

UPPER LIMB INJURY AND PREVENTION IN HANDBALL

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INTRODUCTION

If you work in the field of sports medicine and are interested in upper limb injuries, handball is certainly the sport for you. If you're more enthusiastic about lower limb injuries or even back pain and are only slightly interested in upper limb injuries, don't worry, handball is still the sport for you. You'll get lower limb injuries and the back pains for free.

By its nature, with a combination of running, jumping, side-cutting moves, as well as repetitive throwing, wrestling, collisions, and landing (in various ways!), handball is an injury-prone sport. Although lower limb injuries are more common than upper limb injuries, the latter are relatively common when compared to other team sports. Finger, wrist, elbow, and shoulder injuries are the most common. In this article, we aim to give an overview of the epidemiology and aetiology of the most common upper limb injuries seen in handball and suggest ways to reduce the risk of their occurrence, drawing from over 40 years of experience working with these athletes and injuries. While we acknowledge that there are many specific upper limb

injuries seen in handball that we don't cover specifically in this article, our experience indicates that the ones mentioned below are the ones you will likely encounter.

SHOULDER INJURIES IN HANDBALL

The handball shoulder is subjected to high demands due to the repetitive throwing combined with grappling opponents and landing on the floor, making shoulder injuries very common. However, a large discrepancy in the literature exists regarding injury definition and reporting methodology, making it difficult to compare the incidence and prevalence of reported shoulder injuries. Moreover, since most handball shoulder injuries have a gradual onset, many players tend to continue playing even though they experience shoulder problems and pain. Hence, using a time-loss injury definition will most likely fail to capture a significant number of shoulder injuries in handball¹.

In studies using self-reported questionnaires, the average weekly prevalence of substantial shoulder problems during the season has been reported to be 6% in adolescents² and 8% in adult players³,

with a point prevalence of shoulder pain of 30%, indicating that a significant proportion of players report experiencing shoulder pain to some extent³.

Shoulder Injury Types and Mechanisms

The shoulder injuries seen in handball can be broadly categorized into either throwing-related or a gradual onset or traumatic injuries, the latter primarily resulting from contact with another player, the floor, or from blocking shots. However, due to the combination of physical demands and repetitive throws, it is not uncommon for a throwing-related problem to be initiated by a blunt force to the shoulder or a pull of the arm, which players may not necessarily address since it is considered part of the game.

Most encountered are gradual onset problems, where athletes often cannot recall a specific incident⁴. However, upon closer examination of their history, there is often a noticeable increase in shoulder-specific load at some point. For instance, this could involve an elevated number of throws, particularly during training camps, a change in ball size, starting to throw with a weighted ball, or



Illustration

returning from a significant injury or other break that prevented throwing for a period.

Throwing-related problems can further be subdivided into groups based on mechanism, with deceleration-related issues and acceleration-related problems with or without internal impingement being the most common ones.

Deceleration-related problems often have a clear “too much too soon” history specific to the player. Typically, players will experience pain during the deceleration phase, yet may not show any impairment in throwing velocity. This paradox makes this type of injury particularly problematic since players often continue to participate until their symptoms significantly affect their performance (when they start to lose throwing velocity). In our experience, these players frequently exhibit a lack of shoulder rotational strength, especially in external rotation. They may also have limited internal rotation range of motion (ROM), which could increase stress on the posterior

part of the shoulder during the deceleration phase. However, it's important to note that the internal rotation “deficit” observed in these athletes is often a normal adaptation to throwing. Hence, the total range of motion (TROM), comprising maximum internal and external rotation, is the key measure of interest, and TROM should not differ between the dominant and non-dominant arm. If there is a discrepancy, it should be addressed. In this regard, one can address two issues simultaneously by incorporating rotational loading in end-range positions, which not only enhances strength and tolerance but also likely improves ROM.

In cases of *acceleration-related problems*, players often describe experiencing sharp pain during the cocking phase, which can be located either anteriorly over the long head of the biceps or posterior-superiorly in the shoulder. Anteriorly located pain most likely originates from the significant load on the biceps long head tendon during the late cocking and acceleration phases, possibly

associated with a Superior Labral Anterior to Posterior (SLAP) lesion, often acquired due to repetitive throwing. This suspicion is heightened, especially if the player also experiences clicking/catching within the shoulder joint.

Posterior-superior pain may result from compression of the posterior-superior part of the rotator cuff against the posterior part of the glenoid during the cocking phase, a condition referred to as ‘internal impingement’ or occasionally ‘inside impingement’. As evident, the mechanisms behind acceleration-related problems are multifaceted and not attributed to a single factor but rather to a combination of factors including lack of glenohumeral joint control, involvement of the biceps long head, and inadequate end-range force development, resulting in a lack of control during the cocking phase. Based on our experience, early detection and intervention are crucial, as these problems may otherwise progress into more severe issues.

Acceleration-related problems can also stem from traumatic events, such as when a player is blocked during a throw, particularly during the acceleration phase, increasing the risk of traumatic SLAP lesions and instability. Another scenario is when a player attempts to block a throw in an overhead position as a defenseman, potentially leading to ruptures in the latissimus dorsi, teres major, or subscapularis, often occurring at the muscle-tendon junction. These injuries can also occur when a player attempts to defend against an opponent's breakthrough by attempting to catch or block the opponent, particularly during a fall on the arm or shoulder. Rotator cuff ruptures solely due to throwing without trauma are relatively rare in handball, but a player describing a history of trauma as noted above with abrupt onset of pain and/or loss of function should have a high index of suspicion for a full thickness tear.

Shoulder instability can manifest in various scenarios in handball. As previously mentioned, the repetitive throwing places significant demands on the shoulder, particularly in terms of stability. This repetitive motion can lead to acquired instability, such as SLAP-related problems. Additionally, some players may have congenital hypermobility, which can be advantageous in sports requiring high shoulder mobility, like handball. However, this mobility advantage can become a disadvantage if the athlete struggles to control it, particularly during the cocking and acceleration phases of throwing.

Given the nature of handball, there are several situations where traumatic instability may occur. There is a risk of glenohumeral dislocation or subluxation when falling on the arm, often with the arm outstretched. Acromioclavicular instability primarily occurs when falling on the side of the shoulder with impact on the lateral aspect of the acromion. Moreover, if a player is blocked during the cocking phase of a throw, anterior instability may occur. The latter type is often more problematic due to the throwing position in which they occur, typically with a worse prognosis. These injuries may sometimes involve the brachial plexus, adding to their complexity.

ELBOW INJURIES

Elbow injuries in handball often result from substantial forces, primarily due to falls on the arm and repetitive throwing.

For goalkeepers, the strain is further compounded by repetitive saves with the arm in a supinated/extended position.

Elbow problems are more prevalent among goalkeepers compared to field players, so much so that the term 'Handball Goalie's elbow' is coined. In a study on Norwegian adolescent and adult handball goalkeepers, 41% reported current problems, while 34% reported previous issues. The most common problems included intermittent pain (83%), weakness (22%), and reduced ROM (19%). Additionally, apprehension (15%), numbness (13%), swelling (12%), clicking (12%), and locking (11%) were also relatively common symptoms⁵.

Injury Types and Mechanisms

The most common mechanism for elbow injuries in goalkeepers is the repetitive stretching of the arms during saves, leading to the elbow being forced into valgus and hyperextension. This places stress on the medial collateral ligament (MCL) and the anterior part of the joint capsule, potentially compromising medial stability. Consequently, there may be compression in

the lateral aspect of the elbow and postero-medial olecranon fossa impingement. The repetitive valgus force, combined with compression on the lateral and posterior aspects of the elbow, can lead to loose bodies, osteophyte formations, and avascular necrosis in these regions of the joint⁶, which should be suspected when athletes report symptoms such as clicking or locking. Additionally, some players may experience "tingling" or numbness on the ulnar side of the forearm and hand, indicating possible involvement of the ulnar nerve, which needs to be further investigated.

This stepwise pathway emphasizes the importance of identifying and addressing all these potential anatomic contributors to the player's problem and intervening before they develop more severe structural bone damage or neurological complications. In our experience, many goalkeepers can recall a save that initiated the problem, but initially, the issues did not significantly affect their performance, allowing them to continue playing. Symptoms often begin with pain during certain saves, along with elbow stiffness and muscle tension in the



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Illustration

forearm muscles, particularly the flexors and the pronator teres muscle. Sometimes, athletes experience more pronounced problems originating from the proximal tendons of the forearm flexors and pronator teres, resembling symptoms of golfer's elbow, which may be associated with underlying medial instability of the elbow. Similar to the handball player's shoulder, elbow problems need the clinician to rule out or address any underlying instability.

Although these problems are more common in goalkeepers, field players are not exempt. Valgus stress can occur with a similar mechanism in field players when they block shots or during throws. Additionally, elbow injuries may occur during falls, where the player lands on the arm or in contacts opponents.

HAND AND WRIST INJURIES IN HANDBALL

As the name suggests, there is considerable demand on the hand in handball, including tasks such as catching and throwing the ball, blocking shots, and grappling opponents. Consequently, numerous situations exist where hand or wrist injuries can occur, whether through gradual onset or traumatic events, although the latter are more prevalent.

Hand, wrist, and finger injuries has been reported to account for approximately 9-15% of all traumatic injuries, with a higher frequency in adolescent players^{7,8}, and a higher frequency in females⁸.

Injury Types and Mechanisms

Several injuries can occur, with finger and thumb sprains, dislocations (MCP, DIP, and PIP joints), and fractures being among the more common ones. Finger injuries constitute most of the hand and wrist injuries in handball. Typical scenarios for finger injuries include instances when catching a pass or saving a shot, as well as situations where a player grabs and twists an opponent's shirt and gets their finger caught, often exacerbated by resin-covered fingers. Direct contact with an opponent, such as being hit over the hand and fingers, can also lead to injuries.

MCP joint injuries of the thumb often occur during valgus stress, such as when catching or saving a ball, but can also happen when reaching for a ball on the court or when attempting to break a fall with the ball in hand. Finger PIP joint injuries frequently occur due to direct

impact and axial force, typically from a ball or physical contact. Depending on the force and direction, various structures may be affected, including volar plate tears with or without bony avulsion, fractures, and collateral ligament disruptions.

The most common wrist injuries are ligamentous, but scaphoid fractures and injuries to the triangular fibrocartilage complex (TFCC) are relatively common and must not be overlooked. The primary mechanism for these injuries is falling and landing on an outstretched hand, although the TFCC injuries can also occur after blocking or saving a shot, as well as during 'push' type gym exercises.

INJURY PREVENTION

In a physically intense sport like handball, with numerous complex movements performed at maximum speed, it's unrealistic to expect the complete elimination of all injuries. No matter how diligently one prepares, there's always a risk of injury. The primary risk factor for upper extremity injuries, as well as other handball-related injuries, is simply playing handball. If the goal were to eradicate all handball injuries, ceasing to play the sport would be the only solution. However, considering the underlying mechanisms and the fact that many injuries, particularly those affecting the shoulder, stem from overuse or repeated micro-traumas that can progress into more severe injuries, significant efforts can be made to mitigate the risk of injuries in handball.

Shoulder injury prevention in handball

In the last decade, there has been a greater research focus on shoulder injury prevention in handball, particularly investigating risk factors and prevention strategies. Rotational shoulder strength, especially external rotation strength and the ratio between external and internal rotational strength, has emerged as the most consistent factor associated with shoulder injuries^{9,10,11}. These factors can now be easily assessed in clinical or field settings using a handheld dynamometer (HDD). Additionally, studies have shown that rapid increases in handball training volume can increase the risk of shoulder injuries among players¹⁰. Although the evidence is conflicting, reduced range of motion and scapular dyskinesia have also been associated with shoulder problems^{9,10,11}.

Based on these findings and clinical

experience, handball-specific injury prevention training programs (IPEPs) have been developed and evaluated. Two commonly used programs are the Oslo Sports Trauma Research Center (OSTRC) Shoulder Injury Prevention Programme³ and the Shoulder Control Programme⁴. Both aim to increase shoulder strength, stability, and control, as well as ROM and trunk strength and mobility. Additionally, the Shoulder Control Programme includes a progressive throwing program during the off-season break. These programs typically take approximately 10-15 minutes to perform and are freely available at www.fittoplay.no and www.handballresearchgroup.com.

The OSTRC Shoulder Injury Prevention Programme has been demonstrated to decrease shoulder problems by 28% in adult elite handball players³, while the Shoulder Control Programme has shown to reduce the risk of shoulder injury by 56% in adolescent handball players⁴. It's worth noting that the outcomes in these studies were not diagnosis-specific, so it's difficult to determine whether the programs are more effective at reducing the risk of specific shoulder injuries.

Elbow, wrist and hand injury prevention in handball

To our knowledge, there are currently no handball-specific elbow, wrist, or hand injury prevention programs that have undergone scientific evaluation in larger studies. However, studies on other throwing athletes have shown that training programs incorporating strengthening and mobility exercises for the shoulder, arm, and trunk can reduce the risk of elbow injuries¹². Given the injury mechanisms observed in handball players, emphasis should be placed on strengthening the surrounding muscles to increase tolerance to valgus and hyperextension in the elbow, as well as enhancing the strength of the forearm flexors and extensors. Additionally, improving grip and extension strength in the fingers is important. Increased total rotational range of motion in the shoulder could potentially also reduce valgus stress on the elbow during the throw, particularly in the acceleration phase.

In contrast to the shoulder, which requires a delicate balance between stability and mobility to maintain optimal performance, the elbow, wrists, and fingers can be effectively stabilized

using taping techniques to reduce the risk of recurrent joint injuries. For instance, Goalie's elbow can be taped in a slightly flexed position with anchors around the upper arm and forearm, followed by strips on the medial and anterior sides of the elbow, thereby preventing valgus stress and hyperextension. Similarly, the wrist can be stabilized in various directions to prevent dorsal and palmar flexion, as well as ulnar and radial deviation, when needed often without impacting performance. Additionally, fingers can be effectively taped together to increase stability and reduce the risk of hyperextension/flexion or valgus/varus stress and re-injuries.

Notably, while there are specific shoulder programs that can effectively reduce the risk of injury and potential preventative strategies for elbow, wrist, and hand injuries in handball, it's essential to remember that sports injuries are multifactorial. Addressing just one aspect will not provide a comprehensive solution. These programs and preventive strategies should be viewed as integral components of handball preparation, alongside nutrition, adequate sleep and recovery, strength and conditioning and preseason training. Substituting any of these parts for an injury prevention programme and assuming it will be adequate is not the optimal approach, especially in a chaotic and dynamic sport like handball.

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