Clinical examination is an art and has to be learnt, as it does not come naturally. All patients must be respected, made to feel at ease and assured of their confidentiality and dignity.

A detailed history should always be taken followed by clinical examination.

It is often assumed that clinical examination begins on the couch. This should not be the case, as significant information can be gained by observing the patient as they enter the room and walk towards you or as you approach them.

If the patient is seated they should be asked to stand as this is usually the first part of any orthopaedic clinical examination, except when the hand is being examined. You will observe whether the patient is tall, short, fat, thin, ill, well, energetic or slow. Observe if there is pain or if there are stigmata of orthopaedic disease such as blue sclera (osteogenesis imperfecta), café-au-lait spots (neurofibromatosis), multiple exostoses (diaphyseal aclasis; Figure 1.1), etc.

In addition, the gait pattern, any limb deformities and the use of walking aids will also be noted. This is particularly relevant when examining the lower limbs and spine.

Examples of gait patterns include:

- antalgic gait caused by pain that could be from the sole of the foot to the hip. The stance phase of the affected limb is shortened;
- high stepping gait is seen in patients with hereditary sensorimotor neuropathy or those with a foot drop.

The clinical signs and associated deformities of some clinical conditions, e.g. hallux valgus, may be so characteristic that the diagnosis can be made without a full clinical examination. However, this is not always the case, and an examination carried out in a systematic manner not only instils confidence in the patient but avoids missing important and salient clinical signs.

The system of look, feel, move advocated by Apley is what we recommend, although when examining the wrist and elbow look, move, feel may be preferred.

Figure 1.1 Patient with diaphyseal aclasis (hereditary multiple exostoses). Note the short limbs, bowing of the forearm, swellings around the knees and the large tumor in the left pectoral region.
The part of the musculoskeletal system being examined must be suitably exposed; for example, when examining the shoulder the patient should be undressed to the waist. Modesty in females should be preserved by using a strapless garment to cover the breasts. The patient must be given clear instructions on which clothes to take off. The ease or difficulty of undressing and any associated pain experienced whilst doing so is useful information that helps in the assessment. In addition, it is advisable to expose both limbs for comparison even though only one limb may be affected.

Examination of paediatric patients requires skill and flexibility. Remember to look at the parents as the patient may be presenting with an inherited clinical condition. More information can be acquired by adopting methods of play than using a rigid system of examination as previously suggested. Any tests for tenderness must be carried out at the end.

**Equipment**

The basic equipment required for orthopaedic examination includes a tape measure, goniometer and tendon hammer. In addition to these tools, a pen, key and coin are required for assessment of hand function (Figure 1.2).

**Look**

Inspection is the initial part of any examination and should always be undertaken before palpation and movement. It also forms an important part of palpation and movement.

It is important to look at the part being examined from various angles, e.g. the shoulder joint should be observed from the front, back and side and the axilla must also be inspected. Inspection of the foot is not complete without examining the sole and between the toes. Whilst observing a limb any scars, skin colour changes, swelling, bruising, muscle wasting or alteration in shape or posture are noted. Scars may be the result of injury or previous surgery. Skin colour changes may be the results of infection, vascular compromise or pain syndrome.

Swelling may be localized or diffuse. Localized swelling and its location with respect to the underlying anatomical structures usually gives a clue as to the possible cause, e.g. a well defined swelling in the radiovolar aspect of a wrist is likely to be a ganglion. A swelling on the medial joint line of the knee is likely to be a meniscal cyst.

Diffuse swelling confined to a joint may be the result of excessive:

- synovial fluid from an inflammatory process such as rheumatoid arthritis or osteoarthritis;

![Figure 1.2 Equipment required for examination.](image)
• blood (haemarthrosis) from a recent injury, blood coagulation defect or medication such as warfarin;
• pus from an infection.

Bruising is usually the result of trauma to tissues owing to a recent injury or surgery. Muscle wasting may arise from disuse because of pain, other abnormality or muscle denervation. Muscle wasting is quantified by comparing the affected limb with the normal limb or by measuring the circumference of the limb at a fixed point from a bony landmark.

Alteration in shape or posture may be caused by a congenital anomaly, skeletal dysplasia, joint degeneration or the sequelae of a previous injury.

Finally, inspection should involve looking for and describing any orthosis or walking aid.

Inspection should always be thorough. In clinical examinations at a junior level it is desirable to describe both positive and negative findings. In more senior examinations inspection should still be complete, but is performed much more rapidly with only positive and important negative findings expressed. Examiners may become agitated if senior candidates spend too much time on inspection.

Feel
Irrespective of the joint being examined palpation should always be carried out in a systematic manner with reference to the anatomic landmarks. The details of how to carry out a satisfactory palpation of the various joints are discussed in the relevant chapters, but an essential aspect of palpation is that the examiner must not only look at the joint being examined but also look at the patient’s face to appreciate any areas of tenderness (Figure 1.3).

Ensure that hands are washed or antiseptic gel is used. Rubbing your hands together to warm them makes palpation more comfortable.

Some joints, such as the hip and shoulder, are deeper and therefore significant information may not be gained by palpation compared to the more superficial joints such as the hand, elbow, spine, knee, foot and ankle. By knowing the surface anatomy of these joints, tenderness over the relevant areas may lead to the diagnosis, e.g. tenderness over the lateral epicondyle of the elbow indicates tennis elbow and tenderness over the medial joint line of the knee may indicate a medial meniscus tear.

Move
Both active and passive range of movement of the joint being examined should be assessed. It is advisable to carry out active range of movement before passive as this gives the examiner an idea of the functional range of movement and any associated pain. The patient must be given clear instruction or a demonstration of the range of movement to be carried out. Demonstration is sometimes the best method of communicating to the patient.

• It is always advisable to compare the range of movement of the symptomatic with the asymptomatic or normal joint, and the range achieved should be recorded in degrees as measured by a goniometer.
• Sometimes it may not be possible to assess active range of movement in certain situations (such as with a very young child or a patient with cerebral palsy or other neurological disorder).
Chapter 1: General principles

Score one point if you bend and place your hands flat on the floor without bending your knees.

Score one point for each knee that hyperextends.

Score one point for each elbow that hyperextends.

Score one point for each thumb that will bend back backwards to touch the forearm.

Score one point for each hand when you can bend the little finger MCP joint back beyond 90°.

If you are able to perform all of the above manoeuvres you have a maximum score of 9.

Figure 1.4 Brighton's score.
Complete loss of (active and passive) movement may be the result of previous surgery, e.g. in a patient who has had a previous arthrodesis. A joint that is grossly degenerate may have limited active or passive range of movement. Tendon, muscle or nerve injury may preclude active movement and in these situations only passive movement can be assessed. However, be aware that the patient may use gravity or a trick movement to move the affected joint, thus misleading the examiner. Excessive passive joint movement or movement in abnormal planes may be the result of generalized ligamentous laxity or ligament/bony abnormality. Generalized ligamentous laxity can be assessed fully using Beighton’s scoring system (Figure 1.4). A total score greater than or equal to 4 indicates hypermobility.

**Further examination**

In addition to the triad of look, feel, move, other tests specific to the part being examined may be required to enable the examiner to reach a diagnosis, e.g. the anterior draw or Lachman test for anterior cruciate ligament insufficiency. The various tests will be discussed later in this book in the respective chapters.

The examiner must be prepared to examine the joint above or below the one being examined as the patient may be presenting with referred pain. For example, a patient with a slipped upper femoral epiphysis may present with knee pain, and failure to examine the hip joint will cause the examiner to miss the diagnosis. In addition, pathology in one joint may directly affect adjacent joints.

A neurovascular assessment is also an important aspect of any examination. It is important to ascertain if there is a true neurological deficit or if neurological symptoms are mimicking musculoskeletal symptoms. In some instances (e.g. in patients with nerve palsy) it may be necessary to undertake this assessment early on in the examination after inspection.

Muscle strength is an integral part of the neurological assessment and is best carried out in a systematic manner from proximal to distal and recorded using the MRC scale (Table 1.1). It is important to understand how to differentiate between grade 2 and grade 3 by eliminating gravity (Figures 1.5 and 1.6).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No muscle contraction</td>
</tr>
<tr>
<td>1</td>
<td>Flicker of contraction</td>
</tr>
<tr>
<td>2</td>
<td>Movement with gravity eliminated</td>
</tr>
<tr>
<td>3</td>
<td>Movement against gravity</td>
</tr>
<tr>
<td>4</td>
<td>Movement against gravity and some resistance</td>
</tr>
<tr>
<td>5</td>
<td>Full power</td>
</tr>
</tbody>
</table>

**Table 1.1 MRC scale for muscle strength**

**Figure 1.5** Testing MRC grade 3 muscle power of the quadriceps.
Summary

Summary of general orthopaedic examination principles

1. Respect your patient and ensure that he or she is comfortable.
2. Give clear instructions on what you want the patient to do.
3. Fully expose the region to be examined yet maintain dignity.
4. Observe not only the region being examined but your patient as a whole.
5. Always compare both limbs.
6. When palpating a region remember to look also at the patient’s face.
7. Assess both active and passive range of movement.
8. Special tests are done to help define other findings.
9. Examine the joint above and the joint below as well as performing a neurovascular assessment.
10. Do not cause pain.

Acknowledgement

We would like to acknowledge the help of Edward Oliver in the preparation of this chapter.

Further reading


Chapter

2

Examination of the shoulder

David Limb

Introduction

There is rarely a need to carry out a comprehensive examination of the shoulder including all of the tests described in this chapter. Described below are the elements that can be used to differentiate between possible diagnoses suggested by the clinical presentation. To be successful clinically and to demonstrate competence in professional examinations, interpretation of the available history is combined with an appropriately directed examination of the shoulder. Each test answers a specific question about the state and function of the components of the shoulder or the structures that enable it to work effectively. Pieced together, the clinical examination narrows down the differential diagnosis and may direct one to supplementary investigations that prove a diagnosis. Alternatively, the clinical examination may reassure that treatment can proceed without further expensive tests, pending review to confirm the expected progress. No description of clinical examination of the shoulder can therefore be complete without mention of the history that should be elicited, as this is primarily responsible for focusing the examination to those components that move one efficiently towards the correct diagnosis.

History

Patients often present with shoulders that are painful, unstable and/or stiff. Even basic demographic details are helpful, and it is important to document these for medicolegal reasons. Age, handedness and occupation should be noted. Although an open mind should be kept at all times, instability tends to dominate in the younger age group, impingement symptoms in middle age and rotator cuff tears and arthritis in the older group.

Initially an account is gathered on how the problem began and developed and whether any treatments have been undertaken already, with a note of their outcome. The past medical history and family history may point to conditions or associations relevant to the presenting complaint, whilst the social history may be vital in formulating a treatment plan with the patient – a frail elderly patient with a moderate rotator cuff tear who is complaining of overhead weakness but no pain is very unlikely to want a cuff repair. However, the 50–year-old with the same tear and pseudoparalysis may take quite a different view.

Elements of the history are particularly useful in directing the subsequent clinical examination and these merit further attention. In particular, the surgeon should consider the history of pain, weakness, stiffness and instability.

Pain

Why do patients with shoulder problems suffer so much night pain? It is a frequent complaint, often the main presenting symptom, but elsewhere would suggest tumour or infection. Whilst tumours and infections of the shoulder do cause night pain, it is not a red flag symptom in this context as it is so common in patients with shoulder pathology. The patient may describe pain that is accurately localized or diffuse. Neck pain radiating to the scapula or tip of the shoulder should trigger an assessment of the cervical spine, whilst radiation into the forearm and hand, particularly with parasthesiae, suggests cervical root entrapment. Pain at the tip of the scapula may suggest abdominal pathology, though posterior pain in the upper, outer part of the shoulder blade is usually glenohumeral in origin.
Chapter 2: Examination of the shoulder

Acromioclavicular joint (ACJ) pain is classically localized to the joint itself, the patient pointing with a single finger to the source of their problem. However, it is not uncommon for ACJ pain to radiate towards the root of the neck and, furthermore, ACJ pathology may coexist with impingement syndrome, giving a wider distribution of perceived pain. The pain associated with impingement and rotator cuff disease is often diffusely felt over the deltoid region. However, the patient may report painful clicks that they localize to the anterior and lateral subacromial regions. Just as hip arthritis can present with thigh pain, shoulder arthritis commonly gives pain in the region of the deltoid insertion, at the midpoint of the humeral shaft.

There are some conditions that can be associated with excruciating pain so severe that it limits further clinical tests. Acute calcific tendonitis falls into this category, and may be confirmed by ultrasound or radiographs. The early phases of frozen shoulder can also be extremely painful and the above tests will be negative – this is particularly common in diabetic patients, and the condition also tends to be more severe and longer-lasting in this group. Also normal on radiography and ultrasound is Parsonage-Turner syndrome or brachial neuritis, with neuralgic pain that is associated with weakness, and wasting in the distribution of affected peripheral nerves, unlike the nerve root distribution of cervical disc disease.

Finally, the relationship between pain and movement should be explored, not least to prevent the examiner hurting the patient subsequently. Pain that occurs only through a particular range of movement is a painful arc: rotator cuff disease, including subacromial impingement, often causes a midrange painful arc between about 60° and 120° of abduction and elevation. A high painful arc (for example, the last 30° of elevation) is typical of ACJ disorders. A painful arc with pain felt posteriorly is less common, but can occur with subscapular disorders such as enchondromata, which typically produce ratchet-like crepitus as the lesion moves over the ribs. More commonly (but less understood), abnormal muscle patterning of the scapular muscles causes tilting and the development of subscapular bursitis, causing similar subscapular crepitus. Often the patient with this problem can voluntarily exacerbate their crepitus (and pain if bursitis has developed) by tensing their shoulder girdle as they move the scapula.

Weakness

The commonest cause of perceived weakness of the shoulder is pain inhibition – if a movement hurts, the patient’s brain will not let the muscles contract to produce the movement. Thus subacromial impingement may present with weakness, but this may be reversed by an injection of local anaesthetic into the subacromial space. Such diagnostic test injections are less commonly used now that diagnostic ultrasound is more freely available and can even be integrated into the clinical examination, observing deformation or bunching of the cuff as it moves under the acromion. Furthermore, weakness can be a manifestation of stiffness – if the range is not available the patient may interpret this as them not having the strength to move the arm. A history of inherited disorders or of generalized problems may alert the surgeon to rare neurological or myopathic conditions such as fascioscapulohumeral dystrophy.

However, the majority of patients presenting to shoulder clinic (or to examinations) have a disorder either of the rotator cuff or of the nerves supplying the shoulder girdle muscles. The latter can include entrapment in the neck (cervical nerve root entrapment) or more peripherally. This includes brachial plexus injury, the assessment of which requires a detailed neurological assessment of the upper limb with mapping of all deficits to pinpoint the exact location of the lesion.

Other peripheral nerve problems that can manifest as shoulder pain and weakness include suprascapular nerve entrapment. This can occur in the suprascapular notch, in which case it is known as ‘rucksack palsy’ because prolonged downward traction on the shoulder has been implicated. Wasting and weakness of the supraspinatus and infraspinatus occurs and may be improved by nerve release. Interestingly, retraction of suprascapularis because of cuff tears has been suggested to cause nerve kinking in the notch, exacerbating cuff weakness with large tears. Entrapment of the suprascapular nerve can also occur as it winds round the spinoglenoid notch, often as a result of pressure from cysts or ganglia related to a degenerative posterior labrum. In this case only infraspinatus is involved and the treatment relies on dealing with the cyst causing compression. Axillary nerve weakness, with deltoid wasting, may follow axillary nerve injury. Both this, and musculocutaneous nerve injury, may follow anterior shoulder dislocation.
Common things being common, however, the most frequent cause of weakness in the shoulder clinic is rotator cuff disease and, in particular, rotator cuff tears.

Stiffness
Is the shoulder really stiff, or is the patient referring to pain, which limits them to moving the shoulder slowly or with assistance? If active movements are limited check passive movements, being careful not to hurt the patient. Frozen shoulder causes restriction of both active and passive movement in all planes (global restriction). Arthritic disorders can do the same, but the latter are often associated with crepitus and radiographs demonstrate the pathology, whilst radiographs are normal in cases of frozen shoulder.

Frozen shoulder has been a loosely used term and should best be reserved for the specific condition that causes inflammation, myofibroblastic transformation and contracture associated with severe pain which, for reasons that we do not understand, eventually ‘thaws out’, even without treatment. So-called secondary frozen shoulder refers to stiffness associated with other pathology that is associated with fibrous scarring or contracture of the glenohumeral capsule and subacromial space and is often more resistant to complete reversal. This includes stiffness after even minimally displaced fractures or rotator cuff tears. In the latter case it is important to treat the stiffness as well as the tear – sequentially if necessary – as the rehabilitation programme will be doomed to failure if the shoulder is already stiff before a repair is carried out that typically requires a period of further relative immobility afterwards.

Instability
Laxity may be found on examination of the asymptomatic shoulder. Indeed, an assessment of generalized joint laxity is important in any patient in whom instability is suspected, and can be documented using the Beighton score (Chapter 1). Instability refers to the symptomatic inability to maintain the humeral head centred in the glenoid. Its most extreme manifestation is dislocation, though patients presenting to the shoulder clinic will not usually have a dislocated shoulder (except in the case of chronic dislocation). Rather, they will complain that they can feel the shoulder slipping out of the joint and back in, with or without a past history of dislocation. Silliman and Hawkins’ described a simple classification that broadly categorizes patients into those likely to need surgical treatment and those who may not. TUBS (traumatic, unidirectional, Bankart, surgery) and AMBRI (atraumatic, multidirectional, bilateral, rehabilitation, inferior capsular shift) are useful aide-memoires in this respect. However, this is an oversimplification and the Stanmore classification considers three axes – traumatic structural, atraumatic structural and habitual non-structural (muscle patterning) – allowing any given patient to be plotted at a point recognizing the contribution of all factors and allowing a more holistic treatment plan, and appreciating that more than one pathology can be present. 2 Thus it is important to ask about previous dislocations and their treatment (including any previous surgery), but also about the evolution of symptoms and whether the patient can voluntarily produce subluxation or dislocation.

It should be noted that instability can present as pain in provocative positions of the arm. With fatigue in sports, in particular, anterosuperior instability can manifest as typical impingement symptoms, but these are not best addressed by subacromial decompression.

Examination
Look
Inspection of the shoulder girdle should be systematic and this requires the patient to be undressed to the waist. Garments worn for modesty should leave the scapulae visible and enquiry should be made as to any concealed scars. Observing preparation for examination may be an adjunct to the history, revealing functional difficulties in arm positioning.

The general appearance of the patient may help to identify underlying disease. The shoulder is inspected from the front, back and side. Inspection of the axilla (Figure 2.1) is also required but may more conveniently be carried out during ’move’.

Inspection of the bony contours may reveal prominence of the ACJ or sternoclavicular joint (SCJ) that could be degenerative or traumatic in origin. Deformity of the clavicle is most likely to be a consequence of past trauma. Prominence of the shoulder blade could be a result of structural problems, such as malunion or osteochondroma, but is more often positional (static winging) and will be investigated further when movements are checked.

Evidence of muscle wasting is important, though can be difficult if there is a substantial layer of subcutaneous fat. However, deltoïd wasting can give a
'squared-off' appearance to the shoulder. This can be a result of axillary nerve injury, but chronic shoulder pain and stiffness will also result in deltoid wasting (Figure 2.2). Ruptured long head of biceps will make the biceps appear more prominent because of a dip appearing between the muscle and deltoid (the 'Popeye' sign – Figure 2.3), whilst pectoralis major rupture will cause loss of the anterior axillary fold.

Scapula positioning is checked from behind. Hollowing of the supraspinous and infraspinous fossae suggests tears of the supraspinatus and infraspinatus, respectively (Figure 2.4). Often this gives as good an impression of the functional impact of a rotator cuff tear as does detailed ultrasound examination of the cuff tendons.

Feel
Like inspection, palpation should proceed in a systematic manner (Figure 2.5). Start at the only synovial joint between the upper limb girdle and the trunk – the SCJ – and palpate from this, along the clavicle, to the ACJ. Pathology of the joints may cause local tenderness, but when the patient continues to flinch