding ball and paddle dynamics, the introduction of a larger 40mm ball has been associated with increased injury rates due to the need for short, abrupt, and extremely rapid movements. Finally, while the sources do not explicitly state that the 40mm ball penetrates the

orbital rim as commonly as smaller squash balls, they emphasize that even rare ocular lesions from ball or paddle strikes may warrant the use of eye protection. [10]

Dental and Oral Trauma

Table tennis is categorized as a low-risk discipline for dental and oral injuries. Clinical findings support this, as studies conducted during major events, such as the Pan American Games, reported a 0% prevalence of dental injuries among table tennis players. Similarly, separate audits of athletes in Malaysia found no reported oral injuries in this sport. Consequently, due to the minimal risk of impact-related dental trauma, the use of mouthguards is considered unnecessary for table tennis players. [10]

Preventative and Safety Insights

Since a high proportion of injuries occur during training rather than competition, coaches are advised to closely monitor training load and intensity. Furthermore, to mitigate risks associated with trunk and interlimb asymmetry, researchers suggest incorporating compensatory or corrective exercises into training programs. There is also a clear need for better education regarding injury prevention among nonprofessional athletes, who may have insufficient knowledge and delayed medical treatment. Finally, while safety equipment is not mandated, injured players frequently employ Kinesio taping and protective gear, such as wrist guards or patella straps, to manage existing conditions. [10],[11],[12]

Badminton injury influence on health

General Overview of Badminton Injuries

Badminton is a high-intensity Olympic sport characterized by repetitive forehand overhead motions, rapid multidirectional acceleration and deceleration, and dynamic movements such as lunges and jumps. While musculoskeletal injuries to the lower extremities, particularly the ankle and knee, are the most common, the sport still carries a significant risk for severe head and facial trauma. In fact, badminton was identified as having the highest rate of serious injuries, reaching 62%, among major racket sports during a studied Olympic cycle, which often results in significant downtime for the athletes. [7],[13],[14]

Ocular (Eye) Trauma (High Priority)

Badminton is a leading cause of sports-related blunt ocular trauma, accounting for two-thirds of all such injuries in certain regions. The shuttlecock is particularly dangerous because its base

is made of a hard material, and its small size—which is smaller than a tennis ball—allows it to easily penetrate the orbital rim and deliver a direct hit to the eye. Furthermore, a shuttlecock smashed by an opponent can reach staggering speeds of 400 km/h, causing severe "coup and countercoup" compression and decompression of the eye globe. [13]

These high-velocity impacts result in a wide range of clinical presentations. Hyphaema is the most common injury, appearing in 96% of cases, followed by angle recession at 74%, traumatic cataracts at 35%, commotio retinae at 22%, and both vitreous hemorrhage and lens subluxation at 17% each. [13]

Looking at gameplay scenarios, the vast majority of these injuries occur during singles play, representing 83% of cases and typically stemming from an opponent's smash shots. Nevertheless, doubles play also presents unique safety hazards, such as the risk of being hit by a partner's racket or a fast-moving shuttlecock at close range. [13]

Facial and Dental Trauma

Although shuttlecocks cause the majority of ocular injuries, badminton rackets can exert enough force to knock a player down or cause rupture of the globe. Surveys of pediatric and adolescent players identify the face as an anatomical region susceptible to sports-related pain and injury, though it occurred in less than 2% of reported cases in that specific demographic. Consequently, injuries to the head and face in badminton typically result from direct hits by high-velocity shuttlecocks or rackets, leading to blunt trauma that affects the iris, blood vessels, and lens. [13],[14]

Emergency Management Protocols

Serious ocular injuries, such as severe hyphaema and poor initial visual acuity, frequently warrant hospital admission for inpatient treatment. Furthermore, severe trauma may require surgical intervention, such as the surgical removal of traumatic cataracts or the implantation of scleral-fixated intraocular lenses, which are often necessary for younger patients to ensure long-term stability. Finally, long-term clinical follow-up is essential because complications such as angle-recession glaucoma and retinal-related issues can develop months or even years after the initial impact. [13]

Preventative and Protective Measures

The use of protective eyewear is considered essential to prevent monocular blindness, especially for young adults. Despite the potential for devastating visual loss, compliance remains extremely low, as a clinical audit found that 96% of patients with badminton-related

ocular injuries were not wearing any protective eyewear at the time of injury. Consequently, increasing awareness of the severity of shuttlecock-related trauma is vital for prevention, particularly since even amateur players are susceptible to permanent functional loss and subsequent job-market limitations resulting from monocular blindness. [13]

Squash injury influence on health

The High-Risk Profile of Squash

Squash is recognized as one of the world's most fast-paced, dynamic, and demanding sports, played within a small, enclosed court where players strike a rubber ball off the walls at high speeds. This confined nature of the court, combined with rapid accelerations, decelerations, and constant lunging, creates a high-risk environment for impact injuries. Consequently, injuries typically result from player-to-player collisions, being struck by a racket, or hitting the court infrastructure, such as the junction of the wall and floor. Because of these factors, trauma to the head and eyes is the most significant cause of squash-related hospital presentation, accounting for 48.7% of all emergency department presentations associated with the sport. [15],[16]

Ocular (Eye) Trauma in Squash (High Priority)

The high velocity of the squash ball is a primary factor in injury severity, with recorded speeds reaching up to 230 km/h. The ball is particularly dangerous because its diameter is smaller than the orbital opening, fitting well into the anterior part of the orbit. This mechanical relationship allows the ball to bypass the protective bony orbital rim and strike the eyeball directly, transmitting the full force of the impact to the globe. [15],[26]

Consequently, serious cases frequently involve intraocular damage, such as hyphema and choroidal rupture. Retinal and vascular issues, including retinal tears requiring cryotherapy and angle recession—which can predispose a player to future glaucoma—are also significant clinical concerns. Furthermore, direct impacts can cause orbital fractures, such as blowout fractures of the thin orbital floor or comminuted fractures of the orbital roofs. In contrast, less severe outpatient presentations often involve corneal abrasions or microscopic hyphema. [16],[26]

Facial Skeletal and Soft-Tissue Injuries

Soft-tissue trauma, such as lacerations and wounds to the face and head, is common in these sports and often results from accidental racket strikes or collisions with walls. Furthermore, high-energy blunt force, such as colliding with the corner of a wall, can cause extensive structural craniofacial fractures. These severe skeletal injuries may include Le Fort Type II

fractures, which are pyramidal-shaped fractures passing through the posterior alveolar ridge, maxillary sinus walls, inferior orbital rim, and nasal bones. Additionally, players can suffer zygomatic and maxillary fractures, with damage frequently affecting the zygomatic arch and the right maxilla. Although rare, occurring in roughly 1.3% of cases, depressed frontal bone fractures involving both the inner and outer tables can also occur. Finally, nasal fractures are a frequent outcome, which are often comminuted but not always significantly displaced. [15],[16],[26]

Dental and Oral Trauma

Squash-related dental trauma is classified as a medium-risk category of injury, which is frequently caused by direct collisions with an opponent or sports equipment. Among these dental issues, the most common injury types include crown fractures, subluxation, and complete avulsion. Although these injuries can have far-reaching consequences, research indicates that many players and coaches are not adequately prepared to handle on-court dental emergencies. Indeed, the provided sources emphasize that a significant portion of players and coaches lack the necessary knowledge required for the immediate, effective management of these acute events. [15],[26]

Padel injury influence on health

General Overview of Padel Injury Epidemiology

Padel is associated with a high incidence of injury, with 40% to 70% of players sustaining at least one injury per year. The physical demands of the sport involve continuous accelerations, decelerations, and rapid changes in direction, which lead to a high prevalence of musculoskeletal issues. These injuries predominantly affect the lower limbs, specifically the knee at 18.2% and the ankle or foot at 16.5%, as well as the upper limbs, including the shoulder at 14.8% and the elbow at 10.5%. Furthermore, environmental risks play a significant role, as padel is played in pairs on a confined 10 by 20 meter court featuring side and back walls. This high-density environment, characterized by explosive movements in a small space, ultimately increases the risk of acute trauma. [17]

Ocular (Eye) Trauma in Padel

While the selected sources do not provide specific data on ball velocity or the precise biomechanical relationship between ball size and the orbital rim, they classify padel as a racket sport where visual perception and motor skills are critical. Additionally, environmental hazards exist since the presence of side and back walls is a defining characteristic of the padel court, with scientific literature identifying the glass wall as a specific hazard for maxillofacial trauma.

In terms of overall prevalence, a study of 216 players revealed that face injuries accounted for 2.6% of the total recorded injuries in this sport. Finally, although specific ocular diagnoses like retinal detachment or hyphema were not detailed in the provided excerpts, the sources emphasize that injury incidence significantly impacts player performance and may require surgical intervention in more severe cases of racket sport trauma. [7],[17]

Maxillofacial and Dental Trauma

A unique and significant mechanism of injury in padel is the racket rebounding off the glass wall, which is cited as a specific cause for skin wounds, injuries, and fractures in the maxillofacial region. Consequently, bone injuries constitute 6.5% of the total anatomical structures affected in padel players, and the literature suggests that more experienced players may be more prone to these bone injuries due to prolonged exposure to microtraumas. Finally, while specific dental categories, such as avulsion or luxation, were not statistically broken down in these sources, they are considered part of the broader category of face injuries at 2.6% and bone injuries at 6.5% recorded among players. [17]

Preventive Measures and Protective Eyewear

The provided sources focus primarily on the role of appropriate footwear and racket weight in prevention, noting that players using rackets weighing between 350 and 370 grams showed a higher incidence of muscle and tendon injuries. Additionally, an appropriate warm-up incorporating balance exercises and dynamic stretching is highlighted as highly effective in reducing the injury rate. Regarding safety gaps, the selected sources do not mention polycarbonate sports glasses or current regulations regarding mandatory eyewear, recommending instead that coaches individualize prevention programs based on player level and manage training loads to prevent the development of chronic injuries. Finally, there is a noted need for better education regarding injury prevention, particularly among nonprofessional athletes who may have insufficient knowledge of sports-specific risks. [17]

Frequency of injuries in racquet sports

Overall Injury Distribution in Racket Sports

The injury landscape in racket sports is characterized by a high prevalence of musculoskeletal (MSK) injuries, particularly involving the lower extremities, which are driven by rapid multidirectional accelerations, decelerations, and lunging. In contrast, maxillofacial and

craniofacial injuries represent a statistically smaller but clinically more severe portion of total injuries, with a study across an Olympic cycle revealing that 55% of racket sports athletes suffered a serious injury. [7],[15]

The anatomical distribution of these injuries varies significantly across different disciplines. In tennis, 59% of acute injuries occur in the lower extremities, 30% in the upper extremities, and 11% in the head and trunk, with head injuries specifically accounting for 7% of the total. In padel, facial injuries represent only 2.6% of all recorded injuries, while musculoskeletal structures are most affected, particularly tendons at 40.4%, muscles at 30.7%, and ligaments at 17.5%. Meanwhile, head and neck injuries account for approximately 6.6% of all injuries in collegiate table tennis athletes. [8],[12],[13],[14],[16],[17]

In contrast, squash presents a much higher concentration of upper-body trauma, where head and eye injuries are the primary cause of hospital presentation, accounting for 48.7% of all emergency department visits related to the sport. Finally, although facial pain in badminton is reported in less than 2% of pediatric and adolescent cases, the sport is nonetheless responsible for two-thirds of all sports-related ocular trauma in certain audited tertiary centers. [13],[14],[16]

Maxillofacial vs. Musculoskeletal Injury Characteristics

The clinical profile of these two injury categories differs fundamentally in mechanism and urgency. Reported use and clinical effectiveness of preventive protective equipment.

Table 2. Comparison of musculoskeletal and maxillofacial or ocular injury characteristics.

Feature	Musculoskeletal Injuries (MSK)	Maxillofacial & Ocular Injuries
Common Diagnoses	Sprains, strains, tenosynovitis, and tendon ruptures.	Hyphaema, orbital blowout fractures, crown fractures, and facial lacerations.
Primary Mechanisms	Chronic overuse (e.g., "tennis elbow") or acute joint twists during stop-and-go maneuvers.	Sudden, high-velocity impact from balls (up to 230 km/h) or shuttlecocks (up to 400 km/h).

Treatment Urgency	Often managed with conservative RICER regimes or physical therapy.	Frequently requires emergency surgery or hospitalization (e.g., 96% of badminton ocular cases required admission).
Surgical Necessity	~9% of tennis MSK injuries (e.g., Achilles or meniscus tears) require surgery.	Complex craniofacial fractures (e.g., Le Fort II) require extensive neurosurgical and maxillofacial reconstruction.

[7],[8],[9],[10],[13],[15],[16],[26]

Variations by Specific Racket Sport

The ratio of maxillofacial injuries to other injuries is highly dependent on the equipment used and the court environment. In musculoskeletal-dominant sports such as tennis and table tennis, extremity injuries heavily dominate, with ankle sprains being the most common serious acute injury in tennis at 11%. Meanwhile, the risk for dental and oral injuries in table tennis is so low, showing a 0% prevalence in major games audits, that the use of mouthguards is often considered unnecessary. [8],[10]

In contrast, sports like squash and badminton present a high maxillofacial risk. In squash, the ball is smaller than the orbital rim, allowing it to compress directly into the socket and strike the globe with forces reaching up to 230 km/h, which makes head and eye trauma the leading cause of hospital presentation in this sport. Similarly, the rigid base of a badminton shuttlecock can bypass the protective bony orbit, making it a leading cause of blunt ocular trauma and responsible for 64.4% of hyphaema cases in specific regions. Finally, padel features unique injury mechanisms, presenting a specific risk where the racket rebounds off the glass walls of the court and leads directly to skin wounds and maxillofacial fractures. [13],[16],[17],[26]

Long-Term Impact and Rehabilitation Comparison

The long-term sequelae of these injuries vary from chronic functional instability to permanent sensory loss. In terms of musculoskeletal rehabilitation, typical downtime ranges from 5 to 16 weeks depending on the joint, with an unspecified shoulder injury in tennis averaging 16 weeks of time loss. Furthermore, knee meniscus and shoulder injuries often lead to a persistent loss of

performance, affecting 54% of table tennis players with knee injuries and 64% of badminton players with similar knee issues, while chronic conditions like knee osteoarthritis remain highly prevalent in former elite players. [7],[8],[10]

In contrast, maxillofacial rehabilitation often involves managing sensory loss, as serious ocular injuries carry a significant risk of monocular blindness that can severely impact a player's quality of life and future job opportunities. Additionally, delayed complications are a major concern, as traumatic angle recession, which is found in 74% of audited badminton ocular cases, predisposes the player to developing secondary glaucoma years after the initial trauma. Finally, managing orodental loss is highly time-critical, as success in treating avulsions depends on immediate care; a failure to replant or manage the tooth right away leads to permanent aesthetic changes and the eventual need for expensive prostheses. [13],[15]

Mouthguards protective items effectiveness

Protective Eyewear: Frequency of Use and Effectiveness

Voluntary compliance regarding protective equipment remains alarmingly low across most racket sports, with a systematic review finding that the median percentage of eye injuries occurring when no eyewear was worn was 93%. Similarly, in a clinical study of hospital-presenting sports eye injuries, only 5% of patients were utilizing any form of eye protection at the time of trauma, while in sports like tennis, facial and ocular protection is reported as being essentially absent. [19],[20]

Several barriers to compliance contribute to these statistics. Players frequently cite physical and functional concerns—such as discomfort, restricted peripheral vision, and lens fogging—as primary deterrents. Additionally, a low risk perception plays a major role, as there is a significant lack of awareness regarding the high-risk classification of these sports, and some governing body officials have historically argued that there was no evidence for the need for protection. Instead of using physical barriers, players frequently rely on administrative controls, such as keeping the racket in front of the face or choosing not to turn to watch a partner's shot. [19],[22],[26]

Despite these hurdles, the clinical effectiveness of proper protective equipment is well-documented. Eyewear compliant with ASTM standards, specifically ASTM F803 or F3164, is highly effective, and no eye injuries have been reported when players utilized these certified protectors. Conversely, uncertified equipment often fails and can actually increase injury severity; regular prescription glasses, contact lenses, and industrial (CR39) eyewear frequently shatter upon impact, causing penetrating injuries or globe ruptures. Finally, lensless eye guards,

which are sometimes used in sports like squash, are proven ineffective because the high-velocity ball can easily deform and compress through the opening to strike the eye globe directly. [19]

Dental Protection (Mouthguards): Frequency and Effectiveness

Voluntary compliance rates regarding dental protection are exceptionally low among youth athletes, with a study of organized sports teams revealing that only 6% of boys and 2% of girls utilized mouthguards, while in a survey of 600 squash players, only one individual reported regular mouthguard use. Despite this low uptake, the clinical effectiveness and shock absorption of mouthguards are substantial, as they reduce the likelihood of dental injuries by 1.6 to 1.9 times generally, up to 5.55 times in high-impact sports, and leave athletes 82% to 93% less likely to experience dentoalveolar trauma. [18],[22]

When choosing protection, the distinction between custom-fitted and stock options is critical. Custom-made guards fabricated by a dentist offer the highest level of protection because they ensure bilateral, balanced occlusion and maintain a critical thickness of approximately 3 mm labially and occlusally. Conversely, standard "boil-and-bite" guards can lose 70% to 99% of their thickness during the molding process, severely compromising safety. [22]

In addition to protecting the teeth, mouthguards provide wider craniofacial protection by acting as cushions that distribute impact forces over a larger surface area, which helps prevent jawbone fractures—specifically to the angle and condyle of the mandible—and protects the temporomandibular joint. Finally, there is emerging evidence that mouthguards can aid in concussion prevention, as their use was associated with a 28% reduction in concussion rates in youth ice hockey. [22],[25]

Face Shields and Full-Face Protection

The literature notes that face shields are increasingly common and effective in sports such as cricket, lacrosse, and youth ice hockey. While they are not yet a standard requirement in most racket sports, researchers strongly advocate for the use of faceguards in any athletic activity where there is a high risk of falls or being hit by a projectile. Consequently, in tennis, the absence of facial protection in the presence of high-impact trauma—particularly among male pediatric players—has led researchers to explicitly support the development and adoption of comprehensive facial and eye protection strategies. [18],[22],[23]

The Impact of Mandates and Safety Policies

Mandatory policies have proven to be the most effective public health intervention, as demonstrated in squash and racketball, where the introduction of eyewear mandates dropped the proportion of sports-related eye injuries in those categories from 73% to 23%. This success is mirrored in a floorball case study from Finland, where making protective eyewear mandatory for junior players reduced the incidence of eye injuries in the under-14 age group from 11 to 1 over a comparable nine-year period. In stark contrast to these mandatory successes, sports relying on voluntary compliance, such as tennis and badminton, continue to report serious, preventable injuries, including monocular blindness. Because governing bodies in these sports generally only choose to recommend protection rather than enforce it, the persistently low compliance rates noted above continue to endure. [19],[20]

Summary Table: Compliance vs. Effectiveness

Table 3. Reported use and clinical effectiveness of preventive protective equipment.

Equipment Type	Reported Compliance	Clinical Effectiveness
ASTM-Certified Eyewear	Very Low (~5-7%)	High (Near 100% prevention of ocular trauma)
Mouthguards (Youth)	Low (2-6%)	High (82-93% reduction in dental trauma)
Prescription Glasses	Moderate (as substitute)	Low (Risk of shattering/increased severity)
Lensless Eye Guards	Declining	None (Ball deformation allows eye contact)
Mandatory Policies	High (by regulation)	High (Drastic reduction in population-level injury)

[18],[19],[20],[22],[23],[25],[26]

Conclusions

In conclusion, this review demonstrates clearly that the dynamic surge in the popularity of racket sports carries a significant risk of severe head, ocular, and dental injuries. The highest level of danger is present in disciplines involving high-velocity, small-sized projectiles, such as squash and badminton, where direct impacts to the eye globe can occur and potentially lead to permanent vision loss. Although certified protective equipment—such as polycarbonate eyewear and custom-fitted mouthguards—is remarkably effective in preventing these complications, voluntary player compliance remains alarmingly low due to physical discomfort and low risk perception. Ultimately, official mandates enforced by sports governing bodies prove to be the most effective strategy for drastically reducing these dangerous and costly injuries.

Disclosure

Supplementary Materials

Not applicable

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The authors deny any conflict of interest.

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