Upper limb – pathology, assessment and management

CHAPTER 34

LEARNING OBJECTIVES

To understand
- Anatomy and physiology relevant to upper limb pathology

To be able to explain:
- The diagnosis and treatment of common upper limb problems

SHOULDER GIRDLE

Anatomy and function

The humerus, scapula, clavicle, manubrium sterni and the chest wall are the osseous elements of the shoulder girdle. The main muscle groups are those that control the scapulothoracic and glenohumeral joints, in order that the hand may be placed in space, as defined by a sphere centred on the latter. The clavicle, through the medial sternoclavicular joint and the lateral acromioclavicular joints, acts as a load-transmitting bony strut between the upper limb and the axial skeleton. The whole shoulder girdle moves around the sternoclavicular joint, controlled and limited by those muscles between the thorax and scapula (e.g. trapezius, levator scapulae, rhomboids, serratus anterior and pectoralis minor) and thorax and humerus (e.g. pectoralis major and latissimus dorsi). The glenohumeral joint is controlled by the deltoid and the rotator cuff muscles, the latter composed of the anterior subscapularis, superior supraspinatus and the superoposterior infraspinatus and teres minor. The scapula is integral to shoulder motion by moving around the posterior aspect of the thorax and, in combination, these joints comprising the shoulder girdle afford the greatest range of motion of all the joints of the body, with stability primarily the function of soft-tissue static and dynamic stabilisers (Summary box 34.1; Fig. 34.1).

Summary box 34.1

Function of the shoulder

- To enable the hand to manipulate the environment as described by an arc centred on the shoulder joint
- The design is a compromise between mobility, stability and strength

Clinical history and physical examination

The clinical history and examination are detailed in Chapter 31, but the essential elements to clarify are those that commonly pertain to either loss of joint stability, e.g. anterior/posterior/multidirectional/habitual instability, or loss of joint motion, e.g. primary or secondary frozen shoulder, and pain sources around the shoulder girdle, e.g. calcific tendonitis, rotator cuff disease, superior labrum anterior posterior (SLAP) tears, etc.

Congenital abnormalities

Sprengel shoulder

This is the commonest congenital pathology around the shoulder, and is due to the abnormal descent of the scapula from its embryonic midcervical position. The clinical presentation is a high, small and rotated scapula with a connection to the cervical spine in 50% of cases, by a bony bar, fibrous band or an omovertebral body. Other congenital deformities may be associated, notably rib abnormalities, scoliosis of the thoracic spine or cervical spine anomalies including the Klippel–Feil syndrome (congenital fusion of the cervical vertebrae) (Fig. 34.2). The management is usually for cosmetic rather than functional reasons, especially in unilateral cases. Excision of the omovertebral body or superior angle has a satisfactory cosmetic effect.

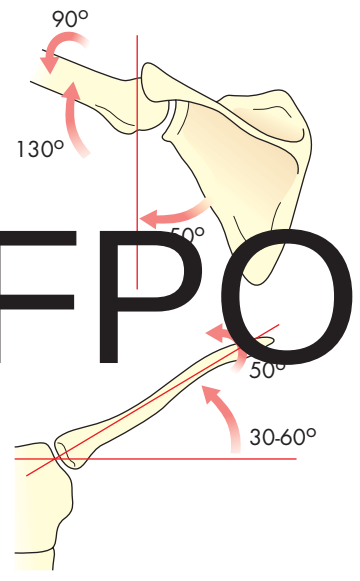

Figure 34.1 Relative motion of the elements of the shoulder girdle.<Q4>

Figure 34.2 Sprengel's shoulder (right) of a 4-year-old girl.

When functional improvement is the primary goal, complex reconstructive procedures are required.

Acquired abnormalities

The vast majority of acquired conditions present with some degree of pain in the shoulder region. The commonest of these acquired pathologies involve the rotator cuff musculature, especially the supraspinatus muscle–tendon unit. The spectrum of pathology that affects the rotator cuff presents, in order of severity, with painful arc syndrome, subacromial impingement, partial-thickness tears, full-thickness tears and cuff tear arthropathy. Calcific tendonitis, frozen shoulder and degenerative arthritis form the remainder of the common painful conditions of the shoulder (Summary box 34.2).

Summary box 34.2

Shoulder pain

- Second commonest musculoskeletal pain after back pain
- The supraspinatus muscle–tendon unit is most commonly diseased and painful

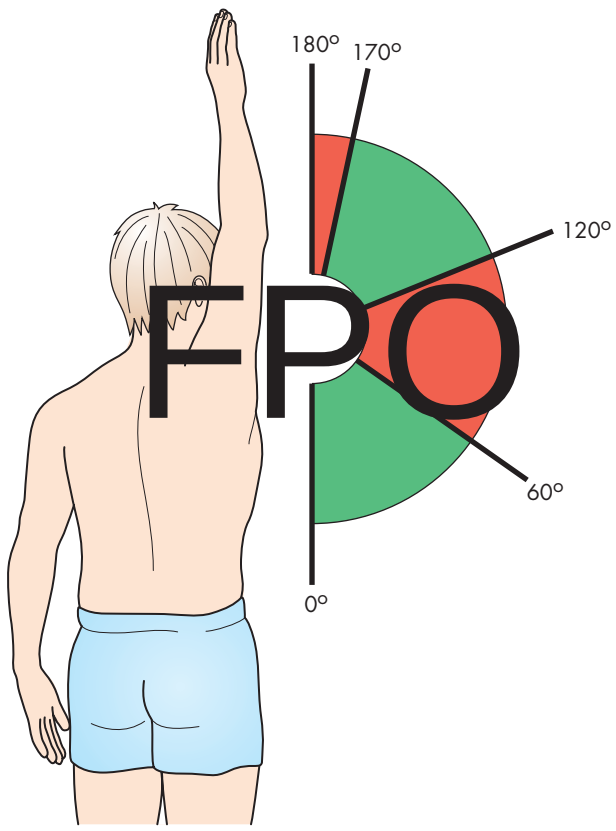

Figure 34.3 Arcs of shoulder girdle motion with subacromial impingement pain between 60° and 120° of abduction, and acromioclavicular joint pain between 170° and 180°.

Rotator cuff disease

The rotator cuff musculature, in particular the supraspinatus tendon, has a relatively poor blood supply, and this predisposes it to degeneration and tearing. The anterolateral portion of the tendon is initially affected; the resultant swelling can lead to impingement on the undersurface of the anterior acromion with its attached coracoacromial (CA) ligament. This leads to pain, particularly on active abduction or flexion, and initially leads to a painful arc between 60° and 120° (Fig. 34.3).

It is believed that abnormalities of the bone occur, with hooking of the anterior acromion. These may be secondary changes, rather than the primary cause of the pain, but surgical treatment is often to remove part of the undersurface of the acromion and CA ligament (Fig. 34.4).

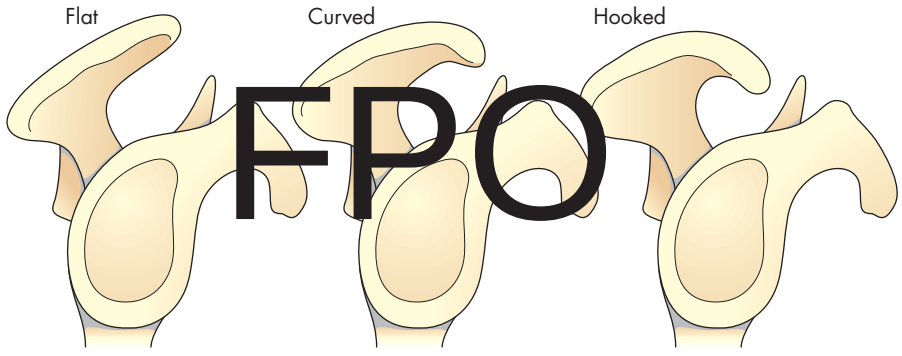

Figure 34.4 The three commonest acromial morphologies.

History and examination

The commonest patient characteristics are middle-aged, history of overuse or specific injury or a gradual onset of symptoms. The pain tends to be exacerbated with overhead activities and reaching across the body, e.g. putting washing on a line or grooming the opposite side of the head. Weakness is a feature in some patients that indicates a rotator cuff tear, as opposed to tendonosis.

Physical examination can rarely reveal local tenderness. Active movements may be limited and usually reproduce the symptoms, which occur between 60° and 120° of abduction and flexion (Fig. 34.3). There is usually much less pain on passive movement, and this confirms the mechanical and dynamic nature of the pain. Weakness of the supraspinatus and infraspinatus, when found, suggests the possibility of a tear in the muscles. Specific impingement tests have been described and help to confirm the diagnosis (Figs 34.5 and 34.6). Radiographs may be normal, but there are usually signs of subacromial sclerosis (Summary box 34.3).

Summary box 34.3

Supraspinatus problems

- Commonly in middle-age
- Activity related, especially arm above the head
- No local tenderness
- Passive movement is less painful than active
- Local anaesthetic into the subacromial region is diagnostic
- Subacromial steroid therapeutic in early tendonosis stage
- Steroids should not be injected without knowledge of the presence of a tear

Subacromial injection of local anaesthetic can temporarily improve symptoms, if the diagnosis is correct, and is a valuable diagnostic tool. Steroid injections should only be used if the patient is not a surgical candidate, or if there is clinical and other diagnostic information to exclude the presence of a repairable tear. In such cases, the steroid, in the form of a depot, can lead to symptom resolution, although this tends to be temporary. In cases of tendonosis, the anti-inflammatory steroid effect allows the rotator cuff the opportunity to be rehabilitated adequately.

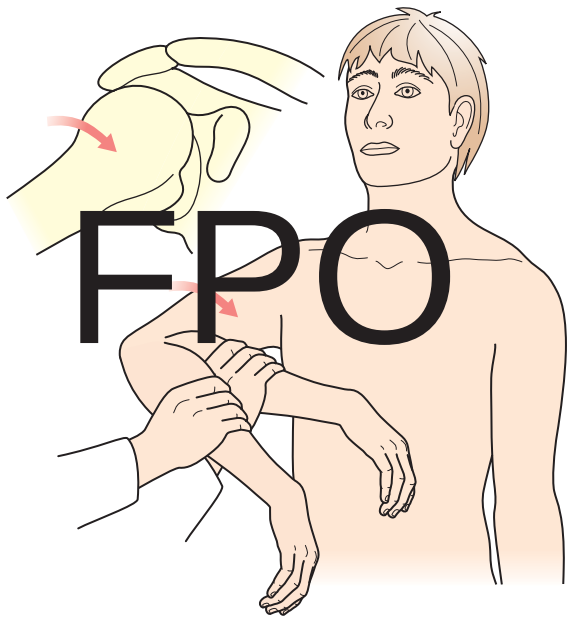

Figure 34.5 Hawkin's impingement test. Impingement pain is reproduced when the shoulder is internally rotated with 90° of forward flexion, thereby locating the greater tuberosity underneath the acromion.

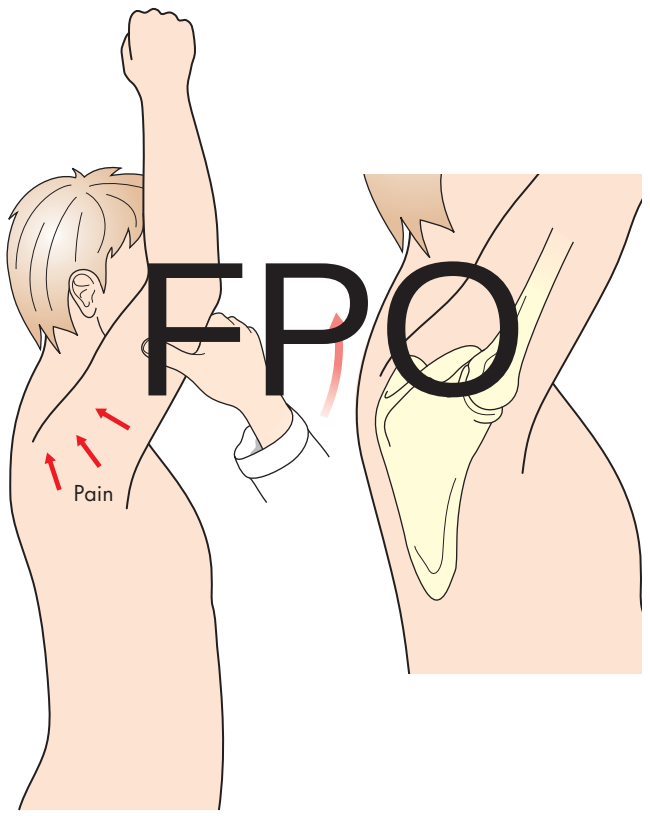

Figure 34.6 Neer's impingement test. Pain is reproduced with full forward flexion.

Investigations

An out-patient clinic subacromial local anaesthetic injection is a useful confirmatory test. Imaging modalities include plain radiography, ultrasound and magnetic resonance imaging (MRI). The last two can determine the presence, size and location of a tear, and are useful preoperative planning tools (Fig. 34.7).

Treatment

It is likely that most early cuff disease, impingement and tendonosis, will settle with non-operative treatment. The initial treatment is by a maximum of three depot steroid injections over a 12-month period if each injection is demonstrated to give good symptomatic relief. Specific rehabilitation should aim to balance the whole rotator cuff, thereby resisting the proximal vector of the deltoid. Surgery is required in those who do not respond to this non-operative rehabilitation or if the symptoms persist beyond a reasonable period of time, as defined by the patient and surgeon, a minimum period of 6 months. Rotator cuff decompression (arthroscopic or open) is performed by removing the acromial overhang and dividing the CA ligament.

In addition, repair of a rotator cuff tear may be required. In the absence of a rotator cuff tear, the prognosis is good (Summary box 34.4).

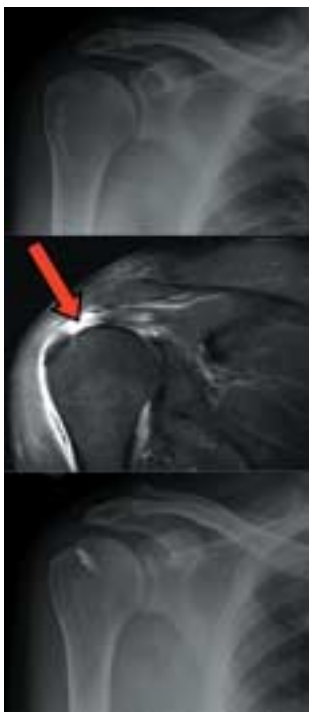

Figure 34.7 (Top) Plain anteroposterior (AP) radiograph demonstrating a roughened subacromion and greater tuberosity. (Middle) T2 weighted coronal magnetic resonance imaging (MRI) scan demonstrating a retracted supraspinatus tear (red arrow). (Bottom) Postoperative AP radiograph demonstrating anchor fixation of the rotator cuff tear.

Summary box 34.4

Treatment of subacromial irritation

- Non-operative treatment includes injections and cuff rehabilitation
- Surgery is indicated if symptoms fail to settle after a minimum of 6 months
- Surgery decompresses the rotator cuff

Rotator cuff tears

Patients with rotator cuff tears are generally older than patients with impingement, and it should be remembered that such tears form a spectrum of pathology from an early stage with small tears to the late stage of complete tear of all muscles.. The supraspinatus muscle tears initially at the anterolateral edge of the tendon, progressing posteriorly to include the remainder of the supraspinatus, infraspinatus and teres minor, thereby creating, in the end-stage pathology, a bald greater tuberosity. The muscle–tendon unit retracts medially once detached. The patient is usually unaware of the rotator cuff tearing, and large tears of several years' duration may be present before the patient seeks medical attention (Fig. 34.8; Summary box 34.5).

Summary box 34.5

Rotator cuff tears

- Occur in older age groups compared with impingement
- 4–20% of 40- to 50-year-olds have an asymptomatic tear
- > 50% of > 70-year-olds have an asymptomatic tear
- Treatment is required in symptomatic patients unresponsive to conservative management
- Outcomes are better following surgical repair of smaller than larger tears
- Subacromial decompression is important for pain relief following cuff repair
- Staged rehabilitation is crucial for good outcomes after surgical intervention

Small tears of the supraspinatus

These are very common and may be found in up to 50% of the normal population, according to MRI data, in the absence of any specific shoulder symptoms. The tear is usually less than 1 cm in length and, in the absence of pain, is insufficient to cause any observable weakness.

Treatment of small tears is dependent on the presence and severity of cuff symptoms. In the absence of symptoms, conservative cuff rehabilitation and regular review generally suffice. Symptom and/or tear progression are indicators for rotator cuff repair, with adjunctive decompression if impingement is defined to be a significant part of the pathology.

Intermediate tears

Tears of 2–4 cm are usually associated with symptoms of impingement and/or weakness of the shoulder, and frequently require decompression and repair of the supraspinatus. Arthroscopic or

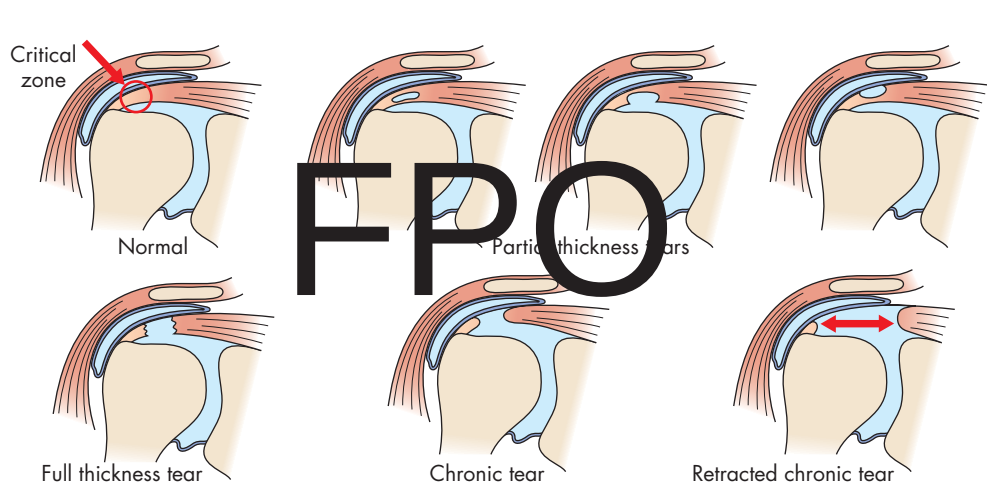

Figure 34.8 Various stages of rotator cuff tear. Initial partial-thickness tears have the potential to progress to full-thickness and retracted tears.

open approaches can be adequately utilised to perform the repair and decompression. The tendon is mobilised and then sutured into a bony trough created on the edge of the greater tuberosity, using suture anchors or osseous sutures. Results of repair are good for intermediate tears, but full recovery will take several months, with an emphasis placed on a graduated rehabilitation protocol.

Large rotator cuff tears

Tears greater than 5 cm (massive) may extend into the infraspinatus and teres minor and are usually associated with weakness of the shoulder. Abduction is typically limited to below 60°, often with a characteristic hunching of the shoulder (Fig. 34.9). With such massive tears, superior humeral head migration can occur, thereby further impairing function. A consequence of the resultant joint incongruity is secondary osteoarthritis of the glenohumeral joint, known as 'cuff tear arthropathy' (Fig. 34.10).

Large cuff tears that are significantly symptomatic and debilitating to the patient should be considered for repair and subacromial decompression. However, such chronic, degenerate tears are not always repairable, even after surgical mobilisation, because of medial muscle–tendon retraction and loss of elasticity of the structure. Options for defect closure include muscle tendon transfers and patch grafts (synthetic or xenografts), although the results of such procedures are less than satisfactory. A primary source of poor results, in this case, is the loss of contractility of the chronically retracted muscles, which undergo disuse atrophy and fatty infiltrative degeneration.

The majority of patients with massive irreparable tears complain of pain rather than loss of function. A successful treatment strategy is to repair, to the greater tuberosity, as much of the mobilised cuff that has retained adequate elasticity, which constitutes a partial repair, in combination with a minimal decompression. Good pain relief and some functional improvement are to be expected. A simple decompression without a partial repair may produce short-term pain relief, but has the potential for accelerated head migration and further erosion of the acromial bone stock.

Figure 34.9 A 75-year-old patient with a > 5 cm retracted rotator cuff tear attempting to abduct the left shoulder, which is limited, by lack of balanced motor power, to below 60°.

Figure 34.10 A massive rotator cuff tear that has led to proximal humeral head migration and secondary osteoarthritis of the glenohumeral joint, 'cuff tear arthropathy'.

Acute rotator cuff tears

Most tears of the supraspinatus result from degeneration and, as discussed above, will be associated with impingement symptoms. Occasionally, a large tear of the rotator cuff can result from trauma in the absence of any previous shoulder symptoms. These patients present soon after the event with profound weakness and loss of function but minimal pain. On examination, there is marked restriction of abduction, usually to less than 90°, with a characteristic hunching of the shoulder. This is due to elevation and rotation of the scapula to attempt to aid abduction. Diagnosis is confirmed by ultrasound or MRI, and early exploration and repair are indicated. Unlike the large degenerate cuff tears, the acute tear is usually repairable if surgery is carried out early. Often no decompression is necessary, as the front edge of the acromion is normal with no evidence of overhang. In middle-aged and elderly patients, an acute cuff tear can occur after shoulder dislocation, on the background of a pre-existent chronic degenerate tear (Summary box 34.6).

Summary box 34.6

Acute rotator cuff tears

- Present with little pain but profound weakness
- Early repair gives good results

Frozen shoulder

This is a description of a painful and stiff shoulder condition of varying aetiologies, some of which remain poorly defined and termed 'idiopathic'. The rotator interval between supraspinatus and subscapularis is affected, as is the shoulder capsule. The disease most commonly affects females in their fifth decade, and is more common in diabetics and patients with heart or thyroid disease. Summary box 34.7 gives a brief summary of the condition.

Summary box 34.7

Frozen shoulder

- Idiopathic or secondary to other defined pathologies
- Symptoms – pain followed by reduced shoulder motion
- Idiopathic usually in females in the fifth decade
- Spontaneous resolution reported in between 1 and 3 years
- Differential diagnoses include calcific tendonitis and rotator cuff tear

History and examination

Idiopathic frozen shoulder is characterised by spontaneous, often severe pain of sudden onset, and may follow minor trauma. Sleep is often disturbed, and the differential diagnoses include infection, fractures and rotator cuff tears. In the early stages, the shoulder is difficult to examine owing to pain but, as the disease progresses, the range of motion reduces, both actively and passively. Local tenderness is often felt anteriorly over the rotator interval. The pathognomonic sign of frozen shoulder is loss of external rotation, and this differentiates it from rotator cuff disease. Plain radiographs exclude other intra-articular pathology.

Clinical course

The clinical course of frozen shoulder can be divided into three stages as follows:

Stage 1 – Painful phase. This can last for 2–9 months. The shoulder becomes increasingly painful, especially at night, and the patient uses the arm less and less. The pain is often very severe, and may be unrelieved by simple analgesics.

Stage 2 – Stiffening phase. This can last for 4–12 months and is associated with a gradual reduction in the range of movement of the shoulder. The pain usually resolves during this period, although there is commonly still an ache, especially at the extremes of the reduced range of movement.

Stage 3 – Thawing phase. This lasts for a further 4–12 months and is associated with a gradual improvement in the range of motion.

The clinical course runs over a period of 1–3 years, and the condition usually resolves without any long-term sequelae.

Treatment

Often no treatment is required, and the condition will resolve as described above. The range of motion may be slightly reduced compared with the unaffected side, but the vast majority of patients have no functional problems.

Treatment in the acute stage is pain relief. Corticosteroids may be tried but have variable effects, and should be avoided if imaging reveals a potentially repairable rotator cuff tear to be present. Active and passive mobilisation can be carried out if comfort allows, but aggressive/painful physiotherapy should be discouraged.

Surgery is usually reserved for prolonged stiffness affecting function, but can also produce good pain relief in the acute stage. Manipulation under anaesthetic may produce an increased range of motion. Arthroscopic distension of the joint with saline allows inspection of the shoulder before treatment. If these measures fail to produce any benefit, open release of the rotator interval can be carried out through an anterior approach, or preferably through an arthroscopic release.

Calcific tendonitis

This is a common disorder of unknown aetiology, which results in an acutely painful shoulder. Calcium is deposited within the supraspinatus, and it is thought that this may be part of a degenerative process or a consequence of a partial degenerative tear of the tendon. The differential diagnosis includes frozen shoulder, with both conditions occurring most commonly in middle-aged women.

History and examination

This pain is usually of rapid onset, often with no precipitating cause. In common with impingement, the pain is felt on the anterolateral aspect of the shoulder and is worse with activity, particularly overhead activities. The pain can be very severe and usually disturbs sleep. On examination, the shoulder is tender anterolaterally, and there is often some painful restriction of active, and sometimes passive, motion. External rotation will be possible, and this differentiates the condition from frozen shoulder.

The calcific deposits can be seen on plain radiographs (Fig. 34.11), lying within the supraspinatus tendon, inferior to the acromion and just medial to the tuberosity of the humerus. They can also be seen on ultrasound and MRI scans.

Treatment

Simple analgesia should be tried, together with rehabilitation. Calcific tendonitis usually responds to subacromial injection of corticosteroid, although a course of several injections may be necessary. The condition is often self-limiting, with resolution of the symptoms and resorption of the calcium.

Surgery

Resistant cases of calcific tendonitis are an indication for surgical treatment. Open excision of the calcific deposits can be carried out through a sabre incision, although arthroscopic subacromial decompression is a less invasive alternative. The calcific deposit can be debrided and removed and, if the remaining cavity is considerable, a simple closure can be performed.

The prognosis for calcific tendonitis is generally good. Summary box 34.8 summarises the condition.

Figure 34.11 Radiograph demonstrating calcific tendonitis.

Summary box 34.8

Calcific tendonitis

- Commonly of unknown aetiology
- Rapid symptomatic onset, usually in middle-aged women
- Plain radiography often reveals the calcific deposits
- Majority of cases are self-limiting
- Resistant cases may be helped by subacromial decompression and deposit removal

Arthritis of the shoulder

Rheumatoid arthritis

The glenohumeral joint is commonly involved in inflammatory arthritides, particularly rheumatoid arthritis (RA), with up to one-third of these patients developing severe problems, prior to the introduction of modern disease-modifying agents. Initially, pain is related to synovitis, and this responds to medical management, including intra-articular steroid injection.

Impingement symptoms can also occur, either with or without a rotator cuff tear. These will respond to subacromial injection, but decompression may be indicated. Arthroscopic synovectomy can be carried out at the same time but, in general, open synovectomy is not indicated in the management of RA of the shoulder. Chemical synovectomy may be indicated for symptoms that are resistant to medical treatment, but this is not commonly performed for RA.

For advanced disease, glenohumeral arthroplasty is indicated, with very good relief of pain, but there is often little improvement in the preoperative stiffness, as this is more a function of the periarticular soft tissues (Summary box 34.9).

Summary box 34.9

Shoulder problems in rheumatoid arthritis

- One-third of cases have glenohumeral joint involvement
- Impingement can lead to rotator cuff tears
- Arthroscopic synovectomy is symptomatically effective
- Glenohumeral joint arthroplasty improves pain, but motion to a lesser degree

Osteoarthritis

Osteoarthritis of the glenohumeral joint is either primary or, more commonly, secondary. Secondary arthritis is commonly post-traumatic (Fig. 34.12) or a result of end-stage rotator cuff disease, in association with a massive tear of the cuff and superior migration of the humeral head (Fig. 34.10).

Treatment

Medical management is the first line of treatment but, if unsuccessful, surgical options are indicated. The two surgical avenues of management are debridement or joint arthroplasty; realigning osteotomies, akin to the knee, have no proven benefit in the shoulder. Whereas shoulder debridement is less predictable for long-term symptomatic relief, both total shoulder replacement (Fig. 34.13) and hemiarthroplasty (Fig. 34.14), without glenoid replacement, have good results in correctly indicated patients. A standard total shoulder arthroplasty should only be carried out if the rotator cuff is intact. In most rheumatoid patients and all patients with cuff tear arthropathy, the cuff is deficient, and the surgical options include hemiarthroplasty, hooded glenoid total shoulder arthroplasty (Fig. 34.15) or a reverse polarity total shoulder arthroplasty (Fig. 34.16). Shoulder arthroplasty is an effective pain-relieving procedure, but is less predictable in restoring motion, especially above shoulder level motion.

Arthrodesis of the joint is an alternative in younger patients, especially with a history of sepsis or any neurological problem that

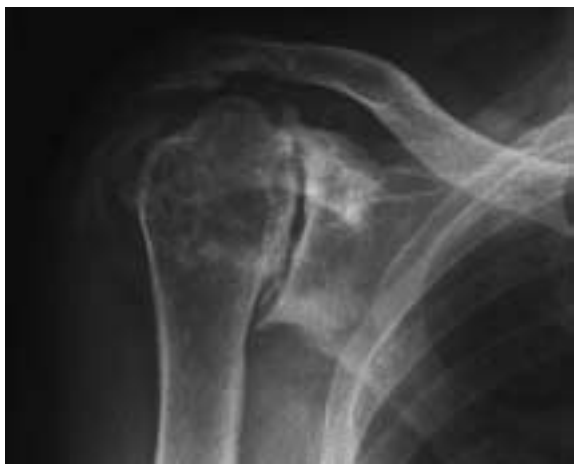

Figure 34.12 Post-traumatic arthritis with malunion of the proximal humerus, collapse of the humeral head and other features of osteoarthritis (subchondral sclerosis and osteophytes).

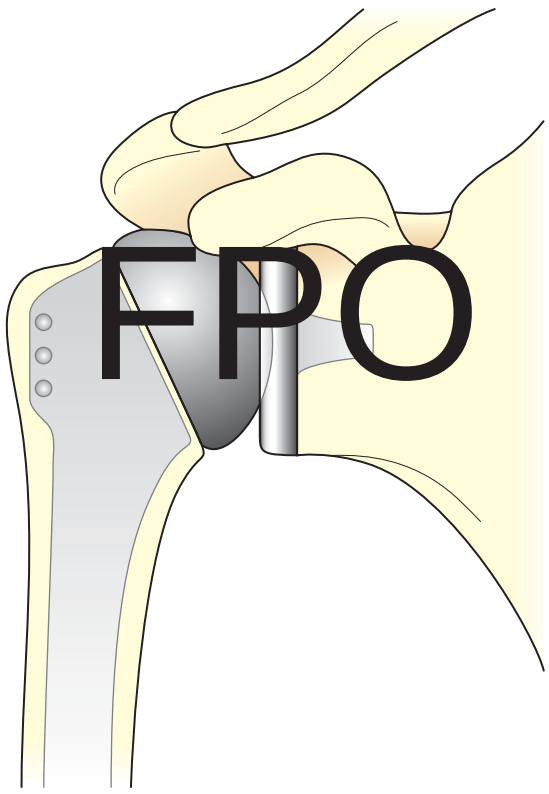

Figure 34.13 Total shoulder arthroplasty, for osteoarthritis, with an intact rotator cuff. Picture from Kvitne, R.S. and Jobe, F.W. *Clin Orthop* 1993, 291:107–123.

Figure 34.14 Hemiarthroplasty in a patient with an intact rotator cuff and reasonable chondral surface on the glenoid. An oversized hemiarthroplasty is an option in the presence of a massive rotator cuff tear.

Figure 34.15 Hooded glenoid total shoulder arthroplasty for cuff-deficient arthropathy. The hooded glenoid resists superior migration of the humeral head, thereby allowing the deltoid to generate a centred rotatory torque and enabling the shoulder to be elevated and abducted.

Figure 34.16 Reverse polarity total shoulder arthroplasty for cuff-deficient arthropathy. The glenosphere resists superior migration of the humerus, thereby allowing the deltoid function.

could destabilise a joint replacement. The peroperative morbidity is higher, and 3–4 months of immobilisation are required for union to occur. The patient retains a moderate range of movement at the shoulder, as a result of motion at the scapulothoracic articulation (Summary box 34.10).

Summary box 34.10

Shoulder osteoarthritis management

- Severe cases are treated by partial or total joint replacement
- If the rotator cuff is beyond repair, a standard total joint replacement is not an option
- Cuff tear arthropathy options are hemiarthroplasty, hooded glenoid or reverse polarity joint replacement
- Pain relief is predictably achieved, but range of motion improvement is less predictable
- Glenohumeral arthrodesis is an option in younger patients
- Post-arthrodesis motion is surprisingly good as a result of scapulothoracic motion

Acromioclavicular joint arthritis

Degenerative changes of the acromioclavicular (AC) joint are relatively common on plain radiographs and are often age related. Symptomatic disease usually manifests in males between 20 and 50 years of age and is frequently post-traumatic. Commonly, sports or manual occupations that load the upper limbs are implicated. The presence of inferior osteophytes implies the potential for impingement of the underlying rotator cuff.

History and examination

The pain is activity related and, unlike most causes of shoulder pain, is well localised, with the patient pointing to the AC joint as the source of the pain. On examination, there is usually a bony abnormality, with prominence of the lateral end of the clavicle. This may be tender, and movement of the joint by depressing the clavicle while pushing up the humerus will reproduce the pain. Flexing and adducting the arm to place the hand behind the opposite shoulder will also produce pain (Fig. 34.3). An intra-

articular injection of local anaesthetic will confirm the joint as the site of the pain. If the symptoms are related to the inferior osteophytes, the pain is less localised, and impingement signs and symptoms are present.

Treatment

Intra-articular injection of corticosteroids usually produces some benefit, and a course of three injections is a standard course of treatment. If medical management fails, then surgery may be appropriate. The distal 0.5–1 cm of the clavicle is excised by an arthroscopic excision or open approach, with good relief of pain and no functional difficulties. In patients with predominantly impingement symptoms, arthroscopic debridement of the osteophytes can be carried out (Summary box 34.11).

Summary box 34.11

Acromioclavicular joint problems

- Usually secondary to either repetitive overload or trauma
- Inferior osteophytes can impinge on the underlying cuff
- Intra-articular local anaesthetic can aid diagnosis
- Intra-articular steroid injection is helpful in some cases
- Lateral end of clavicle excision is curative if recalcitrant to conservative measures

Long head biceps tendon rupture

A relatively common condition, predominantly in the middle to elderly age groups. The pathomechanics appears to involve abrasion of the tendon in the bicipital groove and is associated with rotator cuff tears. Most patients present with few symptoms, although they often seek advice acutely.

History and examination

Usually, the patient feels a sense of 'something giving way' in the front of the shoulder, and this sensation is often linked to a specific exertional event, e.g. lifting or pulling. The upper arm is often bruised, and elbow flexion produces a swelling in the front and middle of the arm. The lump is initially tender and power is diminished (Fig. 34.17).

Treatment

In the vast majority of cases, the treatment is reassurance that the pain and bruising will resolve and that the power will improve over several months (Summary box 34.12).

Summary box 34.12

Proximal biceps tendon rupture

- Rupture of the long head is the commonest
- There is an association with rotator cuff pathology
- Surgery is rarely indicated
- A swelling remains but the power improves over several months

Instability of the glenohumeral joint

Traumatic dislocation of the shoulder is the commonest of all dislocations, with recurrent dislocations or instability being commoner age-related sequelae. A significant proportion (> 50%) of under 25-year-olds develop either recurrent subluxations or

Figure 34.17 Long head biceps tendon rupture – an obvious change in upper arm shape is evident along with acute bruising on the lateral aspect.<Q5>

dislocations. A subgroup of shoulder instability patients dislocate their shoulders after relatively little force (atraumatic dislocation), while another subgroup is able to dislocate or sublux under their own volition (habitual dislocation). A careful clinical history, physical examination and plain radiographs (including lateral and axillary views) often accurately define the pathology in most cases.

Classification

There are many ways of classifying shoulder instability, based on the direction and degree of traumatic energy, as well as differentiating between subluxations and dislocations. There is a spectrum of instability, but three broad groups of instability can be considered (Fig. 34.17; Summary box 34.13).

Summary box 34.13

Classification of dislocations

- Traumatic – unidirectional; surgery usually successful
- Atraumatic – multidirectional, painful; responds to surgery
- Habitual – voluntary with ligament laxity, painless; surgery usually contraindicated
- Remember – patients may have a combination of the above aetiologies

Recurrent traumatic instability

Predominantly unidirectional and commonly anteroinferior. There is a notable traumatic event initially, although less energy is required on subsequent occasions. The patient experiences apprehension during activities that place the humeral head at risk

of displacing towards the vulnerable direction. The shoulder may sublux or dislocate, which may or may not require medically supervised reduction. On examination, there is a full range of motion; with forced abduction and external rotation, apprehension is elicited (Fig. 34.18). Other joints are usually normal. As discussed in the section on trauma, there is usually a Bankart defect, with detachment of the anteroinferior glenoid labrum and damage to the humeral head (Figs 34.19 and 34.20) and, if the instability causes functional difficulties, surgery is indicated. For anterior instability, repair of the Bankart defect, in addition to some tightening of the capsule, will produce good results in 90–95% of patients. This is carried out either through an open anterior deltopectoral approach or arthroscopically (Fig. 34.21). For recurrent posterior instability (which is uncommon), tightening of the posterior capsule is curative, through either an open or an arthroscopic approach (Summary box 34.14).

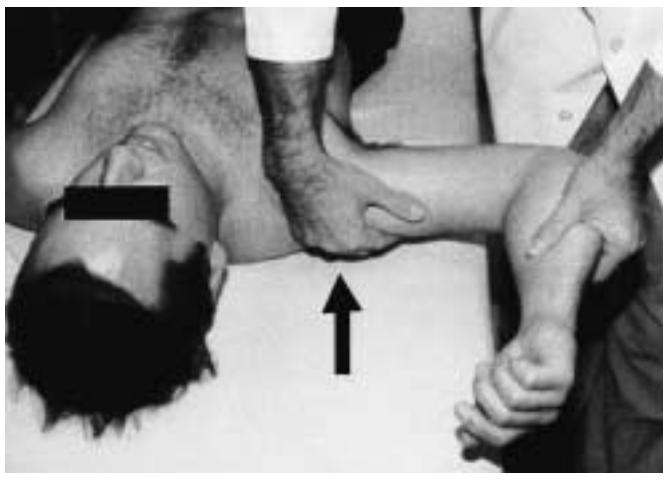

Figure 34.18 Shoulder instability can be clinically tested with an apprehension test; the photograph demonstrates the test while the patient is supine, but the same test can be performed with the patient sitting.

Summary box 34.14

Recurrent traumatic shoulder instability

- Traumatic event initially noted
- Subsequent dislocations/subluxations become easier
- Commonest direction of instability is anteroinferior
- Normal range of motion but positive apprehension sign
- Surgical treatment repairs the labral lesion and tightens the capsule

Atraumatic instability

Although there may be an initiating event, this is often less traumatic, for example a fall climbing stairs rather than a sporting injury. In many cases, there is no initial injury, and the instability may occur in more than one direction. The shoulder usually subluxes rather than dislocates, and the patient can often self-reduce the shoulder. The subluxation is painful, and the patient cannot dislocate the shoulder voluntarily. On examination, generalised ligament laxity is commonly present, and the shoulder can often be subluxed inferiorly to produce a sulcus sign, with a lateral sulcus appearing beneath the acromion as the arm is pulled down. Apprehension tests are again positive, but often in more than one direction. Anterior and posterior drawing of the humeral head often allows laxity to be appreciated (Fig. 34.22).

Physiotherapy, by an experienced therapist, should be tried first in these patients. As well as muscle strengthening, re-education of the patient, and of the shoulder, is necessary, and specific muscle groups may need to be targeted.

Approximately half of patients will require surgery, and a capsular tightening procedure is carried out either through an anterior approach or arthroscopically. This is a successful procedure, but there is a higher failure rate than with patients found to have a Bankart defect. Arthroscopic capsular shrinkage appears not to have an independent role in such patients, although it may have an, as yet incompletely defined, adjunctive role to capsular plication.

Habitual dislocation

This is a much smaller group of patients, but one that does not respond well to surgical treatment. The patient is able to sublux the shoulder at will, either anteroinferiorly (Fig. 34.23) or posteriorly (Fig. 34.24), and this is usually not painful. There is underlying joint laxity, which is usually generalised, and there is rarely a significant traumatic event. The patient may sublux the shoulder as a 'party trick' or for emotional or psychological reasons.

It is vital that these patients are assessed and managed by an experienced therapist. The patient must be educated to avoid subluxing the shoulder and shown exercises as appropriate. Biofeedback re-education of muscles is important. Surgery is associated with a high failure rate and should be avoided in the vast majority of cases. However, recalcitrant cases can be treated by temporary paralysis of the dislocating muscle groups with botulinum toxin, while the stabilising muscle groups are re-educated (Fig. 34.23).

DISORDERS OF THE ELBOW

Tennis elbow (lateral epicondylitis)

This is the most common cause of elbow pain excluding traumatic conditions, and usually occurs in patients in their 30s to 50s. The aetiology is unknown in the majority of cases, but the condition commonly follows a period of overactivity, particularly unaccustomed activity that involves active extension of the wrist. The tendon of extensor carpi radialis brevis is most commonly involved and, at exploration, a partial muscle tear and chronic inflammatory tissue may be evident (Summary box 34.15).

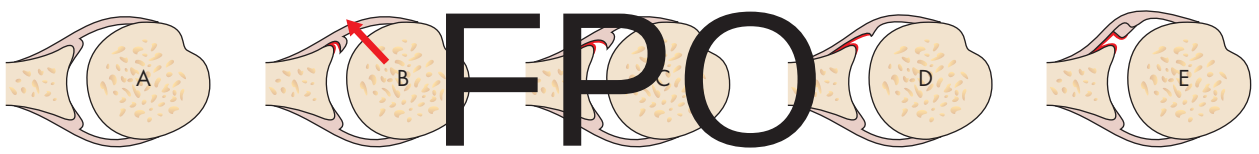

Figure 34.19 Schematic representation of Bankart lesions, which form a spectrum of pathology from minor labral detachment (b) to large detachments with glenoid rim fractures (bony Bankart; e).

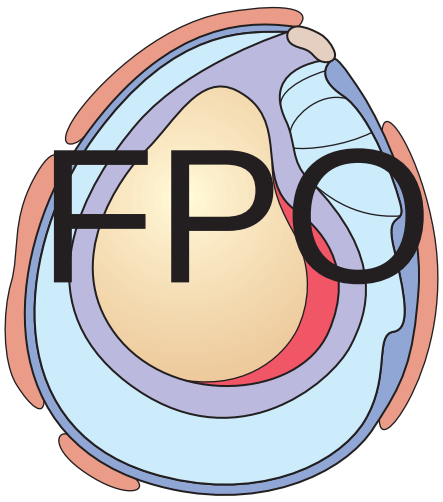

Figure 34.20 An end-on view of the glenoid labrum, demonstrating a labral detachment (red), with the rotator cuff muscles (brown), long head biceps tendon and labrum (grey).

Summary box 34.15

Tennis elbow

- Strenuous or overactivity may precede symptoms
- Anterodistal lateral epicondyle tenderness
- Resisted wrist extension is a reliable diagnostic test
- Local anaesthetic injection is diagnostically helpful
- Vast majority improve with supervised conservative management
- Open or arthroscopic release yields good results in recalcitrant cases
- Arthroscopic release also identifies associated pathology

History and examination

The patient complains of pain around the lateral epicondyle and in the back of the forearm with certain activities. There is not usually a history of trauma, but the patient may relate the onset to a period of unusual or strenuous activity. On examination, the patient is locally tender, which is commonly just distal and anterior to the lateral epicondyle rather than at the apex of the epicondyle itself. Forced palmar flexion and pronation (Fig. 34.25) or resisted wrist extension against resistance (Fig. 34.26) reproduces the pain. Pain with resisted middle finger metacarpal phalangeal joint extension distinguishes the source as the extensor digitorum communis origin. The diagnosis is essentially a clinical one, aided by a local anaesthetic injection into the lateral epicondylar region. The need for ultrasound or MRI is minimal, as the vast majority are adequately diagnosed with clinical examination.

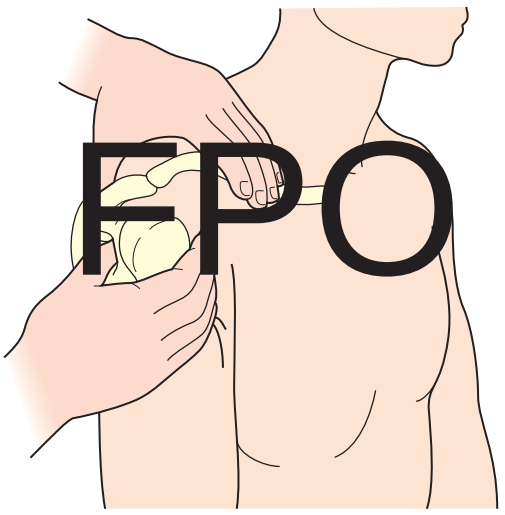

Figure 34.22 Generalised laxity can be appreciated by drawing the humeral head in anterior and posterior directions, and further confirmed by the sulcus sign.

Treatment

The prognosis is generally good with most cases resolving without medical input, especially if the precipitating activity is avoided. Persistent cases can be aided with simple analgesia or a local injection of hydrocortisone, depending on severity, but repeated injections should be avoided. Other effective non-surgical measures include extensor mass stretching exercises and deep massage of the extensor mass, followed by cooling the elbow with ice packs. Open or arthroscopic surgery (Fig. 34.27) may be indicated occasionally, and local excision of the abnormal tissue will produce good results in 70–90% of patients.

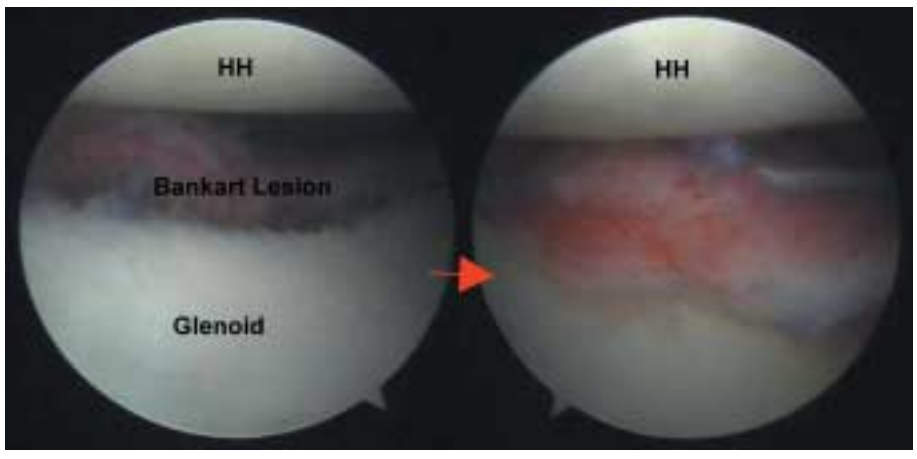

Figure 34.21 An arthroscopic view of a detached labrum (a) followed by an arthroscopic repair (b). HH, humeral head.

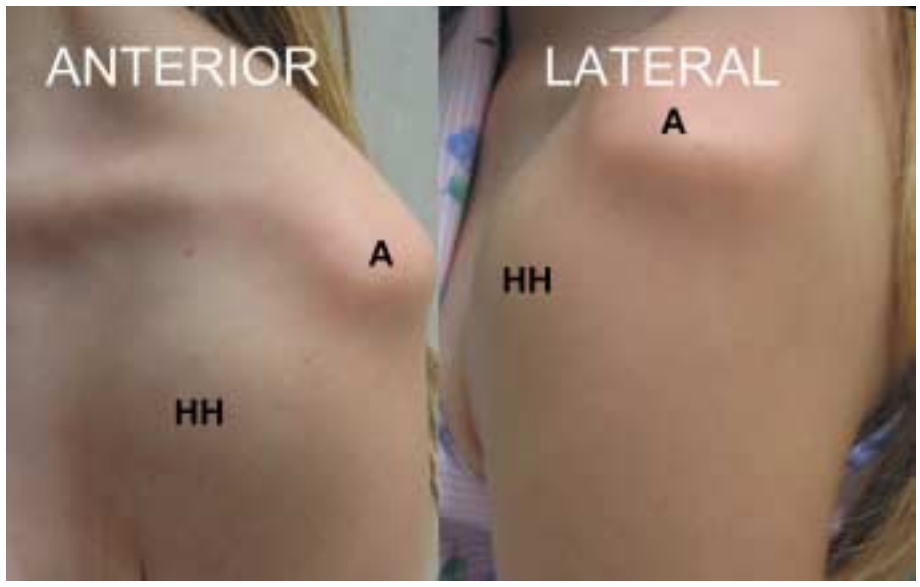

Figure 34.23 Anteroinferior habitual subluxation of the left shoulder in a 12-year-old girl. This was treated successfully with a combination of botulinum toxin to the pectoralis major muscle, biofeedback muscle re-education and a temporary anterior glenoid rim K-wire. A, acromion; HH, humeral head.

Golfer's elbow (medial epicondylitis)

This is less common and involves the flexor–pronator origin at the medial epicondyle. Ulnar nerve symptoms due to irritation or compression are part of the differential diagnosis, and treatment follows similar lines. If non-surgical management fails and surgical excision of the degenerate muscle origin is carried out, further imaging such as ultrasound or MRI is occasionally required, but this is essentially a clinical diagnosis.

Arthritis of the elbow

Rheumatoid arthritis

The elbow is commonly involved in rheumatoid arthritis, which can be a source of discomfort and functional limitation. Medical management is increasingly successful, but surgery is occasionally required. Radial head excision and synovectomy (open or arthroscopic) is effective for painful and restricted pro-supination, with good short-term results, although relapses are frequent. Elbow arthroplasty is a very effective modality for pain relief and functional restoration in end-stage disease (Fig. 34.28), with up to 90% implant survival at 10 years (Fig. 34.29), with gross bony destruction. The functional outcomes are gratifying and of significant benefit to this group of debilitated patients (Fig. 34.30; Summary box 34.16).

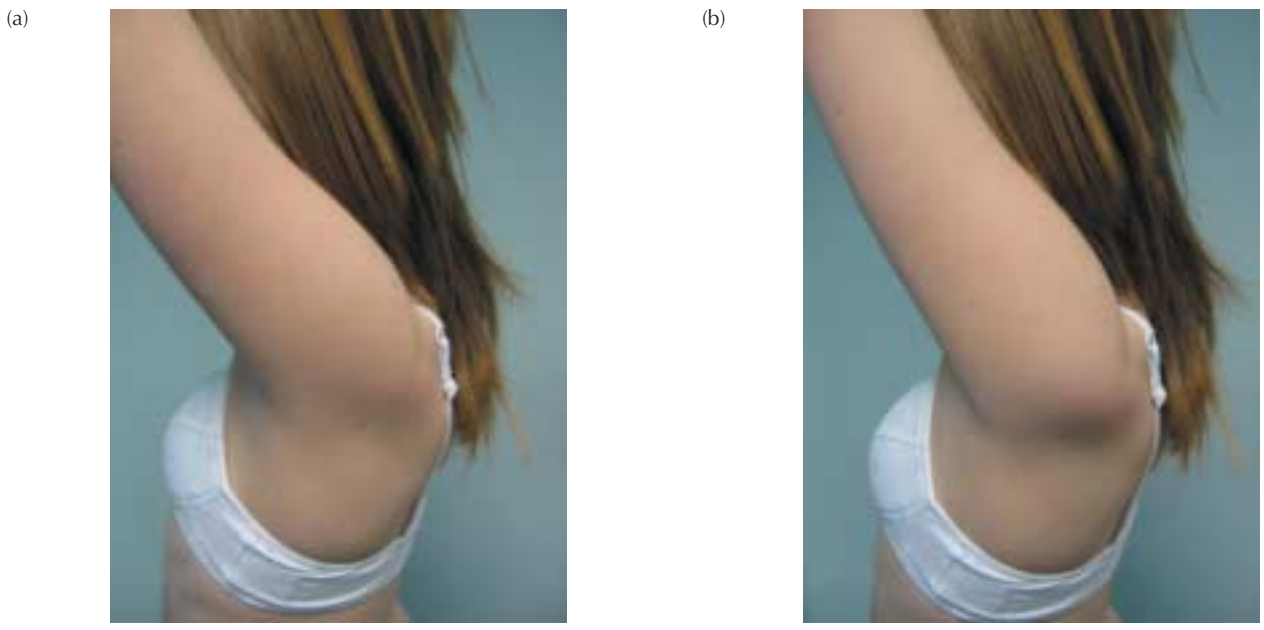

Figure 34.24 Posterior habitual instability of the shoulder in a 14-year-old girl that completely responded to biofeedback muscle re-education; (a) reduced, (b) posteriorly subluxed.

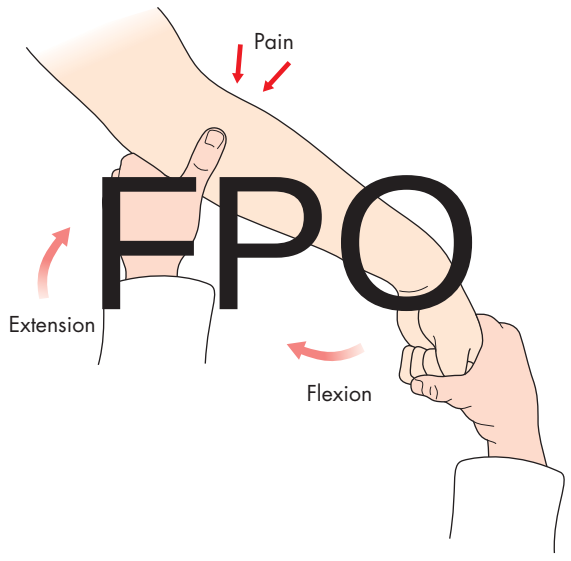

Figure 34.25 Tennis elbow test 1. Pain is reproduced with wrist flexion and forearm pronation against resistance.

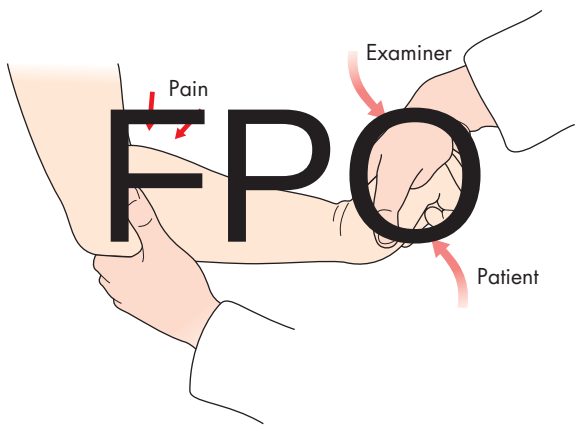

Figure 34.26 Tennis elbow test 2. Pain is reproduced with resisted wrist extension.

Summary box 34.16

Rheumatoid arthritis of the elbow

- Surgical management is less frequently required due to the success of medical treatment
- A painful rheumatoid radial head can be excised to improve pain and pro-supination
- End-stage elbow disease is well treated with a total elbow arthroplasty
- Elbow replacement surgery is technically challenging if little bone stock is present

Osteoarthritis

Primary osteoarthritis of the elbow is increasing in frequency, but most cases of arthritis are secondary to previous trauma, osteochondritis dissecans or congenital problems. The typical patient demographic is a 40- to 60-year-old male, working in a heavy manual occupation (Fig. 34.31). Pain is the primary problem, along with locking although, on examination, there will usually

(a)

(b)

(c)

Figure 34.27 Arthroscopic view of tennis elbow. Arrows highlight the visible pathology. (a) Capsular splits; (b) capsular partial rupture; (c) complete capsular and ECRB rupture. C, capitellum.<Q2>

Figure 34.28 Typical end-stage rheumatoid arthritic destruction of the elbow joint, with characteristic erosion of the olecranon process and distal humeral columns.

Figure 34.29 A linked total elbow arthroplasty (Coonrad–Morrey) of the patient from Fig. 34.27. Of note is the lack of olecranon process and columns.<Q3>

Figure 34.30 Final functional outcome of the patient in Fig. 34.27, 1 year after a Coonrad–Morrey linked total elbow arthroplasty.

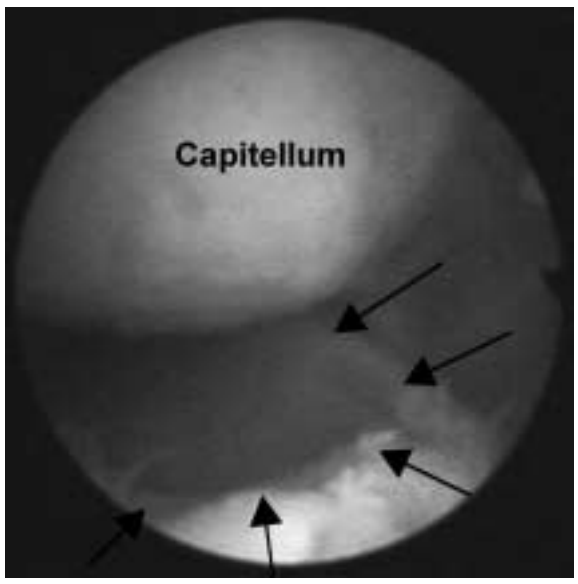

Figure 34.31 Arthroscopic view of primary osteoarthritis of the radiocapitellar joint in a young male labourer.

be some crepitus, pain with motion and some degree of fixed flexion deformity. The history and examination should concentrate on differentiating the pain of a degenerate joint, which is activity related and predictable, from that of sudden unexpected pain and locking, which suggests loose bodies within the elbow (Figs 34.32 and 34.33). In addition, ulnar nerve symptoms are more common in the arthritic elbow.

Treatment

No treatment is required in most cases other than reassurance about the nature of the condition. Osteoarthritic elbows seldom deteriorate rapidly, and the symptoms often improve after retirement. For the patient who is unable to carry out normal activities, there are surgical procedures that alleviate symptoms but may not guarantee a return to heavy manual work. Debridement, with or without augmentation with hyaluronic acid supplementation, will alleviate painful symptoms and increase the range of motion in the earlier stages; loss of motion is rarely a major complaint. Interposition arthroplasty using tendon, fascia or cutis is an option, although the outcomes are less predictable. Prosthetic joint arthroplasty is better for a more predictable symptomatic relief, but patients wishing to return to a heavy manual profession should be precluded. Other options that are less acceptable but should be considered in certain situations are resection arthroplasty and arthrodesis.

In general, the results of elbow replacement for osteoarthritis are not as good as for rheumatoid arthritis, probably as a consequence of different lifestyles of the patients (Summary box 34.17).

Summary box 34.17

Elbow osteoarthritis

- Initial management – decrease forces across elbow
- Decrease activities, change occupation
- Joint-preserving measures include arthroscopic/open debridement
- When conservative measures fail, consider prosthetic arthroplasty in low-demand patients

Figure 34.32 Plain radiographs of primary degenerative osteoarthritis of the elbow. White arrows, osteophytes.

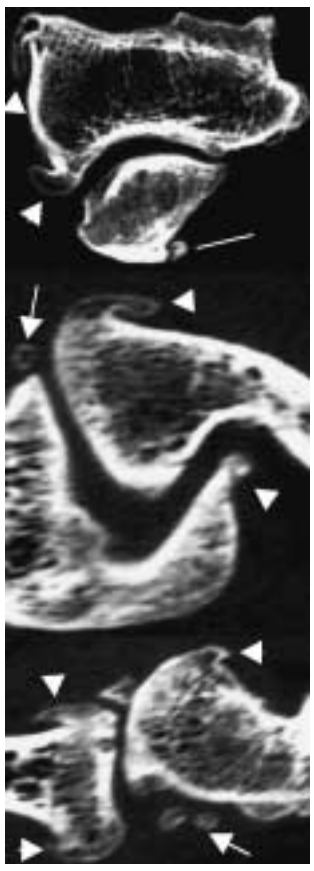

Figure 34.33 Computerised tomography (CT) scans of primary degenerative osteoarthritis of the elbow. Arrows, loose bodies; headless arrows, osteophytes; white line, broken osteophyte.

Summary box 34.18

Other common elbow problems

- Osteochondritis dissecans – occurs in teenage boys. Detached fragment can be repaired or removed
- Olecranon bursitis – usually chemical not septic
- Ulnar nerve compression – may present with numbness in the hand. May need to be decompressed

Loose bodies

After the knee, the elbow is the second commonest site of symptomatic loose bodies. The most common cause is osteoarthritis but, in younger patients, osteochondritis dissecans is the usual cause. Most patients complain of sudden unexpected pain and locking of the elbow, and often they have to shake or manipulate the elbow to relieve it. Plain radiographs will confirm the diagnosis in 90% of cases, and further investigation is not necessary (Fig. 34.34). Arthroscopic removal is effective and, in the presence of mechanical symptoms, good results can be expected (Fig. 34.35). The removal of loose bodies from a degenerate elbow in isolation may not result in any lasting benefit, due to the degenerative symptomatology from the remainder of the joint (Summary box 34.18).

Osteochondritis dissecans

Osteochondritis dissecans is much less common in the elbow than in the knee, and usually affects the capitellum. Teenage boys are usually affected, and the condition is often related to sporting activities. The main symptoms are pain and swelling and, on examination, there is loss of full extension. Treatment is normally conservative, with a rest from sports, but arthroscopic removal may be required if the fragment detaches and the patient develops mechanical symptoms suggestive of a loose body.

Olecranon bursitis

Inflammation of the olecranon bursa is relatively common. The elbow is often very red, warm, swollen and painful, and a septic arthritis may initially be suspected. The signs and symptoms are, however, confined to the back of the elbow (Fig. 34.36), and movement within an arc of 30–130° is usually possible. The bursitis is usually chemical rather than infective, and management

(a)

(b)

Figure 34.34 Radiograph of elbow loose bodies.

consists of rest, ice, anti-inflammatories and a compression dressing. If there is any suspicion of a penetrating wound, antibiotics should be administered, but formal drainage of the bursa should be avoided, unless purulent material is present.

Chronic bursitis can occur and may be associated with calcific nodules of the bursal lining (Fig. 34.37). When troublesome, surgical excision is beneficial.

Distal biceps tendon rupture

Rupture of the distal insertion of the biceps is an uncommon condition that usually occurs in younger patients, particularly after a sporting injury. Again, pain and weakness are present but, unlike rupture of the long head, the weakness will not improve. Surgical repair is indicated in the demanding younger age groups, with good functional restoration (Fig. 34.38).

Ulnar nerve compression

This is the second commonest peripheral nerve entrapment after carpal tunnel syndrome. The most common sites of compression are around the elbow, especially if associated with a significant cubitus valgus angular deformity (Fig. 34.39): there are a number of other possible sites:

Figure 34.35 Arthroscopically removed loose bodies from the patient in Fig. 34.33.

Figure 34.36 Olecranon bursa.

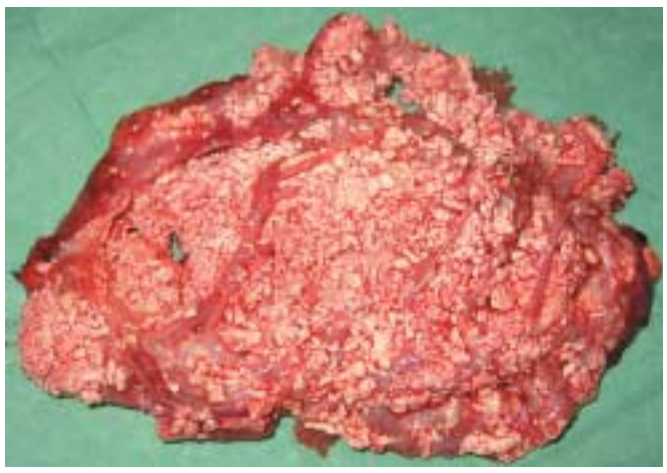

Figure 34.37 A very large chronic olecranon bursa, excised and its internal lining exposed, revealing a dense calcific component to the lining.

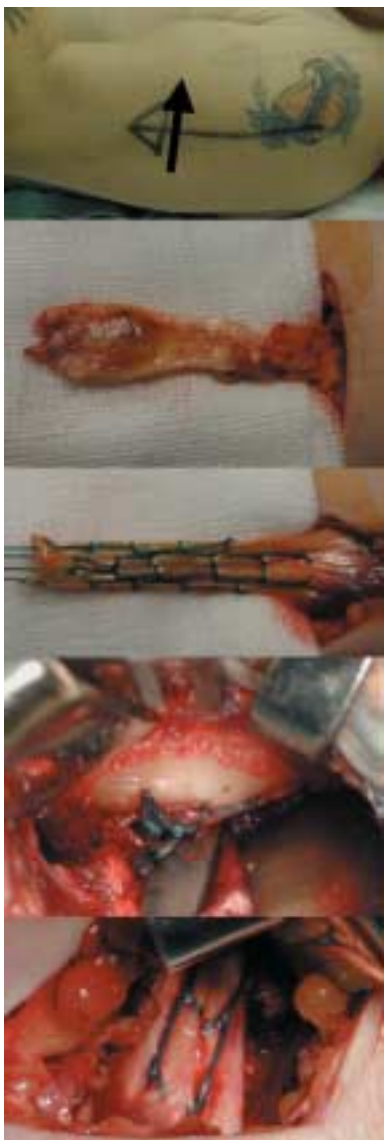

Figure 34.38 Rupture of the distal biceps tendon. (a) Change in contour of the distal arm, (b) ruptures the end of the distal tendon, (c) is secured with non-absorbable suture, (d) reattached to the bicipital tuberosity of the radius, (e) and inspected to confirm an adequate tension.

Figure 34.39 Significant cubitus valgus deformity of the right elbow in a 32-year-old female, following a childhood malunited supracondylar fracture.

- the arcade of Struthers and the medial intermuscular septum – as the nerve passes into the posterior compartment of the distal humerus;
- medial epicondyle – particularly if osteophytes are present;
- cubital tunnel – as the nerve passes between the two heads of the flexor carpi ulnaris (Fig. 34.40).

A nerve palsy may also be due to a flexion or a valgus deformity of the elbow.

History and examination

Unlike carpal tunnel syndrome, compression of the ulnar nerve may not be painful, and the patient may present with weakness of the hand in association with paraesthesia. On examination, a positive Tinel's sign is usually present, particularly at the site of compression, and wasting (Fig. 34.41) and weakness of the intrinsic

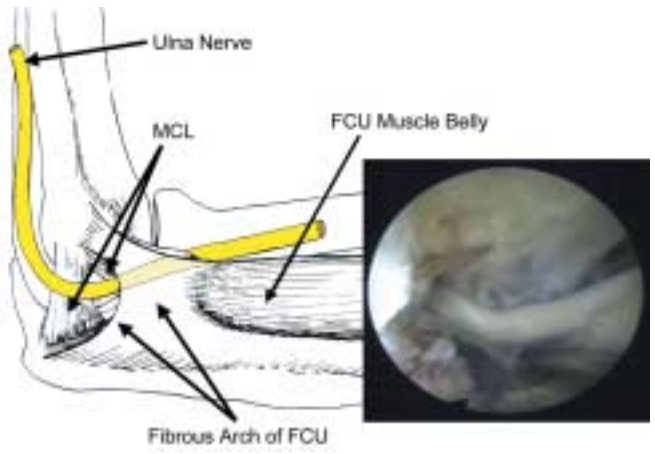

Figure 34.40 Anatomy of the cubital tunnel site of ulna nerve compression, with a view of arthroscopic ulna nerve decompression (inset).

(a)

(b)

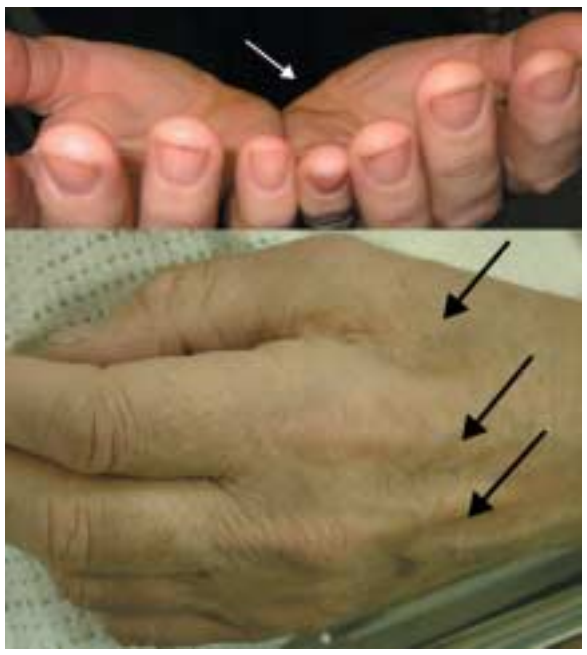

Figure 34.41 Clinical signs of ulna neuropathy. (a) Hypothenar eminence wasting; (b) interosseous muscle wasting.

muscles of the hand are evident. Nerve conduction studies have an unpredictable diagnostic value in the earlier stages of the pathology, and are frequently no more informative than a good clinical examination. Plain radiographs are of value to screen for deformity, medial impinging osteophytes and medial epicondylar pathology.

Treatment

Despite the absence of pain, decompression of the nerve should be carried out. The nerve can be explored through an open or arthroscopic approach. Surgical options include simple decompression, decompression with partial medial epicondylectomy and anterior transposition. Transposition is usually necessary in cases of deformity or if the nerve is unstable after decompression. For most other situations, decompression without transposition is sufficient, provided all sites of possible compression have been explored.

Any paraesthesia should resolve, but the prognosis for the return of hand power should be guarded as the recovery is unpredictable.

Compression of both radial and median nerves at the elbow occurs, but this is much less common than ulnar nerve compression.

INFECTIONS OF THE UPPER LIMB

Osteomyelitis

Osteomyelitis of the upper limb is very uncommon in adults, unless there are specific predisposing factors such as penetrating wounds. As with other sites, staphylococci and streptococci are commonly implicated, although other organisms may be encountered in the immunocompromised patient. The treatment of osteomyelitis of the upper limb does not differ from that in other sites.

In children, osteomyelitis of the proximal humeral metaphysis can occur, but this is much less common than osteomyelitis of the proximal femur or around the knee.

Septic arthritis

In both adults and children, septic arthritis of the shoulder or elbow is uncommon. Arthroscopy is preferred to formal arthrotomy for washing out the shoulder. The elbow may be washed out arthroscopically or via a lateral Kocher-type approach.

Tuberculosis

The shoulder and elbow are relatively uncommon sites for tuberculosis (TB), but the incidence appears to be increasing (Fig. 34.42), and treatment is along conventional lines. Secondary degeneration can occur and may be difficult to manage. A previously infected joint is one of the few indications for shoulder arthrodesis, but the elbow presents a dilemma. Arthrodesis of the elbow is not a good procedure, and there is little information on the outcome of other methods of treatment after previous TB (Summary box 34.19).

Summary box 34.19

Sepsis in the shoulder and elbow

- Most commonly occurs following trauma
- Early diagnosis and aggressive treatment are important
- A treatment for sepsis is arthrodesis
- Elbow function after arthrodesis is mostly unacceptable

Figure 34.42 Tuberculosis of the ulna shaft in an Indian female, revealing a bony erosive lesion, which responded to conventional antituberculous chemotherapy without surgery.

Tumours of the upper limb

Tumours are unusual around the elbow, but the proximal humerus is a relatively common site. It is the third most common site for both osteosarcomas and fibrosarcomas after the distal femur and proximal tibia. Treatment is along conventional lines. The shoulder is the second most common peripheral site after the proximal femur for chondrosarcomas, and the scapula body is also a common site. The principal method of treatment for chondrosarcomas is surgical excision, and this may be technically difficult around the shoulder. Subtotal excision of the scapula can be carried out with good preservation of function if the glenoid can be left. The humerus is also a relatively common site for lymphomas and Ewing's tumour. Treatment is, again, along conventional lines (Summary box 34.20).

Summary box 34.20

Tumours in the upper limb

- These are rare apart from metastases in the humerus
- The shoulder and upper humerus are a site for osteo-, fibro- and chondrosarcomas
- Common soft-tissue tumours of the hand include granulomas, inclusion cysts, ganglia and giant cell tumours of the tendon sheath (Fig. 34.43)

Benign and intermediate tumours such as osteochondromas, giant cell tumours and aneurysmal bone cysts are also relatively common. The proximal humerus is the most common site for unicameral bone cysts, which are thought to represent an abnormality of cells of the growth plate (Fig. 34.44). They commonly present as pathological fractures in children around the age of 10 years and affect boys more commonly than girls. The lesion may resolve after fracturing, but local medical treatment is often required. Benign soft-tissue tumours that are common are lipomas (Fig. 34.45) and fibromas (Fig. 34.46), with ganglia (Fig. 34.47) sometimes posing diagnostic challenges.

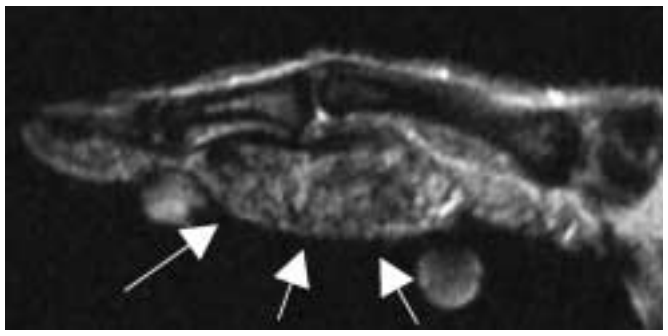

Figure 34.43 Giant cell tumour of the tendon sheath (magnetic resonance imaging).

Figure 34.44 Unicameral bone cyst of the proximal humerus in a 12-year-old boy.

The humeral shaft is a common site for secondary deposits (Fig. 34.48), and intramedullary nailing may be required for pathological fracture or impending fracture, if the patient is fit for surgery. In the majority of cases, primary tumours are found in the breast or prostate, but secondary spread from the thyroid, lung, kidney and bowel can also occur.

HAND

Function

The hand is a complicated and highly sensate organ that is designed to manipulate the environment, and therefore has some prerequisites to function effectively (Summary box 34.21).

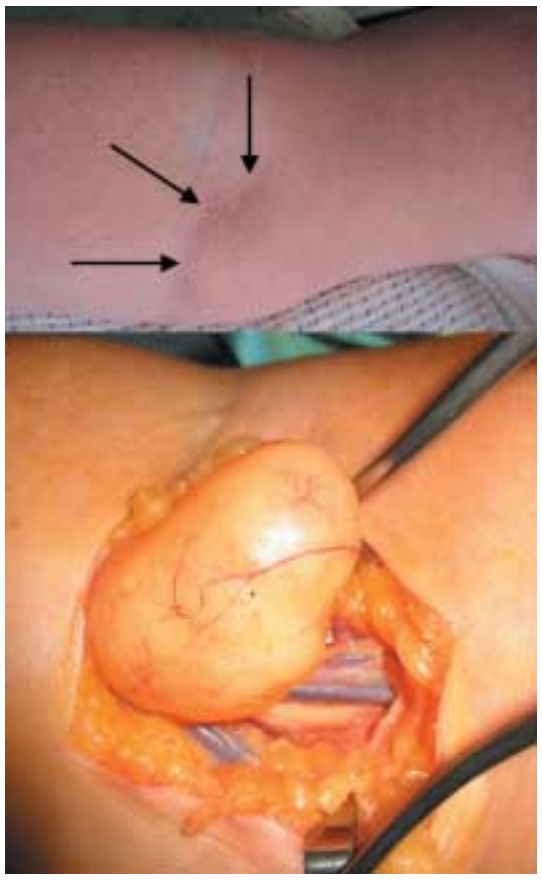

Figure 34.45 Antecubital lipoma, which presented with median nerve compression neuropathic symptoms. (a) Antecubital swelling; (b) lipoma defined with the underlying median nerve and brachial artery/vein.

Summary box 34.21

Prerequisites for hand function

- Flexible and strong
- Sensitive and pain free
- Coordinated

The index finger works against the thumb, which acts as a post, in order to achieve a fine pinch grip, e.g. picking up a small object, whereas the little and ring fingers provide power grip, e.g. holding a hammer, and curl into the palm. The thumb presses against the side of the index finger for key grip and presses the tips of the index and middle fingers for chuck grip (holding a pen). All the fingers curl for hook grip (holding a suitcase). A stable wrist is required to allow these hand functions (Summary box 34.22).

Summary box 34.22

The five functions of the hand

- Fine pinch, e.g. picking up a small object
- Power grip, e.g. holding hammer
- Key grip, e.g. holding key
- Chuck grip, e.g. holding a pen
- Hook grip, e.g. carrying a suitcase

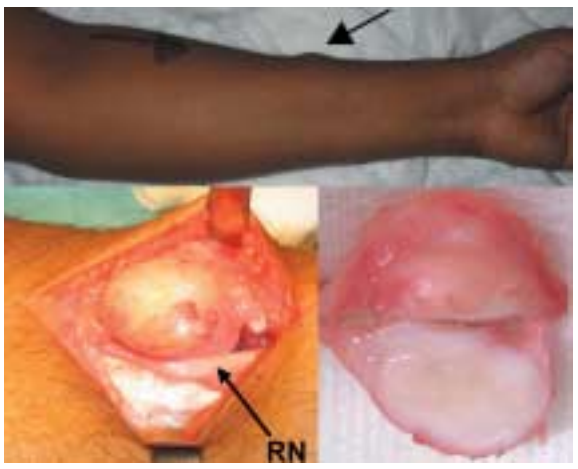

Figure 34.46 Fibroma of the forearm. (a) Swelling on the radial border of the mid-forearm, a firm but mobile swelling. (b) Fibroma defined with the underlying radial nerve, which was the source of the sensory neuropathy. (3) Fibroma bivalved revealing a dense fibrous interior.

(a)

(b)

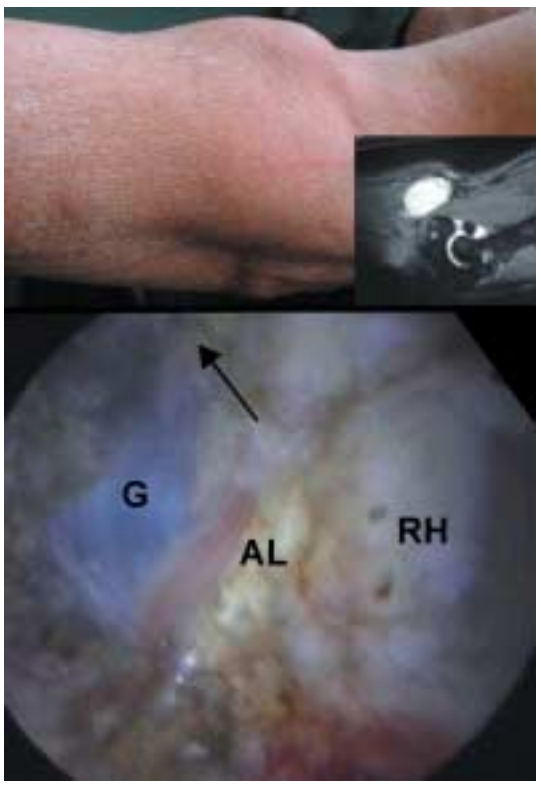

Figure 34.47 Antecubital ganglion (G) causing considerable elbow discomfort. (a) Antecubital soft and fluctuant swelling, with a magnetic resonance imaging (MRI) inset revealing a fluid-filled mass. (b) Arthroscopic excision view revealing its close relationship to the annular ligament (AL) and radial nerve (arrow). RH, radial head.

Clinical history and physical examination

The initial clinical history should ascertain the patient's age, occupation and left or right handedness. An important aspect of assessment is the function and pain of the hand with a lesser importance placed on cosmesis, with care being taken to assess

Figure 34.48 A pathological distal humeral shaft fracture through a secondary renal cell carcinoma deposit. This patient was not fit for surgery and hence was treated in a plaster cast.

rotational malalignments of the digits (Fig. 34.49). Sensation and weakness are also specifically questioned.

Tendons

Examination should begin with inspection for deformity, scars, nodules, etc. Tendon function can be tested with the passive tenodesis method: the wrist is moved from flexion to extension passively, normal function is demonstrated by the fingers curling

Figure 34.49 Rotational malalignment of the little finger.

into flexion with wrist extension and should open with wrist flexion. This motion arc should be smooth and coordinated, thereby establishing the function of each tendon.

Nerves

The neurological status of the hand should be assessed by sensation on each side of the digits (light touch and two-point discrimination). Tinel's test (nerve percussion that produces tingling) allows the examination of a compressed nerve or a nerve tip that is regenerating and advancing following an injury. Sweat gland function in the hand, assessed by passing a pen across the surface of a digit, can assess whether a nerve is intact, in which case the pen sticks to the skin, or severed, if the pen glides smoothly over the skin without resistance.

Circulation

The capillary refill time can be examined with nail bed compression and observing the time taken to reperfuse. Arterial supply by the radial and ulnar arteries can be tested with the Allen test: the patient elevates and tightly clenches the fist. The Allen test can identify whether both radial and ulnar arteries are intact. In this test, the patient squeezes his or her hand to express the blood, and then both arteries are compressed by the examiner's fingers. The hand will be white. The examiner then releases one artery; if the hand does not 'pink up', that artery is occluded or divided. The test is repeated for the other artery. Compression of the fingernail will cause it to go white. On release of the examiner's finger, return of a normal pink colour within 2 s confirms a proper distal artery circulation (Fig. 34.50; Summary box 34.23).

(a)

(b)

(c)

Figure 34.50 Allen's test.

Summary box 34.23

Examination of the hand

- Tendons – Passive tenodesis test for function
- Nerves – Two-point discrimination for sensation
- Nerves – Skin sweat test for autonomic nerve function
- Arteries – Allen test for circulation

Investigations

The following are specific investigations for the hand and wrist: (1) electrophysiology provides data regarding nerve function and is helpful in carpal and Guyon's tunnel syndromes if the clinical picture is not conclusive; (2) MRI can be helpful to detect Kienböck's lunate and scaphoid fracture fragment vascularity; (3) radioisotope bone scans can be helpful in elusive cases of wrist pain for increased signals identifying areas of higher vascularity; (4) wrist arthroscopy can be a useful diagnostic aid for triangular fibrocartilage complex (TFCC) tears, carpal instabilities and arthritis.

Hand treatment – basic principles

Prevent swelling and stiffness

Following injury, surgery or infection, the hand swells (Fig. 34.51), leading to an extended metacarpophalangeal joint and flexed interphalangeal joint position. This position can, if prolonged, lead to collateral ligament shrinkage; as the wrist swells, it tends to fall into a position of flexion, the metacarpophalangeal joints extend and the interphalangeal joints flex. This position becomes permanent as the collateral ligaments shrink and the oedematous tissues fibrose. The hand cannot then function properly. To avoid this, the following three principles should be observed:

1 Elevation in a high sling, without excess elbow flexion, which impairs venous drainage.

Figure 34.51 Hand swelling following surgery is to be avoided.

2 Splintage. The wrist should be splinted initially in the position of safety – the 'Edinburgh' position described by James is designed to avoid fixed flexion contractures. Dressings must not be too tight.
3 Movement. Rehabilitation should be planned to mobilise all joints as early as possible (see also Summary box 34.24).

Summary box 34.24

General principles of treatment

Avoid swelling and stiffness by:

- Elevation – to reduce swelling
- Splintage – to avoid contractures
- Movement – to pump away swelling and encourage suppleness

Many other basic principles apply to the surgical treatment of the hand and are listed in Summary box 34.25.

Summary box 34.25

Hand surgery principles

- Local anaesthetic or a regional blockade in most cases
- Arm or finger tourniquets
- Incisions should cross a flexor crease at 45° angles

Thumb ulnar collateral ligament

Gamekeeper's thumb is a chronic overuse stretching of the ulnar collateral ligament of the thumb. An acute form of this injury is the skier's thumb, radial hyperabduction of the thumb. Patients present with pain and instability of the thumb when attempting to maintain a power pinch grip between the thumb and index finger. Most stable sprains can be managed conservatively with 3–4 weeks of splintage. When unstable, the ulnar collateral ligament should be either repaired, if possible, or reconstructed with a suitable graft.

Triangular fibrocartilage complex

This is a structure that is in continuity with the dorsal and volar wrist capsules and primarily serves to stabilise the distal radioulnar joint and acts as part of the proximal articulation of the triquetrum. It can undergo traumatic or degenerative tears, thereby presenting with ulna-sided wrist pain, and distal radioulnar instability. Diagnosis by magnetic resonance arthrography or diagnostic arthroscopy can effectively lead to repair of the traumatic tears and debridement of the ragged degenerative tears.

Infections

Most hand infections can be treated initially with elevation, static splintage and presumptive antibiosis. Surgical drainage may be necessary if pus is evident, and antibiosis should be altered in accordance with microbiological investigation of the pus. If swelling and inflammation settles, with or without surgical intervention, supervised motion is instigated to avoid stiffness (Summary box 34.26).

Summary box 34.26

Hand infections – treatment

- Elevation, splinting and antibiotics if no pus
- Surgical drainage if pus is present
- Tendon sheath pus needs irrigation
- Bites should be explored, cleaned and managed with broad-spectrum antibiotics
- All infections need early mobilisation once inflammation settles

Paronychia

Acute paronychia is the commonest hand infection, often due to inappropriate nail trimming or skin picking around the nail fold (Fig. 34.52). After initial inflammation, pus accumulates beside the nail and needs to be surgically released, with or without the excision of the outer quarter of the nail. Chronic paronychia appears over several weeks and is usually a fungal infection, unrelated to the acute form. It commonly occurs in patients whose hands are frequently immersed, and microscopy of scrapings and fungal cultures reveals the diagnosis. Management ranges from advice to keep the hand dry and the use of antifungal creams to nail fold surgery.

Pulp space (felon)

Pus trapped between the specialised fingertip septae causes intense fingertip pain, and may lead to terminal phalangeal bone infection, erosion and sequestrum formation. The last of these will need to be drained and debrided. A common differential diagnosis with small vesicles and crusts is the self-resolving herpetic whitlow, especially in dental workers, caused by the herpes simplex virus.

Flexor tendon sheath infection

The clinical presentation is of a swollen flexed finger, which is painful with passive motion and tender on tendon sheath palpation. If the infection, commonly by staphylococcus or streptococcus, is untreated, adhesions between the tendon and its sheath lead to a stiff and useless finger. Management is by early saline irrigation of the sheath, with a catheter passed into the sheath, with early motion once signs of inflammation resolve.

Bites

Animal or human bites can lead to infection and consequent loss of function, commonly due to staphylococcus. Broad-spectrum antibiotics are generally effective. Wounds should be explored thoroughly, excised, washed out, damaged tendons repaired and splinted, and appropriate antibiotics commenced.

Figure 34.52 Acute paronychia.

Other infections

Mycobacterial infections

Tuberculosis in the hand may involve the tenosynovium, joints or bone. The most dramatic form is the compound palmar ganglion, with synovial swelling, proximal and distal to the transverse carpal ligament. The diagnosis is made with a biopsy, and synovectomy and prolonged chemotherapy are the basis of treatment.

Pilonidal sinus

A hair implanted in the palm or web space can cause a recurrently infected cyst (Fig. 34.53), which should be excised.

Palmar space infections

The whole hand becomes swollen and tender, as pus collects on either side of the septum. Treatment is by incision and drainage and thorough washout of the wound.

Web space infections

Pus can collect in the potential space surrounding the lumbricals, which pass from the palm, across the deep transverse metacarpal ligament into the extensor mechanism. The web space swells, and swelling tends to spread adjacent fingers apart. Pus is drained through a longitudinal incision over the web space.

Arthritis

Rheumatoid arthritis

Rheumatoid arthritis has many deforming and devastating effects (Box 34.1) and presents with the classic symptoms of morning stiffness, symmetric arthritis, especially involving the hand, hand deformities and rheumatoid nodules. Further diagnostic criteria include seropositive rheumatoid factor and radiographic changes, e.g. erosive changes and periarticular decalcification (Table 34.1). Rheumatoid synovitis (pannus) destroys ligaments, tendons and joints, producing pain, deformity and loss of function. Zig-zag

Figure 34.53 Pilonidal sinus in a barber.

Box 34.1
Deformities in rheumatoid arthritis

Fingers
Swan neck deformity
Boutonnière deformity
Extensor tendon rupture
Flexor tendon rupture
Flexor synovitis

Metacarpophalangeal joints
Flexion
Ulnar deviation
Subluxation, dislocation

Wrist
Radial deviation
Carpal supination
Prominent ulnar head
Extensor tenosynovitis

Table 34.1 Radiographic differences between rheumatoid and osteoarthritis

Rheumatoid arthritis	Osteoarthritis
Periarticular osteoporosis/ subchondral erosions	Subchondral sclerosis and cysts
Periarticular soft-tissue swelling	Less pronounced swelling
Joint space narrowing	Joint space narrowing
Marginal erosions	Marginal osteophytes
Joint deformity/malalignment	Less pronounced deformities
Ankylosis	Less common ankylosis

collapse is a typical rheumatoid feature, e.g. boutonnière (Fig. 34.54), swan neck (Fig. 34.55), ulnar drift of the metacarpophalangeal joints with radial drift of the wrist. Simple activities of daily living, such as thumb pinch and opening jars, stress the weakened ligaments, thus producing greater deformities. Any treatment is primarily dictated by pain and disability, not deformity.

Management

Non-operative treatment is primarily directed at slowing progression and improving symptoms. Specific aids help patients to perform daily tasks, e.g. turning taps and opening jars, and splints improve symptoms during flare-ups, all of which serve to decrease further damage to weakened ligaments. The primary indications for operative treatment are: (1) pain relief; (2) functional improvement; (3) to prevent disease progression; and (4) cosmesis. In general, the hand and wrist should be treated after the shoulder and elbow, and the more reliable operations, e.g. wrist and thumb fusion, should be considered prior to less predictable operations, e.g. soft-tissue reconstructions, as discussed below.

1. Synovectomy can improve pain and increase function, even following tendon rupture, eliminate trigger finger and cure carpal tunnel syndrome in these patients.
2. Distal ulna excision may reduce the risk of extensor tendon rupture, protects the repair of ruptured extensor tendons and has a cosmetic benefit. Post-excision instability can be treated with soft-tissue stabilisation or ulna head arthroplasty.
3. Prosthetic arthroplasty of the wrist is relatively unpredictable, whereas metacarpophalangeal and interphalangeal joint replacement is more predictable for pain relief and functional improvement, with the proviso of functioning soft-tissue stabilisers, e.g. repairable/reconstructable collateral ligaments and tendons.
4. Arthrodesis of the wrist, thumb and some of the smaller joints provides good pain relief, and creates a stable axis against which other parts of the hand can function. For example, when the flexor pollicis longus tendon ruptures and is symptomatic, the most reliable solution is to arthrodese the interphalangeal joint of the thumb.
5. Tendon reconstructions. Some ruptured tendons cause significant morbidity, often solved by either a local joint fusion or tendon transfer, e.g. extensor indicis transfer for an extensor pollicis longus rupture. Multiple tendon ruptures can be treated by creating a mass tendon action, with side-to-side tendon suture or multiple tendon transfers.

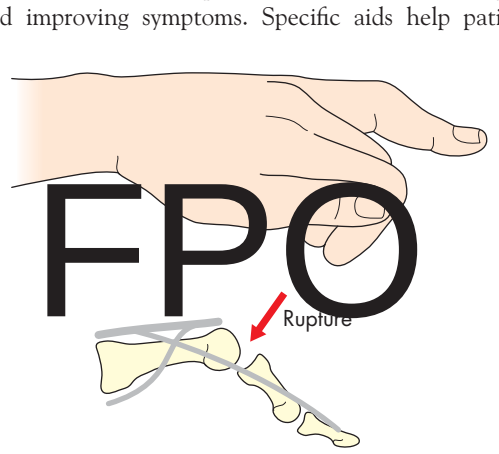

Figure 34.54 Boutonniere deformity.

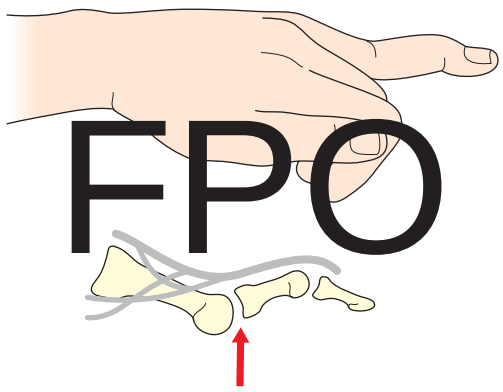

Figure 34.55 Swan neck deformity.

Osteoarthritis

Wrist

The radiocarpal joint can develop primary or secondary osteoarthritis, e.g. after intra-articular trauma and infection (Fig. 34.56). Non-operative management begins with conservative measures, e.g. analgesia, splints, activity modification and activity aids. Operative management, following failed conservative treatment, includes wrist arthrodesis in 20° extension and radiocarpal arthroplasty, a much less predictable option than fusion. Specific

Figure 34.56 Radiocarpal osteoarthritis.

and localised arthritis of the carpus, e.g. post-scaphoid fracture or scapholunate disruption, can be managed with either fragment excision or limited arthrodesis. Pisotriquetral arthritis, with clinical tenderness and confirmed by a 30° supinated lateral radiograph (Fig. 34.57), can be treated with rest, splintage, corticosteroid injection or pisiform excision as a last resort.

Hand

Commonly affected are the distal interphalangeal (Heberden's nodes), proximal interphalangeal (Bouchard's) and the thumb carpometacarpal joints (Fig. 34.58). Symptoms rarely correlate with appearance or radiographic appearances. Affected joint arthrodesis eliminates pain at the expense of motion, but function is often well tolerated. Joint arthroplasty (Fig. 34.59) is an option in some cases, as is trapezial excision for basal thumb arthritis (Summary box 34.27).

Summary box 34.27

Wrist and hand osteoarthritis (management)

- Wrist arthrodesis – maintains acceptable function and improves pain
- Distal interphalangeal joint fusion – maintains acceptable function
- Excision of the trapezium – improves pain but decreases stability and reduces pinch strength

Figure 34.57 Pisotriquetral arthritis (arrow).

Figure 34.58 Osteoarthritis of the hand.

Figure 34.59 Proximal interphalangeal joint replacement.

Other arthritides

Gout

Gout commonly causes pain, joint redness, occasional tophi and can be differentially diagnosed as septic arthritis. Serum urate and negative microscopic birefringence of joint aspirated sodium urate crystals are diagnostic.

Psoriasis

Psoriatic arthropathy of the hand and wrist is asymmetric, with pitted nails and destructive radiographic features including a pencil in cup appearance.

Systemic lupus erythematosus (SLE)

SLE arthropathy is common in young females (15–25 years), with rheumatoid-like deformities, but without joint narrowing or erosions.

Dupuytren's contracture

An autosomal dominant trait with an association with Anglo-Saxon lineage, age, smoking, use of vibrating tools, pulmonary tuberculosis, epilepsy, acquired immunodeficiency syndrome (AIDS) and alcoholic cirrhosis. Clinical features include palmar nodules, skin puckering, cords of the palm and digits, flexion contractures of the digits, Garrod's knuckle pads [thickened skin on proximal interphalangeal joint (PIPJ) dorsum; Fig. 34.60]. Penile thickening and curvature (Peyronie's disease) and plantar thickening (Ledderhose's disease) are associations. Deformities that rapidly progress or are of functional consequence are indications for surgical correction. Surgical goals include deformity correction, protection of neurovascular bundles, which are often intricately entangled with the fibrous tissue, and skin coverage, often requiring Z-plasties (Fig. 34.61; Summary box 34.28).

Summary box 34.28

Dupuytren's contracture

- Autosomal dominant inheritance (trait)
- Fibroblastic hyperplasia with resultant skin nodules, cords and deformities
- Management is surgical if rapidly progressive or functionally debilitating

Tendon disorders

Trigger finger

Triggering occurs in a finger or thumb when there is size disproportion between a flexor tendon and its sheath, often with a nodule developing in the tendon (Fig. 34.62). Initial management is with a steroid injection into the sheath, followed by surgical tendon sheath release if non-responsive, with careful preservation of the digital nerves. Rheumatoid triggering may be due to synovitis or tendon nodules, and treatment is with synovectomy and excision of a slip of the FDS tendon<Q1> without dividing the A1 pulley (Summary box 34.29).

Figure 34.60 Garrod's knuckle pads.

Figure 34.61 Dupuytren's disease.

Figure 34.62 Trigger thumb in a child.

Summary box 34.29

Trigger finger

- Flexor sheath thickening catches flexor tendon/nodule
- Often painful with attempted straightening of the digit
- Initial management is with tendon sheath steroid injection
- Surgical release of the A1 pulley relieves the symptoms
- Paediatric trigger thumb and fingers frequently resolve spontaneously
- Rheumatoid triggering is treated by synovectomy, partial tendon excision, but sheath preservation

de Quervain's disease

This is believed to be an overuse pathology of the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) in the first dorsal wrist compartment, most common in middle-aged females, although pregnancy and inflammatory arthritides are also implicated. Dorsoradial wrist pain and tenderness, along with Finkelstein's test (pain with wrist and thumb ulnar deviation

while the thumb is fully flexed), are diagnostic. Management ranges from non-steroidal anti-inflammatory analgesia, splintage and steroid injection to surgical release of the extensor retinaculum of the first compartment if the non-operative measures fail.

Neuropathies

Median nerve (carpal tunnel syndrome)

A common pathology presenting with painful wakening at night with tingling in the radial three and a half digits of the hand. There may also be weakness of the abductor pollicis brevis, leading to clumsiness with fine movements. Advanced cases may be observed to have thenar eminence wasting. Specific reliable clinical tests include: (1) Tinel's percussion over the carpal tunnel; (2) Phalen's test (reproduction of paraesthesia with full wrist flexion); and (3) carpal tunnel compression with full wrist flexion. Rarely does electrophysiological testing add to the clinical tests, but it is a good tool for tracking changes. Non-operative treatment modalities include night splintage of the wrist in extension and steroid injections into the carpal tunnel. Operative options serve to de-roof the carpal tunnel, thereby creating space for the nerve, without compression (Summary box 34.30).

Summary box 34.30

Carpal tunnel syndrome

- Night pain is common and relieved by shaking the hand
- Less common features are numbness and clumsiness
- Thenar wasting is an advanced sign
- Clinically, Tinel's and Phalen's tests are useful
- Electrophysiology is rarely useful beyond clinical tests
- Treatment options include splints, steroid injection and surgical decompression

Ulnar nerve (Guyon's tunnel syndrome)

Compression of the ulnar nerve due to ganglia, osteophytes or fractured hook of hamate can lead to hypothenar wasting (Fig. 34.63) and ulnar territory dysfunction, with preservation of dorsal sensation of the little finger and the ulnar half of the ring finger.

Kienböck's disease

Commonly thought to be an avascular phenomenon, the aetiology is unclear, but probably involves both ischaemia and microtrauma of the lunate. A possible correlation with a negative ulnar variance (relatively short ulna) has been suggested. The pathological stages progress from sclerosis to collapse and, finally, arthritis. Clinical presentation with wrist pain and weakness can be positively diagnosed with plain radiographs and MRI scans; the latter are able to detect very early lesions before they are visible on radiographs (Fig. 34.64). Early stage treatment is with wrist splintage, with analgesia, or radial shortening to reduce compressive forces, thereby potentially decreasing the risk of disease progression. Advanced stage disease may require limited fusion to alleviate pain.

Figure 34.63 Ulnar nerve neuropathy with hypothenar wasting.

Ganglion cysts

These are the commonest hand swellings, causing patient concern and occasional discomfort. They are commonest on the wrist dorsum**,** but can be on the volar surface (Fig. 34.65).

Figure 34.64 Kienböck's disease.

Figure 34.65 Volar wrist ganglion.

Physical examination reveals a smooth, fluctuant, transilluminable swelling, most which resolve following aspiration or being 'hit with a large book'. Surgical excision aims to remove the whole ganglion, including its connection to the underlying joint/sheath. Patients should be informed regarding the possibility of recurrence.

Congenital differences

The true rate of congenital malformations is difficult to assess, but a fundamental has to be correct identification (Fig. 34.66), communication of the findings to the parents and child, and management involving a multidisciplinary team. The classification by Swanson, later adopted by the International Federation of Societies of Surgeries of the Hand, is reproduced in Table 34.2.<Q6>

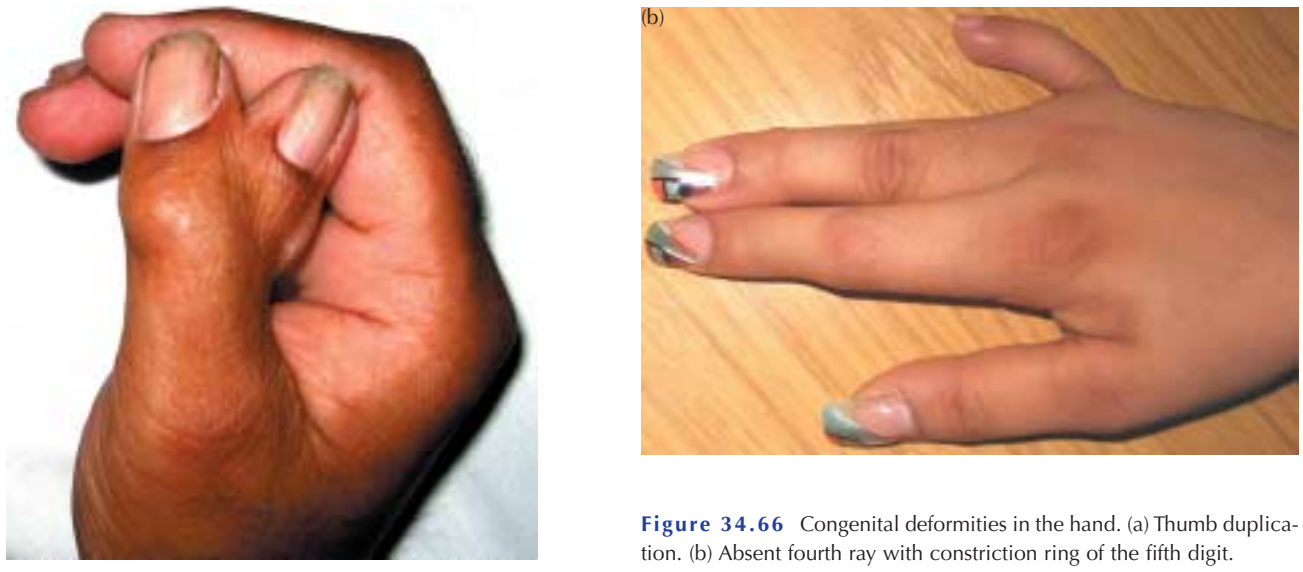

Figure 34.66 Congenital deformities in the hand. (a) Thumb duplication. (b) Absent fourth ray with constriction ring of the fifth digit.

Table 34.2 Congenital malformations (hand and wrist)

A Defects in formation due to arrested development	(1) Transverse agenesis (2) Longitudinal agenesis (a) radial ray aplasia; (b) median ray aplasia; (c) ulnar ray aplasia (3) Thumb aplasia/hypoplasia
B Defects in differentiation/separation	(1) Syndactyly (2) Camptodactyly (3) Clinodactyly (4) Kirner deformity (5) Radioulnar synostosis
C Duplications	(1) Supernumerary phalanges (2) Supernumerary digits (polydactyly) (Fig. 34.66)
D Excess development/hyperplasia	Macrodactyly
E Insufficient development/hypoplasia	Thumb hypoplasia
F Constricting (amniotic) bands	Simple amniotic band syndrome
G Generalised skeletal anomalies	Marfan, Turner, Down syndrome

<Q1> Please define FDS.
<Q2> Please define ECRB.
<Q3> In the legends to Figs 34.29 and 34.30, please check that the reference to Fig. 34.27 is correct and it should not be Fig. 34.28 that is referred to instead.
<Q4> You mention using Fig. 28.10 from the previous edition. Please confirm which figure this should be in this edition.
<Q5> Fig. 34.17 is a re-use of Fig. 28.12 from the previous edition, but a completely new version of Fig. 34.17 is supplied. Please advise.
<Q6> Do you wish to include up to 10 items of Further reading?