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REVIEW

Evaluation and Management of Hand, Wrist and Elbow Injuries in Ice Hockey

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Abstract: Ice hockey continues to be a popular, fast-paced, contact sport enjoyed internationally. Due to the physicality of the game, players are at a higher risk of injury. In the 2010 Winter Olympics, men's ice hockey had the highest injury rate compared to any other sport. In this review, we present a comprehensive analysis of evaluation and management strategies of common hand, wrist, and elbow injuries in ice hockey players. Future reseach focusing on the incidence and outcomes of these hand, wrist and elbow injuries in ice hockey players is warranted.

Keywords: ice hockey, dorsal ulnotriquetral ligament, olecranon bursitis, Os styloideum, gamekeeper's thumb

Introduction

Ice hockey is an increasingly popular, fast-paced, contact sport enjoyed internationally.[1,2] Due to the physical nature of the game and expansive growth of the sport worldwide, players are at risk for a multitude of potential injuries. In the 2010 Winter Olympics, more than 30% of male ice hockey players were injured – the highest injury rate of any other sport played during the competition.[3] In the United States alone, it is estimated up to 20,000 hockey players visit the emergency department (ED) each year.[4] As participation in hockey continues to increase, a similar rise in hockey-related injuries is also expected.[5]

The rate of upper extremity injuries in ice hockey is reported to be about 14.8 per 1000 player-years, with most occurring during gameplay rather than practice.[6] Elbow, wrist, and hand injuries comprise nearly 14.1% of all hockey-related visits to the ED with the most common mechanisms of injuries consisting of falls, collisions, and contact with either sticks or the surrounding boards.[4,6] Despite these statistics, there is a paucity of literature regarding more specific anatomic incidence of these injuries as well as position-specific, ie forward, defensemen, goaltender, data. Though protective equipment, skates, ice surface, and many rules are the same in the men's and women's game, body-checking remains unique to the adolescent and adult men's game.[7,8]

In general, there are few studies evaluating data regarding the specific epidemiology of hand, wrist, and elbow injuries in ice hockey players, which may be a limitation in the recognition and treatment of these injuries. However, for physicians who care for these players, it is imperative to understand the more common injuries that arise in these athletes.

In this article, we present a review of evaluation and management strategies of common hand, wrist, and elbow injuries in ice hockey players as well as valuable return to play strategies (Table 1).

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Elbow

Olecranon Bursitis

The olecranon bursa, because of its superficial location, is susceptible to infection and inflammation. It most commonly occurs with repeated trauma or sports-related elbow injuries, which can lead to bleeding into the bursa and subsequent inflammation.[9] Most patients present with swelling about the olecranon and posterior elbow pain, which leads to difficulty with activities of daily living. On physical exam, patients will often have tenderness over the posterior elbow, erythema or overlying cellulitis, and warmth. Though patients will often have a full elbow range of pain, they may experience pain at the end range of flexion and extension.

As it is primarily a clinical diagnosis, imaging is not often required. MRI will show fluid collection (Figure 1). However, in less evident cases, further workup with fluid analysis may be necessary to differentiate between aseptic and septic etiologies. Aspirated fluid can be analyzed for

Table 1 Summary of Common Elbow, Forearm, Wrist and Hand Injuries

Condition	Description	Treatment	Return to Play
Olecranon Bursitis	Pain and swelling posterior elbow; tender to palpation	± Aspiration; Antibiotics (Keflex, Augmentin, Bactrim) NSAID (meloxicam) Compression wrap Soap and Water	If aspirated, place bandage over the site before placing on elbow pad; RTP can take 7–10 days or possibly longer if does not respond
Ulnar Collateral Ligament tear	Can be repetitive from slap shots or acute injury from check, collision into the boards	Hinged elbow brace, NSAID, possible PRP	4–6 weeks if dominant elbow; sooner if it is not
Forearm Contusion	Most commonly from a slash from an opponent's stick	Ice, compressive wrap, can wear Kevlar sleeve	Immediately as long as can safely grip the stick and function
Hook of Hamate Fracture	Results from the repetitive impact of the hockey stick, volar wrist pain	NSAID, splint immobilization, possible surgical excision	When pain free during stick-handling and shooting; Range 6–12 weeks depending on if treated with surgery or non-op
TFCC	Pain is ulnar on the wrist, sometimes with popping, clicking	MRI to confirm, initial treatment NSAID, ice, splint. Can escalate to cortisone shot in season or possible surgery	Depends on symptoms can be as rapid as 1–2 weeks to as long as 5 months if surgery is required
DUTL Injuries "Hockey Wrist"	Can present with ulnar sided wrist pain, with repetitive flexion and pronation	NSAID < ice, removable wrist splint	When pain resolves and grip strength on stick returns. Usually 1–2 weeks
Gamekeeper's Thumb	Hyperabduction injury to the thumb, UCL injury with laxity on testing at 30° flexion	Splint to immobilize thumb MCP, NSAID May require surgery if Stener lesion or complete tear	Partial tears can require 4–6 weeks Full thickness tears requiring surgery can take 3 months
Scaphoid Fracture	Fall on outstretched hand, with wrist hyperextension; snuffbox tenderness	Non-displaced or minimal displacement can be treated in thumb spica cast, surgery for displaced or proximal pole fractures	Can take between 6–12 weeks to get back on the ice if dominant hand
Os Styloideum	Dorsal wrist pain, nontraumatic. Repetitive wrist extension usual culprit	NSAID, possible use of wrist splint or immobilization	7–10 days
Metacarpal Fractures	Pain and swelling at the site, usually from a slash from an opponents' stick	Most can be treated in a cast, if significant displacement or multiple fractures can be ORIF vs CRPP	Variable but typically 4–6 weeks or until the player can grip the stick and be effective

Figure 1 MRI image of Olecranon bursitis on sagittal view.
Note: Courtesy of Dr. Marc Brown, Columbia University, New York, NY.

gram stain, culture, WBC count, and glucose levels. A positive gram stain is diagnostic, though this has been shown to be true in about 50% to 60% of all cases.[10,11] Other lab findings that should heighten suspicion for a septic bursitis include a WBC >10,000/mm^3, a predominance of polymorphonuclear cells, and fluid glucose <50% serum levels.[11] Furthermore, bursal fluid sent for culture is essential to determine appropriate antimicrobial coverage.

In general, olecranon bursitis should be treated based on the cause. In aseptic patients, most times all that is required for treatment is ice, NSAIDS and a compressive dressing. Sayegh and Strauch showed that, although aseptic bursitis is associated with higher overall complication rate (11.3%) compared to septic cases, those treated with surgical management had significantly more complications than the nonoperatively treated group.[12] This systematic review suggests that non-surgical management is optimal given better clinical outcomes and lower complication rates. Another recent review also demonstrated that empiric antibiotic treatment without aspiration can be used to successfully treat septic olecranon bursitis.[13] Despite this, multiple arthroscopic and open surgical interventions have been described.[14–16]

Tuff and Chrobak published a case report of septic olecranon bursitis in hockey players diagnosed with bursal aspiration. In both cases, a course of oral antibiotics (Cephalexin 500 mg 4 times a day), anti-inflammatories (Naproxen 375 mg twice a day), rest, and cryotherapy resulted in a resolution of clinical symptoms and all patients were able to return to play.[9] One player returned on the fifth day of treatment, another on the seventh, and the third in 3 weeks. It is important to follow up on culture data from the aspiration as to ensure appropriate antibiotic treatment. One patient in the study did not follow up and, thus, had a prolonged course of symptoms and a longer time to return to play.[9] If aspirating the suspecting septic olecranon bursitis, we recommend using a long spinal needle to have the entry point be well proximal to the olecranon. This is to avoid the needle mark being within the confines of the hockey player's elbow pad, when they return to play (which could create another entry point for infection).

Ulnar Collateral Ligament Injury

Elbow ulnar collateral ligament (UCL) injuries are common in the overhead throwing athlete; however, hockey players can also be afflicted by this pathology.[17] The UCL is the primary stabilizer of the elbow to valgus stress. Repeated stress to the ligament can lead to attenuation, microtears, and eventual rupture.[18] In hockey players, it has been suggested that repetitive slap shots may be the culprit of this pathology.[17]

A thorough physical exam of the shoulder, elbow, and wrist must be performed. Patients with UCL tears often have point tenderness over the medial epicondyle,[19] compared to those with medial epicondylitis who have pain with resisted wrist flexion and forearm pronation. With a suspected UCL injury, assessing tenderness at the anatomic origin and insertion of the ligament, as well as functional integrity of the ligament with the moving valgus stress test is essential. Neurovascular exam, with particular attention to ulnar nerve pathology, subluxation or compromised grip strength, should be evaluated as this will influence future treatment options.

With respect to imaging, plain film radiographs should be obtained to rule out any associated fracture. Valgus stress radiographs of bilateral elbows can help demonstrate joint space widening when suspected on the affected side. However, it should be noted that even with a complete UCL rupture, medial joint space widening is minimal and can be difficult to detect. For example, Rijke et al found that only greater than 0.5 mm of widening was diagnostic

Figure 2 Coronal MRI image of ulnar collateral ligament tear of the elbow.
Note: The orange arrow shows the location of the midsubstance tear in this player.

for complete or high-grade tears on ultrasound therefore, magnetic resonance imaging (MRI) remains the gold standard for evaluating UCL pathology and associated conditions (Figure 2).[20]

As with most ligamentous injuries, a trial of nonoperative management is initially recommended with operative intervention limited to refractory cases. PRP has been used in the treatment of this pathology, and the McCrum study demonstrated that after 2 autologous PRP injections, 3 elite ice hockey players in their series were able to return to play at 36 days from the injury.[17] The UCL injury is much more likely to be symptomatic for players with the injury on their dominant stick side. A left-handed player places the right hand on top of the stick, but the left shoulder and elbow are responsible for most of the motion to shoot and pass the puck.[2] Therefore, a left-handed player with a left elbow UCL is much more likely to be symptomatic and have it affect their play than if the injury was to their right elbow.

Forearm

Contusions

Forearm, wrist and hand contusions are quite common in ice hockey (Figure 3).[21] The contusions almost always occur from a direct blow to the area, resulting in pain, weakness and functional loss. In some cases, contusions that are significant enough can alter wrist or hand function. These can cause the player to miss some practices or games if they cannot be effective stick-handling and shooting. Usually, return to the ice is allowed when the player

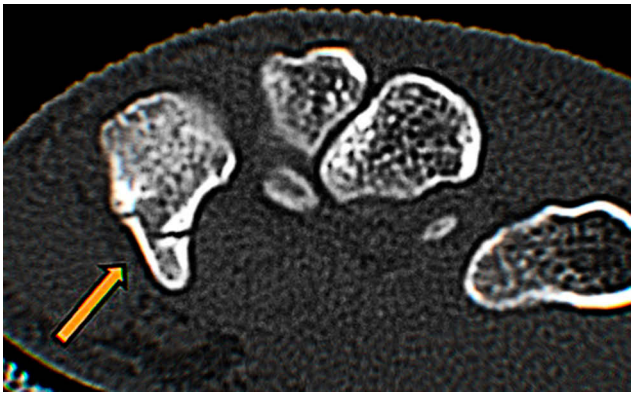

Figure 3 Axial cut of CT of hand.
Note: Orange arrow denotes a transverse hook of the hamate fracture.

demonstrates full ROM of the wrist and/or elbow and the strength has returned. Time missed can be up to a week in severe contusions.

Wrist

Hamate Fractures

Hook of the hamate fractures are common injuries in athletes and hockey players are no exception. For most, the mechanism of injury involves a direct blow from a puck or fall on an outstretched hand.[22,23] Prone to misdiagnosis, patients often complain of persistent ulnar-sided wrist pain that may initially be treated as a sprain. Index plain films of the hand and wrist may be negative, but computed tomography can be used to better elucidate and characterize osseous pathology. Non-operative treatment of hamate fractures involves initial immobilization as they are often mistreated as sprains or tendon-related injuries. There is concern that failure to recognize a hook of the hamate fracture can lead to late complications, such as flexor tendon rupture and ulnar nerve dysfunction.[24] One author suggests definitive excision of the symptomatic hamate in the ice hockey player.[22] This allows early return to play with a protective pad worn in the glove. Once tenderness at the surgical site subsides, unprotected play may resume.[22]

The repetitive impact to the hamate during typical game-related stick play has also been postulated to be a cause hook of the hamate fractures in ice hockey players.[23] The tip of the ice hockey stick contacts with the ulnar side of the carpal row and continuously strikes the hamate during stick-handling.[23] Athletes that underwent operative intervention had no statistically significant difference between pre-and post-injury performance when compared to matched controls.[25] Bansal et al showed that

athletes, who underwent operative intervention, were able to return to play in a relatively short time frame, about 6 weeks, with only 14% (11 patients) returning at 12 weeks.[26] Additionally, professional athletes experienced a shorter interval between symptom onset to surgical intervention compared to amateur and high school players further highlighting the preference towards surgical intervention in order to restore higher-level athletes to their baselines.[26] Transient ulnar nerve dysfunction, in the form of sensory disturbance over the ulnar wrist or motor weakness, was seen in 16 patients.[26] Amongst higher-level amateur athletes, similar results have been reported as hamate excisions showed significant reductions in pain and achievement of normal function using the DASH Sport/Performing Arts Module.[27]

Injuries to the Triangular Fibrocartilage Complex (TFCC)

Injuries to the scapholunate ligament and the triangular fibrocartilage complex (TFCC) are some of the most common soft tissue injuries in hockey players. The TFCC is a crucial stabilizer of the distal radioulnar joint (DRUJ) and degeneration of this complex can lead to chronic pain, dysfunction and the risk of instability.[28] Specific to hockey, repetitive load bearing, rotational stress, and impact to the wrist from contact with the ice or surrounding boards can lead to hypersupination.[28] TFCC tears are commonly classified as either traumatic or degenerative with further grading based on injury location and severity.[29]

Patients with TFCC pathology most commonly present with ulnar-sided wrist pain which differs from pain from the aforementioned hook of the hamate fractures which tend to be more palmar in location. Clinically, the pain can be vague and nonspecific with tenderness localized in the fovea. The players can note mechanical symptoms, such as clicking and popping. Given the functional role of the TFCC in providing stability to the DRUJ, it is critical to assess the stability and integrity of the complex. Evaluation of the DRUJ can be done with a number of special tests. For example, the piano-key test is performed with the examiner depressing the ulnar head volarly before being released. The exam is considered positive if the ulna springs back.[30]

Radiographic evaluation with standard PA and lateral X-rays should be obtained on both the affected and unaffected wrist. Although plain radiographs are often negative, practitioners must be aware that evidence of DRUJ incongruity on imaging may suggest an acute TFCC injury.[31] On the posterior-anterior view, one may see widening of the distal radioulnar space when compared to the contralateral side.[32] In elite athletes, or those patients with persistent pain refractory to conservative measures, magnetic resonance imaging (MRI) should be performed (Figure 4). Older literature report sensitivities and specificities of 74% and 80%, respectively, with MR arthrogram, however, MRI has become the imaging modality of choice with sensitivities reaching 90%.[33–35] As seen in other intra-articular pathologies however, the most accurate method of diagnosis for TFCC tears is direct visualization with wrist arthroscopy, which can be both diagnostic and therapeutic.[36,37]

Non-operative management of TFCC pathology consists of rest, immobilization NSAIDs, and steroid injections.[38] For more symptomatic injuries, corticosteroid injections can not only decrease pain, but also be diagnostic. Yet, when deciding on the appropriate course of treatment, Ko et al suggest incorporating individual factors such as the patient's sport, competition level, and seasonal timing when developing a treatment plan.[31]

Surgical management is based, primarily, on the type and severity of the tear. Arthroscopic debridement success rates vary based on tear characteristics. In peripheral tears with adequate vascular supply, the injury pattern may be amenable to open over arthroscopic repair.[39] In adolescent and pediatric athletes, surgical management of TFCC injuries after failure of conservative treatment has been shown to allow for return to sport at the previous level of participation in 80% of patients.[40] The average time to return to play was 4.8 months after surgery in this patient population.[40]

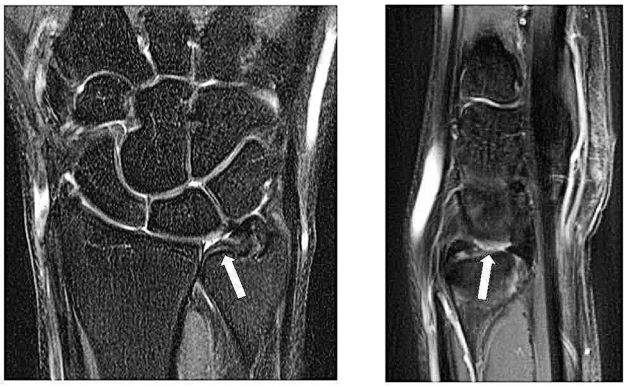

Figure 4 Coronal and Sagittal MRI images of the wrist.
Note: White arrows point to the incongruous TFCC.

Dorsal Ulnotriquetral Ligament (DUTL) Injuries ("Hockey Wrist")

In hockey players with persistent ulnar-sided wrist pain, in addition to hook of hamate fractures and TFCC injuries, dorsal ulnotriquetral ligament (DUTL) injuries should be added to the differential. While more uncommon, these injuries present similarly to TFCC injuries including pain with direct palpation to the fovea and a reproduction of symptoms with pronation, flexion, and radial deviation of the wrist. The authors suggest the flexion-pronation hand positioning when using a hockey stick can lead to "hockey wrist" or DUTL sprains.[41] Originally described in golfers, hockey players are also susceptible to DUTL injuries, as a similar arc of motion is utilized during gameplay.[42] Sandman et al performed a biomechanical study on fresh frozen cadavers with wrist motion, similar to that of a hockey player taking a wrist shot, to determine load-to-failure and trends in DUTL ligament injury.[41]

Though little data have been published regarding "hockey wrist", the diagnostic and treatment options are quite like those of TFCC tears. Advanced imaging may be necessary to identify the injury (Figure 5). As such, initial management consists of immobilization, often with a removable wrist splint. As there is a paucity of literature regarding the specific treatment of "hockey wrist", many practitioners use a treatment algorithm similarly used for most soft-tissue wrist injuries.

Hand

Gamekeeper's Thumb

The most common injuries to the thumb in hockey players are the radial and ulnar collateral ligaments (UCL) of the metacarpophalangeal (MP) joint.[43] Patients present, most commonly, with swelling, ecchymosis, and pain to the thumb with limited range of motion after a hyperabduction injury. Depending on the injury, tenderness can be localized either radially or laterally. Testing stability of the MP joint with a valgus stress with the thumb in 30 degrees of flexion will yield laxity in the radio-ulnar plane if the ligament is disrupted.[44] In the more acute setting, testing stability can introduce significant discomfort so anesthetic injections prior to the exam may be indicated.[45]

With respect to imaging, plain films can show an avulsion fracture of UCL insertion on the proximal phalanx of the thumb. There is some literature suggesting more advanced imaging, such as ultrasound or MRI, is warranted if clinical suspicion is high and radiographs are negative (Figure 6).[46–48]

The decision to proceed with nonoperative versus operative treatment is dependent on the type of tear (partial versus full thickness), and the presence of an associated avulsion fracture or Stener lesion. A Stener lesion is indicative of ulnar collateral ligament avulsion with or without a bony attachment displaced beneath the adductor aponeurosis. The presence of a Stener lesion is often predictive of the need for surgical repair.

There is no specific literature on return to play in hockey players with thumb UCL injuries. Ritting et al suggest that, regardless of operative or nonoperative treatment, return to play with injury is feasible if the thumb can be immobilized during games/practice.[44] These authors suggest nonoperative management for partial injuries with MCP joint immobilization for at least 4 weeks.[44] Return to play is decided based on the return of full strength and range of motion in the thumb, without tenderness to palpation. Timing of return to play is dependent on the severity of injury with players suffering from full-thickness tears returning to gameplay in 3 months; however, shorter recoveries have been seen in partial thickness tears.[45]

Scaphoid Fractures

Scaphoid fractures are the most common carpal fracture in athletes and generally occur as a result of traumatic wrist hyperextension past 95 degrees, a common occurrence in hockey players as a result of recurrent collisions and falls.[49,50] Physical examination typically demonstrates tenderness to the anatomic snuff box dorsally and volarly. Often, acute, minimally displaced scaphoid fractures are poorly visualized on plain radiographs and more advanced imaging is required for diagnosis.[51] Although the

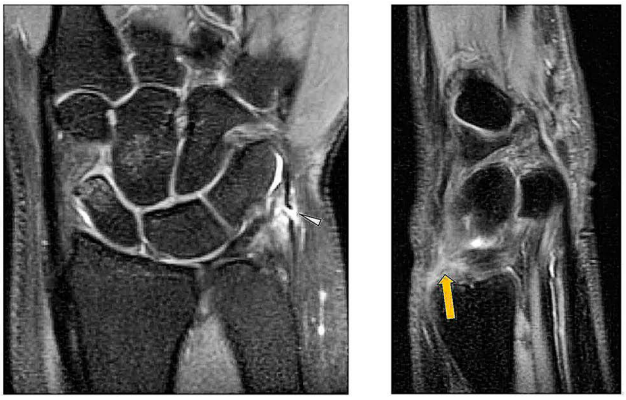

Figure 5 Coronal and sagittal MRI images of the wrist.
Note: The orange arrow and white triangle show increased signal, consistent with dorsal ulnotriquetral ligament injury.

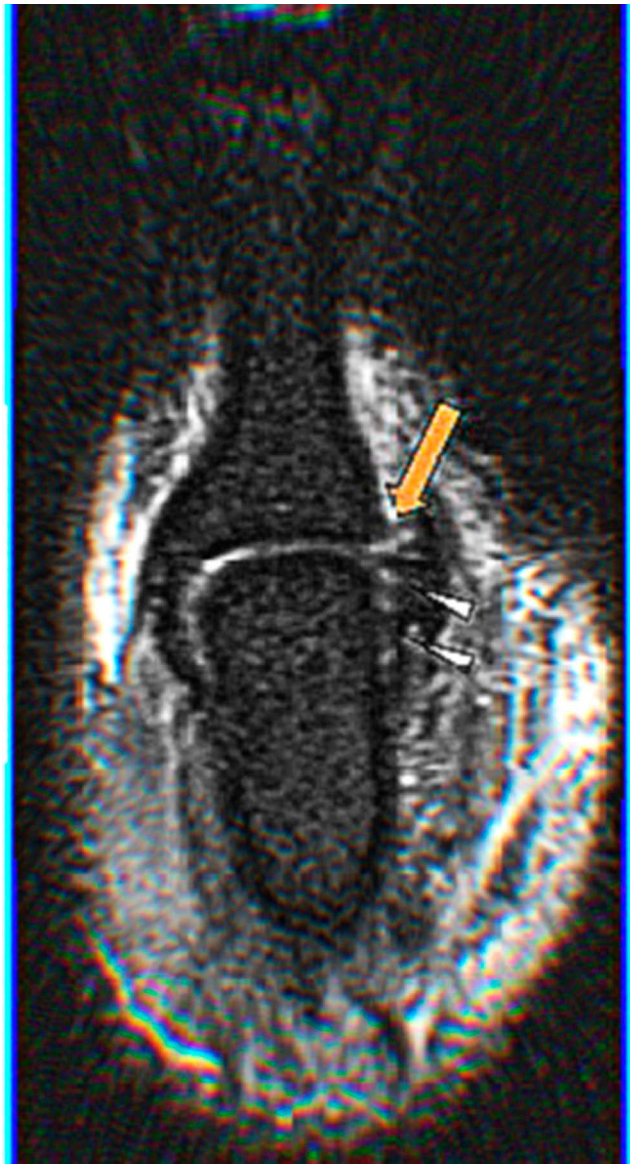

Figure 6 MRI image of thumb with orange arrow showing the avulsion fracture and white triangles indicating the Stener lesion.

availability of CT has made it the imaging modality of choice, MRI has been shown to be the most sensitive for diagnosis and is our advanced imaging modality of choice.[52]

Location of the fracture is critical in the management of scaphoid injury. Proximal pole fractures are susceptible to nonunion due to the retrograde blood supply to the bone creating a watershed area. As such, these injuries may benefit from operative intervention and compression screw fixation.[53] Minimally displaced fractures of the scaphoid can be treated with cast immobilization with high rates of union (Figure 7). In athletes, however, surgical fixation can allow for significantly faster return to play.[54,55] One study showed patients who were underwent surgical fixation returned to sport at a mean 6.4 weeks compared to those treated non-operatively who return at an average of 15.5 weeks.[56] Depending on their handedness, hockey players may be able to return to sport more quickly than many other athletes as they wear protective gloves and can often grip a hockey stick while wearing a splint or cast. Some allow return to play after percutaneous screw fixation 2 weeks postoperatively in a splint with no restrictions at the 6-week postoperative visit as long as there is radiographic evidence of healing.

Os Stylodieum and Carpal Bossing

Os styloideum is an accessory ossicle that is connected by fibrous union to the dorsal 2nd or 3rd metacarpal or capitate.[57] It is thought to be a response to repetitive microtrauma, similar to bone formation that occurs in the hip of ice hockey players with the Cam bump or a Bennett's lesion seen in baseball throwers.[57] "Carpal bossing" is a bony dorsal protuberance at the base of the 2nd and 3rd metacarpals that presents with varying symptomatology. While the etiology of symptomatology is unclear, it is thought to be due to the combination of a persistence of the bony protuberance and local irritation as well as a degenerative process, potentially secondary to repetitive trauma.[58] Os styloideum and carpal bossing are not synonymous terms.[57]

A carpal boss is easily palpated on the dorsal aspect of a flexed wrist. It can be distinguished from a ganglion cyst as it has a characteristic hard consistency and cannot be transilluminated. During examination, Fusi et al describe a provocative maneuver in which the examiner flexes the

Figure 7 Coronal CT image of hand.
Note: Black arrow shows nondisplaced scaphoid fracture.

metacarpophalangeal joints of the 2nd and 3rd digits and applies axial traction to reproduce the symptomatic carpal boss.[59] Further imaging is often required to definitively diagnose a carpal boss as benign bony lesions or, less frequently, malignant masses can have similar findings on exam (Figure 8).

There have been no large studies examining the efficacy of conservative treatment for Os styoideum or carpal bossing, but in the case series from Greditzer et al,[57] all the involved ice hockey players with Os styloideum returned to sport within a week. Treatment with NSAIDs, rest and, local corticosteroid injections are usually attempted initially but have been shown in multiple small series to be ineffective at providing long-term symptomatic relief.[60] Surgery is not typically required but may be a viable option in refractory cases.

A single case series described a symptomatic carpal boss after direct compressive trauma to a player's flexed wrist after being checked into the boards.[61] After a short course of rest, cryotherapy and physiotherapy, he was able to return to play with minimal pain and completed the season without complications.

Metacarpal Fractures

Hand fractures comprise one-third of all fractures during athletic competition, with metacarpal fractures comprising two-thirds of hand-related injuries.[62] The mechanism of injury is generally a direct blow to the hand.[63] In hockey, this is usually due to being struck with a stick. Diagnosis is relatively straightforward as the athlete generally presents with dorsal hand pain, swelling and deformity with fracture evident on plain radiographs (Figure 9).

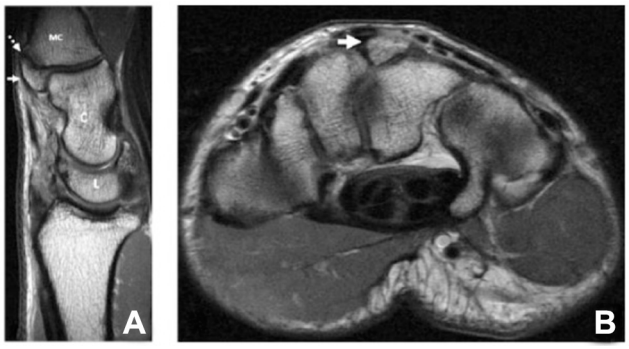

Figure 8 Sagittal and axial MRI images of the hand with white arrows show os stylodieum.
Note: Greditzer et al, *Sports Health*, Volume 9, Issue 5, page 5. © 2017. Reprinted by Permission of SAGE Publications, Inc.

Eighty percent of sports-related metacarpal fractures are closed and minimally displaced on presentation and are thus amenable to treatment with a protective playing orthosis.[64] Operative fixation is reserved for the remaining displaced or unstable fractures, which are treated with closed reduction percutaneous pinning (CRPP) or open reduction internal fixation (ORIF).[63]

Although hockey has not specifically been studied in regards to time to return to play after a metacarpal fracture, the average playing time lost due to a metacarpal fracture in other non-throwing, contact sports was 12.3 days for non-operative fractures and 22.0 days for operative fractures.[62] Patients who were treated with CRPP missed significantly more time, 30.7 days, than those treated with ORIF, 19.7 days.[65]

Figure 9 Posteroanterior radiograph of the hand.
Note: Yellow arrows denote oblique, midshaft metacarpal fractures.

In the experience of our authors, unless multiple metacarpals are fractured, our authors prefer non-operative treatment with splinting given physicality of play. We have found most players return to play within three to 6 weeks regardless of treatment modality.

Rationale for Differences in Injury

In United States emergency departments, it is estimated over 18,000 patients present with ice hockey-related injuries each year.[4] Over 90% of these patients are men with about 50% ranging between the ages of 9 to 18.[4] These statistics do not, however, consider those injuries at the semi-professional and professional levels. These gender differences however may be secondary to the larger number of men who play ice hockey compared to women. Further, activities inherent to the men's ice hockey such as checking rules may contribute to the different incidence and injury patterns seen between the men and women. A recent epidemiological study looking at NCAA men's and women's hockey found a higher rate and number of upper extremity injuries in men's hockey.[21] Wrist sprains and finger contusions were common injuries seen in both men and women in the study.[21]

In a study looking at incidence of injuries in junior ice hockey players, the most common mechanism was puck (31%) and stick (18%) contact.[66] The authors, however, only analyzed injuries during tournament games and did not evaluate those that occurred during practice or training. Moreover, the injury reporting system relied on the individual team physician to record the mechanism and type of injury.

Another study found that across US high school sports, boys ice hockey had the second highest proportion of hand/wrist injuries with 18.2% requiring surgical fixation.[67] These same authors showed that boys ice hockey, the sport which requires players to wear protective gloves, had the lowest proportion of injuries attributed to contact with a playing apparatus (27.9%). Even with this protective equipment, a national database study of high school sports-related injuries found the rate of fractures in boy's hockey to be 3.08 per 10,000 athletic exposures.[68]

Summary

Injuries sustained by ice hockey players in the upper extremity can be broken down into two categories: direct trauma and overuse. For both types of injury, targeted prevention strategies are warranted; however, there is a paucity of data regarding hand, wrist, and elbow injuries in ice hockey players in general. There is currently no published off-season wrist or forearm strengthening program on injury prevention for ice hockey, but with the high number of injuries should be an area of research.

Given the frequency with which hockey players incur upper extremity injuries in both the acute and subacute setting, a thorough history and physical examination by trainers and, in the appropriate circumstances, orthopedic surgeons are crucial for determining the appropriate treatment strategy. The current literature on management and outcomes related to these injuries remains limited as, there are also no specific data examining differences in incidence or injury patterns or incidence by player age, level of play, or position. Thus, there is room for future research to evaluate the effect these injuries have on future athletic performance. Furthermore, many of the injuries we described in our review can be chronic and, therefore, debilitating, which may have lifelong consequences. As such, treating physicians, therapists, trainers and healthcare professionals should have a heightened awareness of these frequent injuries to ensure expedient diagnosis and treatment.

Disclosure

Charles A Popkin, MD is a member of the USA Hockey Safety and Protective Equipment Committee and team physician for USA Hockey. Dr. Popkin also reports educational and travel support from Arthrex and educational support from Smith and Nephew outside the submitted work. The authors report no other conflicts of interest in this work.

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