# Managing the stiff elbow

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## Abstract

Significant loss of the arc of elbow motion can cause difficulties with many activities of daily living. Elbow stiffness can be due to traumatic and atraumatic causes, and the osseous and soft tissue structures of the elbow can both contribute to the contracture. This article reviews the assessment of patients with elbow stiffness and highlights the importance of prevention of contracture after surgery or trauma. Non-operative options and operative techniques are discussed, and the outcomes after each are summarized. Non-operative treatment can be successful in patients with mild contractures and with symptoms that have been present less than 6 months. In patients with more severe contracture, open or arthroscopic arthrolysis may allow patients to regain a functional range of motion. An understanding of the anatomical structures that contribute to the contracture is essential to achieve a successful surgical outcome.


**Keywords** arthrolysis; contracture; elbow; joint capsule release

## Introduction

The elbow is a constrained synovial hinge joint, which functions to position the hand in space. Normal elbow motion ranges from approximately 0° (full extension) to 145° flexion, with 80° of supination and 80° of pronation. Morrey et al. have previously stated that the functional arc of motion required for the majority of activities of daily living is 100° (from 30° to 130° flexion) and 100° of forearm rotation (50° pronation and 50° supination).[1] However, recent studies have suggested that a greater range of motion may be required for contemporary activities, for example 140° flexion for using a mobile telephone or 65° pronation for typing on a computer keyboard.[2] Elbow stiffness is a common cause of functional impairment in the upper limb. Post-traumatic contracture is the most frequent aetiological factor, but a number of atraumatic conditions can also lead to debilitating loss of motion at the elbow. The exact cause, pathophysiological mechanisms and anatomic structures involved dictate treatment and affect prognosis. This review aims to outline the aetiology, classification and management options available for managing the stiff elbow.

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## The aetiology of elbow stiffness

Elbow stiffness can be considered to occur due to either bony or soft tissue causes, and traumatic or atraumatic causes.

### Bone *versus* soft tissue causes

Both bony and soft tissue structures around the elbow can contribute to elbow stiffness. In many instances soft tissue contracture co-exists with distortion of the bony anatomy. Each element needs to be addressed when considering the management of elbow stiffness.

The highly constrained osseous anatomy of the elbow serves to predispose it to stiffness. The articulation between the trochlea and the capitellum of the distal humerus with the trochlea notch of the ulna and the radial head respectively provides inherent osseous stability. The coronoid, radial and olecranon fossae of the distal humerus accommodate the coronoid process of the ulna, the radial head and olecranon respectively. Distortion of the articular and bony anatomy with scar tissue, fracture callus, ectopic bone or malunion leads to loss of the extremes of motion (Figure 1).

The articular capsule provides a soft tissue envelope around the elbow, with well-defined medial and lateral ligament complexes that offer varus, valgus and rotational stability to the joint. The capsule is an important structure in the aetiology of post-traumatic elbow stiffness. Trauma to the capsule or ligaments has been shown to initiate a myofibroblastic and mast cell response that leads to fibrosis and subsequent joint contracture.[3]

The flexor and extensor muscle-tendon units that cross the elbow joint can also contribute to elbow stiffness in a number of ways. The brachialis muscle lies in very close proximity to the anterior capsule and commonly tears with elbow dislocations.[4] Injured skeletal muscle will fibrose during the healing process.[5] Direct trauma to muscle is also thought to create a local osteoinductive environment that can trigger the differentiation of mesenchymal progenitor cells into osteoblasts, with the subsequent formation of heterotopic ossification (HO) (Figure 2).[6] The incidence of HO after simple elbow dislocation is 3%, and following complex fracture dislocations of the elbow this figure can rise up to 20%.[7,8] Furthermore, approximately 80% of patients with concomitant head injury may develop HO around the elbow.[9] Immobilization of the elbow after injury or surgery will also facilitate joint contracture. Muscles can atrophy and shorten, displaying sarcomere degeneration and molecular changes, within the first 6 hours after immobilization.[10]

Finally, skin contractures can occur around joints after burn injuries. Patients with burns around the elbow are also susceptible to developing HO, which tends to form in the posteromedial joint, often encasing the ulnar nerve. Good outcomes have been reported following open excision of the heterotopic bone and transposition of the ulnar nerve in these patients.[11]

### Atraumatic *versus* traumatic causes

Atraumatic causes of elbow stiffness can be divided into congenital or acquired causes. Congenital conditions that can cause elbow contracture include arthrogryposis, congenital radial head dislocation and congenital proximal radioulnar synostosis. Acquired atraumatic stiffness of the elbow is often secondary to

 

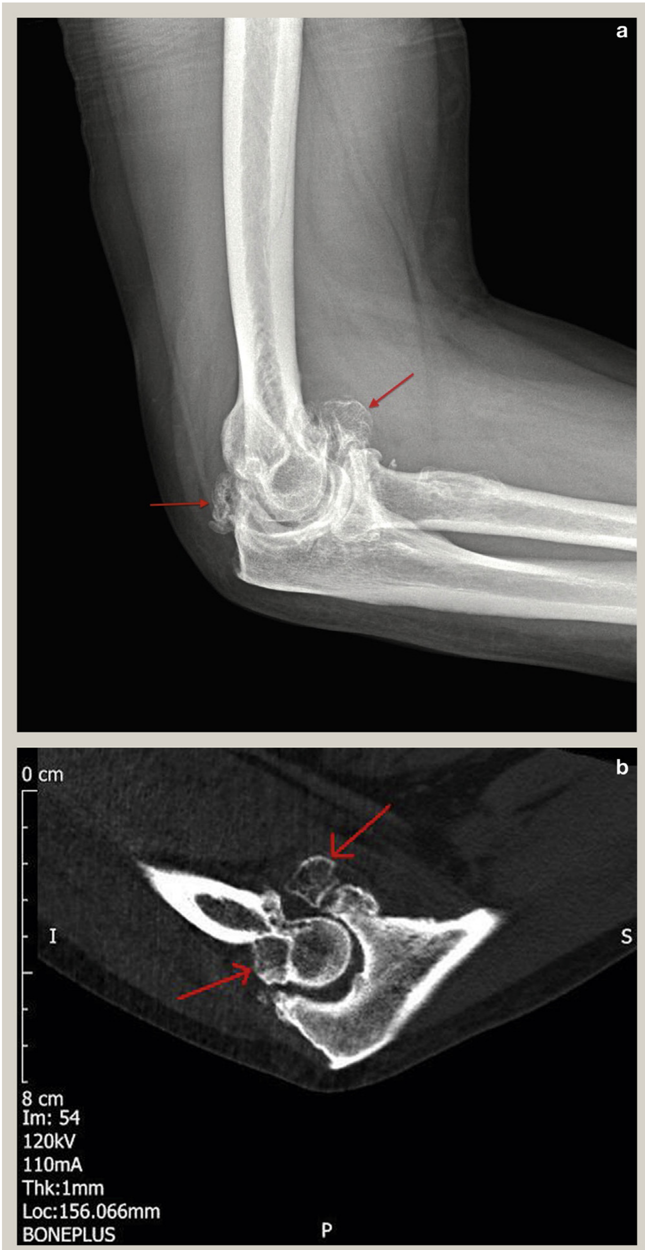


**Figure 1** Plain lateral X-ray (**a**) and sagittal CT image (**b**) of osteoarthritic elbows. Arrows indicate osteophytes and loose bodies in the olecranon fossa which would limit extension, and in the coronoid fossa which would limit flexion.

arthropathy with secondary capsular contracture. The common arthropathies include osteoarthritis, rheumatoid arthritis, post-septic arthritis and haemophilic arthritis. Osteoarthritis is unique compared to other arthropathies in that there is relative preservation of articular cartilage and joint space, with hypertrophic marginal osteophyte formation (Figure 1).

Trauma to the elbow can have direct or delayed effects on it's range of movement. A displaced periarticular fracture with haemarthrosis can cause a direct and immediate physical block to elbow motion. Immobilization of the injured joint can subsequently lead to intra-articular and capsular fibrosis and shortening of muscle sarcomeres.[12,13] Malunion, with incongruent


**Figure 2** Heterotopic ossification in the anterior elbow.

articular surfaces (Figure 3), in the longer term can lead to post-traumatic arthritis with cartilage degeneration, osteophyte formation and capsular fibrosis. Thus the fundamental fracture management principles of anatomic reduction, rigid fixation and early mobilization are crucial to minimize elbow stiffness in trauma patients.

## Classification

The two most commonly used classification systems for elbow stiffness are the Morrey anatomical classification[14] and the Kay classification.[15]

Morrey's three part system separates the factors causing stiffness into intrinsic, extrinsic or mixed. Intrinsic factors are intra-articular, such as mal- or non-united intra-articular fractures, osteophytes, intra-articular adhesions, synovitis, thickened capsule and loose bodies. Extrinsic factors include contracture of skin, muscles, ligaments and heterotopic ossification. Extrinsic contractures secondary to intra-articular pathology are classified as mixed.

According to the 5-part Kay classification, type 1 is a pure soft tissue contracture, such as a skin contracture in a burns patient; type 2 is a soft tissue contracture with associated ossification, as seen in head injury patients with heterotopic ossification; type 3 is a non-displaced fracture with ensuing soft tissue contracture, as commonly seen after simple radial head fractures; type 4 is a displaced intra-articular fracture with soft tissue contracture and type 5 is the with the formation of a post-traumatic ossific bar that typically results in ankylosis.

 