

HANDBALL ELBOW

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INTRODUCTION

The elbow facilitates the highly skilled functions of the forearm, wrist and hand that are needed for athletic throwing performance. The majority of injuries to the elbow in these athletes are chronic overuse injuries. These injuries are the results of repetitive intrinsic or extrinsic overload, or both, resulting in micro-rupture of the soft tissues such as capsule, ligaments or tendons. The micro-rupture of the soft tissue results in compromise of the soft tissue by an imperfect healing process. These athletic elbow injuries are often referred to by colloquialisms such as: tennis elbow, golfer's elbow, climber's elbow, little leaguer's elbow.

Handball is a popular team sport and because of its popularity, handball injuries have recently become a subject of increased medical interest. Handball players impose high demands on their upper extremities

and for that reason, a large number of elite handball players suffer from elbow pain. 'Handball elbow' is a popular term which has been used over the years to describe a variety of chronic lesions occurring in and around the elbow. The author felt that despite this being a recognised problem among these athletes, it was important to define terms accurately to eliminate confusion. It is also felt that an accurate diagnosis must be secured first, in order to make it possible to develop an effective treatment plan for these athletes as well as preventive programmes.

The purpose of this paper is to define the significance and mechanism of chronic elbow injuries in handball to assess their pattern based upon an anatomical and biomechanical study and then to evaluate with various imaging techniques, pathological changes of the elbow in these athletes.

EPIDEMIOLOGY

Two separate large epidemiological studies designed as a questionnaire survey concerning elbow problems in handball players were recently published^{1,2}. They show that the prevalence of past and present elbow problems was high as 51% in goalkeepers and 32% in field players. The pain in these players was on the medial side of the elbow in 51% of cases. These findings suggest that the prevalence of elbow problems in handball is at least as high as that observed in tennis, golf and baseball. It may be argued that the reason for the high prevalence of elbow problems found in this study may be that a wide definition of elbow injury was utilised which included any injury, even those which didn't cause missed playing time, contrary to other definitions of the injury commonly used in the literature^{3,4}. While it is likely impossible to compare cultural differences between



Figure 1: Blocking a ball typical for goalkeepers.

sports, it is the experience of those working with handball players to note that they regularly continue to participate despite the presence of seemingly significant pathology. Injury definitions which only include missed games are likely to substantially under-report the true burden of injury in this group. In this regard, more modern approaches to injury reporting may prove useful⁵.

As well these, studies identified two different patterns of elbow injuries in handball players:

1. repeated hyperextension trauma to the extended arm while blocking a ball, typical for goalkeepers (88.5%) (Figure 1) and
2. mechanism of repeated overhead throwing (73%) typical for field player.

The majority of goalkeepers reported bilateral problems, whereas field players mainly complained of problems in their throwing arm.

ELBOW INJURY IN GOALKEEPERS

Impact injuries of the elbow caused by the ball hitting a fully extended distal part of the forearm in handball goalkeepers have been well-described by Tyrdal et al^{6,7}. According

to their epidemiological study, 75% of goalkeepers in team handball experience elbow problems during their career. Almost all (95%) goalkeepers sustained their injuries through hyperextension trauma of the elbow when blocking shots. The ball impact on the forearm of a goalkeeper is considerable at a speed that can reach between 100 to 130 km/hour with the ball weighing 475 g.

As we know from previous studies, the medial collateral ligament complex of the elbow is the predominant stabiliser to valgus stress^{8,9}. The relationship between the functional tightness of the different bands of the anterior oblique complex of the MCL and the degree of elbow flexion may help to explain elbow lesions in handball goalkeepers depending on the position of the elbow at the time of injury. When blocking the shot, the elbow is in extension away from the body. This position of the upper extremity tightens the anterior bundles of the anterior oblique complex. The force of the blow to the forearm produces a valgus load on the elbow and stresses the anterior bundles of the medial collateral ligament complex.

In the cadaveric study designed to mimic injury mechanism seen in handball goalkeepers, Tyrdal et al⁷ confirmed that the anatomic lesions produced on the specimens were consistent with injury mechanism in handball goalkeepers. His study confirms some patterns of elbow lesion such as L-shaped ruptures of the pronator flexor origin with elongation of the anterior part of the medial collateral ligament, anterior capsule rupture and occasional incomplete rupture of the lateral collateral ligament and localised fragmentation of the cartilage near the posterior edge of the ulna (Figure 2). The majority of lesions produced by the mechanism of traumatic hyperextension were the lesions of the medial side of the elbow. While these injuries begin with an acute trauma, the symptoms soon become chronic as the athlete continues to suffer intermittent aggravations while continuing to play despite the medial elbow pain.

In a study regarding imaging of the elbow lesions produced by the mechanism of hyperextension in 30 handball goalkeepers, Popovic et al¹⁰ found important pathological changes on XR, US and MRI. No significant differences were found between

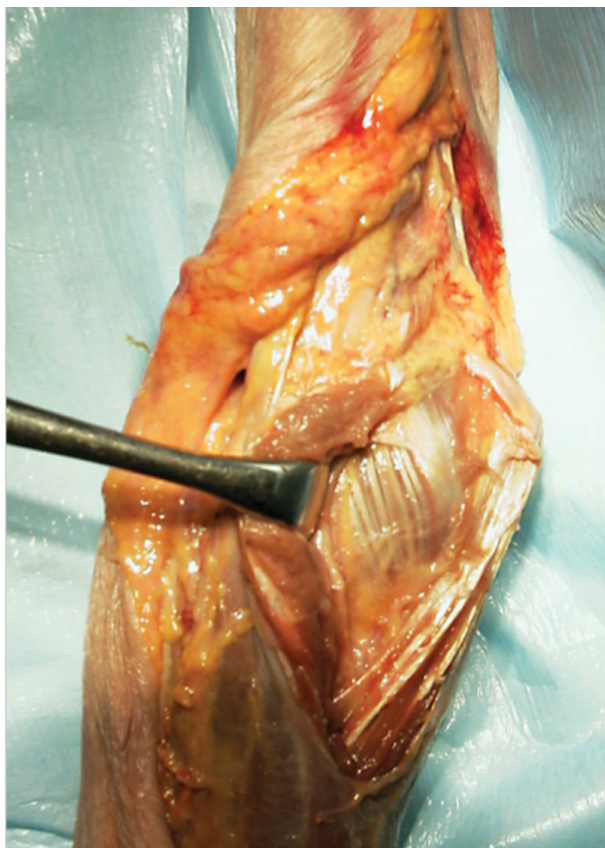


Figure 2 (left): L-shaped rupture of the pronator flexor origin in cadaveric study.



the dominant and non-dominant elbow in these mostly asymptomatic athletes. The radiological findings in that study demonstrated: hypertrophic osteophytes and traction spurs in 67%, loose bodies in 5.5% and periarticular calcification in 5.5% of cases.

Stress radiographs using a Telos stress device with 15 daN valgus stress confirm medial joint opening in some players that probably reflects certain MCL laxity in goalkeepers as a consequent trauma to repetitive hyperextension trauma of the elbow joint.

Ultrasonographic examination in this study disclosed in 67% of the goalkeepers elbow joint effusion mainly (44%) in the annular recess as well as the coronoid fossa (39%) and the olecranon fossa (33%).

Thickening of the MCL flexor-pronator tendon and triceps tendon of both elbows in goalkeepers compared with the normal population was demonstrated on US examination. We can argue that repetitive hyperextension trauma of the elbow in these athletes results in micro rupture of the soft tissue around the elbow with imperfect healing process of the MCL, flexor-pronator tendon, extensor tendon and triceps tendon resulting in thickening of these structures seen on US examination.

Based on the findings in this imaging study¹⁰, it seems that repetitive hyperextension stress of the elbow in handball goalkeepers provokes small amounts of various pathologic changes confirmed on US examination and increased medial laxity of the elbow seen on stress radiography. This laxity can ultimately lead to chronic repetitive injuries of the elbow especially in goalkeepers with poor dynamic muscular stabilisation of the elbow. However, athletes who participate in other sports that involve similar impact injuries of the elbow, such as soccer goalkeepers and volleyball players, can be likewise affected.

ELBOW PROBLEMS IN FIELD PLAYERS

In field players, the main injury mechanism of elbow overuse problems was repetitive throwing, and accordingly, mainly in the throwing arm. During overhead throwing, field players place repetitive high valgus stress on the medial aspect of the elbow joint. During a normal season of handball practice and completion, each player performs around 60,000 throwing motions at a speed up to 130 km/hour.

Throwing is a highly dynamic activity in which body segments move through large arcs of motion with high movement speeds, and subsequently large joint forces and

torques are generated at the elbow. During each throw in handball, the elbow is subject to both imposed forces and functional demands. The elbow is best disposed to control movement in the sagittal (flexion/extension) plane, however during throwing, large rotational torques are generated at the shoulder and transmitted to the elbow as valgus stresses which the passive and active restraints are ill-equipped to deal with. This presents a major challenge to the stabilising structures of the elbow. In the throwing arm, an enormous amount of force is generated about the medial aspect of the elbow during late cocking and early acceleration phase of throwing. This force is transmitted to the ulnar collateral ligament, radiocapitellar articulation and the surrounding soft tissue structures.

Slocum⁶ was the first to describe valgus extension overload injuries to the elbow in throwing athletes as the triad of medial tension, lateral compression and posterior impingement injuries (Figure 3). Most of these elbow injuries involve soft tissue, including ligaments, tendon, muscle as well as cartilage.

Medial compartment

Medial tension stress is responsible for most localised injuries of the elbow

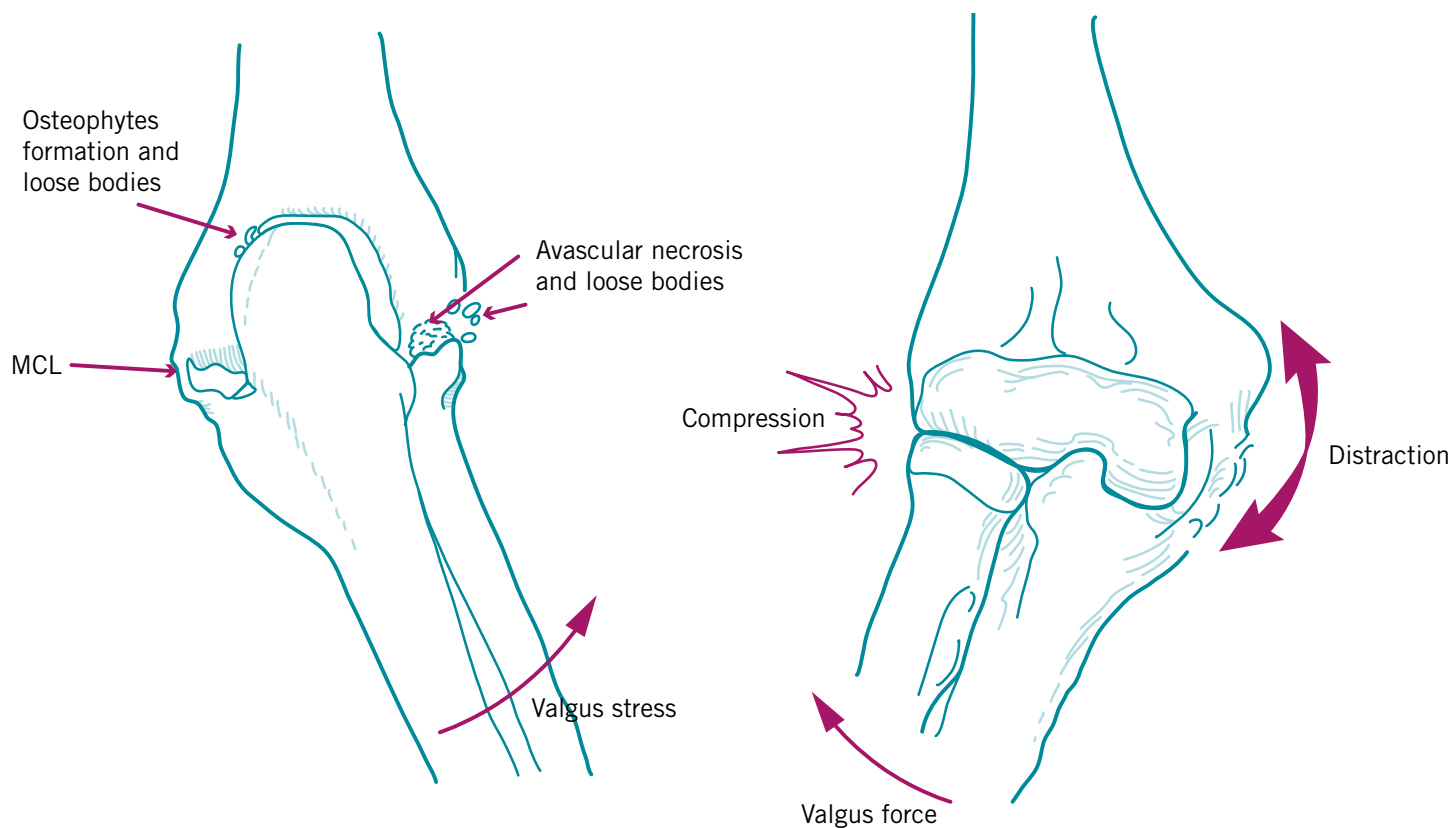


Figure 3: Valgus extension overload injuries of the elbow.

observed in field handball players. Medial musculotendinous injuries are quite common in these players especially involving the muscles that originate at medial epicondyle flexor-pronator mass. These muscles act to dynamically assist in controlling elbow stability while throwing. Because of the intensity of activity, number of repetitions and abnormal forces occurring from valgus stress, the MCL is at high risk of injury. Subtle injury of this ligament can lead to disability of dynamic medial instability of the elbow in these athletes. The medial collateral ligament is most susceptible to injury when the flexor-pronator muscle mass weakens and fatigues due to repetitive throwing and overuse.

Lateral compartment

The lateral compartment of the elbow in field handball players is subject to high compressive forces which can lead to lateral elbow compression injury. According to the study of Morrey et al⁸, 33% of the varus torque needed to resist valgus torque applied by the forearm is supplied by the joint articulation. This valgus torque can cause compression between the radial head

and the humeral capitellum. Inappropriate muscle contraction, especially about the elbow, or loss of joint integrity on the medial side of the elbow can cause this compressive force to increase. This excessive or repetitive compressive force can result in avascular necrosis, osteochondritis dissecans or osteochondral chip fractures in the lateral compartment.

In adult handball players this repetitive valgus stress in the presence of an incompetent MCL results in a radiocapitellar overload syndrome. This chronic radiocapitellar overload produces degenerative changes in the articular cartilage. Consequently loose-body formation can occur as the articular cartilage fragments break off into the joint. In these cases athletes report pain associated with catching, clicking or locking of the dominant elbow.

Posterior compartment of the elbow

Valgus extension overload syndrome is a common final pathway for posterior elbow problems that result from excessive valgus forces. After repetitive extension of the elbow during throwing, the

olecranon is repeatedly and forcefully driven into the olecranon fossa. This can result in posteromedial olecranon impingement within the olecranon fossa, especially in athletes with an attenuated medial collateral ligament. The tip of the olecranon, which is intra-articular, causes local inflammation and, if this persists, eventually chondromalacia and osteophytes. With continued impingement,

players regularly continue to play despite the presence of seemingly significant pathology

these osteophytes break off and become loose bodies within the joint. Loose bodies may cause a mechanical block to flexion or extension or may produce synovitis resulting in an effusion and a stiff elbow. Bony hypertrophy of the olecranon and narrowing of the olecranon fossa have been reported in throwers, predisposing these athletes to impingement of the olecranon process on the medial wall of the olecranon fossa. These athletes have pain with full extension, passive or active, and later some limitation of elbow extension.

IMAGING OF OVERUSE INJURIES IN FIELD PLAYERS

Careful imaging of the elbow joint focusing on the relevant anatomic structures leads to more meaningful interpretation of these images and prevents the physician from missing coexisting pathology.

Radiographic evaluation is helpful in evaluating the elbow joint for overuse injury. Plain radiographs which include anteroposterior, lateral, oblique and axial views can identify degenerative changes and loose bodies in the elbow. The posteromedial osteophyte is seen easily on the anteroposterior view and the hyper flexion axial view.

Valgus stress radiography has been described by some authors as an important tool in diagnosing elbow instability^{2,11}. If stress radiography is used, comparison should be made with the contralateral elbow as valgus stress radiography used only on the injured elbow can lead to a false-positive assessment of instability.

Ultrasound is an excellent modality for rapid comparative evaluation of soft tissue pathology about the elbow. It is an inexpensive technique, well-tolerated by patients. It is, however, limited in its ability to demonstrate the entire articular cartilage and it is operator-dependent.

MRI provides clinically useful information in assessing the elbow joint and has become the method of choice in evaluating elbow problems in throwing athletes. Integrity of the ligaments and associated injuries are readily seen as well as articular surfaces and adjacent neuromuscular structures. Administered gadolinium may provide

additional information in an assessment of throwing elbow pathology.

The imaging manifestations of musculoskeletal stress at the elbow associated with handball have been studied².

In their study using comparative plain films, stress radiographs, ultrasound and MRI in 40 uninjured elite field handball players, Popovic et al² tried to compare the manifestations of elbow stress due to repetitive valgus forces between the dominant and non-dominant elbow in these athletes. Generalised bony hypertrophy of the dominant extremity on XR was observed in all players. A significantly greater medial joint opening was measured in the dominant elbow compared with the non-dominant elbow. The ultrasound findings showed statistically significant bilateral differences in thickness of the flexor-pronator tendon, extensor tendon, MCL and triceps tendon, and values were systematically higher in the dominant elbow. In 33% of the players, small loose bodies were found in the dominant elbow. MRI confirmed these findings which suggests that US alone can be of use in describing these features clinically. This study confirmed that repetitive stress on the dominant elbow in field handball players is responsible for physiologic and pathologic changes.

CONCLUSION

The elbow joint in handball players is subject to great valgus stress and, as a result, is exposed to a wide variety of possible injuries. Epidemiological studies show that medial elbow pain affects a significant number of players in handball, with prevalence at least as high as observed in other throwing sports. The most common mechanism of injury is repetitive hyperextension trauma to the extended arm in goalkeepers and repetitive throwing motion in field players.

Pathomechanics of hyperextension trauma similar to that of handball goalkeepers, showed in cadaveric studies of Tyrdal et al⁷, four types of lesions:

1. anterior capsule rupture,
2. transversal and longitudinal rupture

of the flexor-pronator origin with elongation of the anterior part of the MCL,

3. occasionally incomplete rupture of LCL and
4. detachment of small fragments of cartilage near the posterior edge of the olecranon.

Biomechanical analysis of the throwing motion in field players revealed that transition from late cocking phase to early acceleration phase places extreme valgus stress on the medial structures of the elbow. These repeated insults are largely to blame for the patterns of elbow injury seen.





Based on imaging studies it is reasonable to conclude that repetitive valgus stress in field players results in typical overuse injuries of the dominant elbow. On the other hand, repetitive hyperextension stress of the elbow in handball goalkeepers provokes similar pathologic changes bilaterally.

On the basis of these findings, the existence of two different specific elbow injury patterns can be confirmed in handball players. In the long-term they provoke similar final overuse injuries of the elbow, which can be designated with a general term such as 'handball elbow'.

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