4 Some Important Pairs of Clinical Terms

Before introducing you to the various clinical conditions of the musculoskeletal system, it is important to explain the meaning of several important pairs of clinical terms in the musculoskeletal language to avoid confusion from the start. The terms of each pair have opposite meanings and, as such, are frequently confused in the minds of students (occasionally even in the minds of practitioners). All the terms describe either movements of joints or deformities in limbs, therefore, they are used frequently in discussions of clinical conditions of the musculoskeletal system. Once you have learned these terms thoroughly, they will become as much a part of your vocabulary as “right” and “left,” and you will no longer have to stop and figure out which is which in any given pair.

TERMS DESCRIBING MOVEMENTS OF JOINTS

Active and Passive Movement
Movement of a joint may be either active or passive. Active movement occurs as a result of the individual’s own muscular activity. Passive movement occurs as a result of an external force, such as movement of the joint by another individual (e.g., a physiotherapist), gravity, or even—in the case of continuous passive motion (CPM)—by a motorized device (as discussed in Chapters 3, 6 and 18).

Abduction and Adduction
The movements of abduction and adduction occur at the shoulder, hip, metacarpophalangeal, and metatarsophalangeal joints.

Abduction is the movement of a part away from the midline of the body (Fig. 4.1).
Adduction is the movement of a part toward the midline of the body (Fig. 4.2).

In the hand and foot, the midline used as a reference for the digits is a line along the middle finger and middle toe, respectively.

"If you wish to converse with me, define your terms."
—Voltaire

Flexion and Extension
The movements of flexion and extension occur at the elbow, metacarpophalangeal, interphalangeal (finger), knee, and interphalangeal (toe) joints, that is, flexion from a zero position of complete extension. In these joints, extension beyond zero is called hyperextension. Flexion of the shoulder is also called forward elevation from the anatomical position (described further on).

Dorsiflexion and Plantar (or Palmar) Flexion
The movements of dorsiflexion and plantar flexion occur at the ankle and metatarsophalangeal joints. The movements of dorsiflexion and palmar flexion occur at the wrist.

. Dorsiflexion is the movement of the foot or toes in the direction of the dorsal surface (Fig. 4.3) as well as movement of the hand in the direction of the dorsal surface (Fig. 4.4).

Plantar flexion is the movement of the foot or toes in the direction of the plantar surface (Fig. 4.5).

Palmar flexion is the movement of the hand or fingers in the direction of the palmar surface (Fig. 4.6).

Eversion and Inversion
The movements of eversion and inversion occur by simultaneous motion at the subtalar and midtarsal joints of the foot.

Eversion is the turning of the plantar surface of the foot outward in relation to the leg (Fig. 4.7).

Inversion is the turning of the plantar surface of the foot inward in relation to the leg (Fig. 4.8).
Internal Rotation and External Rotation
The movements of internal rotation (medial rotation) and external rotation (lateral rotation) occur at the shoulder, the hip, and to a slight degree at the knee.

Internal (medial) rotation is the turning of the anterior surface of the limb inward or medially (Fig. 4.9).

External (lateral) rotation is the turning of the anterior surface of the limb outward or laterally (Fig. 4.10).

Pronation and Supination
The movements of pronation and supination occur in the forearm through the elbow and wrist joint and in the forefoot through the midtarsal joint.

Pronation of the forearm (assessed with the elbow flexed to 90°) is the turning of the palmar surface of the hand downward (Fig. 4.11).

Pronation of the forefoot usually refers to a deformity in which the forefoot is maintained in a position of eversion (Fig. 4.7).
Figure 4.5.  Left. Plantar flexion at right ankle and metatarsophalangeal joints of toes of right foot.

Figure 4.6.  Right. Palmar flexion at right wrist, metacarpophalangeal joints, and interphalangeal joints of fingers of right hand.

Figure 4.7.  Left. Eversion of right foot at subtalar and midtarsal joints.

Figure 4.8.  Right. Inversion of right foot at subtalar and midtarsal joints.

Figure 4.9.  Left. Internal (medial) rotation at right shoulder and right hip.

Figure 4.10.  Right. External (lateral) rotation of right shoulder and right hip.
Postural deformity is associated with, or the result of, a given posture. This type of deformity can be corrected by the patient's own muscle action.

Static deformity is one associated with the role of gravity when the body is not in motion.

Dynamic deformity occurs as a result of the patient's own muscle action. Such a deformity is usually the result of muscle imbalance and is not resistant to passive correction; it is a mobile deformity.

Fixed or structural deformity is relatively resistant to passive correction.

**Calcaneus and Equinus**

Calcaneus and equinus deformities occur at the ankle only (ankle calcaneus, ankle equinus).

Calcaneus is a deformity in which the foot is maintained in a position of dorsiflexion so that on weightbearing, only the heel touches the floor (Fig. 4.13).

Equinus is a deformity in which the foot is maintained in a position of plantar flexion so

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**TERMS DESCRIBING DEFORMITIES IN LIMBS**

The types and causes of musculoskeletal deformities are discussed in a general way in Chapter 3, but the descriptive terminology of such deformities merits discussion here. The following terms are used clinically in describing joint deformities.
that on weight-bearing, only the forefoot touches the floor (Fig. 4.14).

Cavus and Planus
These deformities occur only in the foot (pes cavus and pes planus).

*Pes cavus* is an exaggeration of the normal longitudinal arch of the foot, an unduly high arch (Fig. 4.15). The combined deformity of calcaneus of the hind foot and equinus, or plantar flexion, of the forefoot is called *calcaneonavus*.

*Pes planus* is a diminution of the normal longitudinal arch of the foot, an unduly low arch, or flat foot (Fig. 4.16).

Internal Torsion and External Torsion
Internal torsion and external torsion represent a twist in the longitudinal axis of a long bone, usually the tibia or femur.

In *internal torsion*, the anterior aspect of the distal end of the long bone is twisted inward or medially in relation to the anterior aspect of its proximal end, for example, internal tibial torsion (Fig. 4.17) and internal femoral torsion.

In *external torsion*, the anterior aspect of the distal end of the long bone is twisted outward or laterally in relation to the anterior aspect of its proximal end, for example, external tibial torsion (Fig. 4.18) and external femoral torsion.

Anteversion and Retroversion
Anteversion and retroversion refer to the relationship between the neck of the femur and the femoral shaft.

*Femoral anteversion* exists when the knee is directed anteriorly; the femoral neck is directed anteriorly to some degree (Fig. 4.19).

![Figure 4.17. Left. Internal torsion of the tibia (bilateral).](image1)

![Figure 4.18. Right. External torsion of the tibia (bilateral).](image2)

![Figure 4.19. Top. Anteversion of the femoral neck (femoral anteversion). The dotted lines outline the femoral condyles in relation to a horizontal surface. The upper solid line represents the axis of the femoral neck.](image3)

![Figure 4.20. Bottom. Retroversion of the femoral neck (femoral retroversion). The dotted lines outline the femoral condyles in relation to a horizontal surface. The lower solid line represents the axis of the femoral neck.](image4)
Femoral retroversion exists when the knee is directed anteriorly; the femoral neck is directed posteriorly to some degree (Fig. 4.20).

**Angulation or Bowing Deformities**

An angulation deformity occurs most frequently at the site of a fracture in the shaft of a long bone but may also occur as a bowing deformity within an intact bone. Considerable confusion exists concerning the description of such angulation or bowing deformities (e.g., anterior or posterior? medial or lateral?) The adjective describing an angulation or bowing deformity refers to the direction in which the apex of the angle points (rather than the direction in which the distal fragment points).

**Varus and Valgus**

The deformities of varus and valgus refer to abnormal angulation within a limb. The angulation deformity is usually in a joint, or in a bone near a joint, but it may also occur through the shaft of a long bone. This particular pair of terms has probably caused more confusion than any other pair, partly because the original Latin terms had the opposite meaning to that which is now universally accepted. You will
find it easy to remember which is which by thinking of the patient in the anatomical position within an imaginary circle.

**Varus**

Varus is an angulation that **conforms** to an imaginary circle in which the patient is placed (Fig. 4.21).

_Cubitus varus_ is a decrease in the normal carrying angle at the elbow.

_Coxa vara_ is a decrease in the femoral neck-shaft angle (less than 130°) (e.g., an angle of 90° conforms more to a circle than does the normal angle of 130°).

**Genu varum** is also called _bow leg_ in which the knees are apart when the feet are together.

_Heel varus_ is a decrease in the normal angle between the axis of the leg and that of the heel, as in the position of inversion.

_Talipes equinovarus_ is an inversion deformity of the foot combined with an equinus or plantar flexion deformity of the ankle. This combination is seen in a congenital clubfoot.

_Metatarsus varus_ is more properly called _metatarsus adductus_—an adduction deformity of the forefoot in relation to the hind foot.

_Hallux varus_ is an adduction deformity of the great toe through the metatarsophalangeal joint.

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**Figure 4.22.** A valgus deformity is an angulation of the deformity that does not conform to an imaginary circle in which the patient is placed.
Valgus
Valgus is an angulation that does not conform to an imaginary circle in which the patient is placed (Fig. 4.22).

Cubitus valgus is an increase in the normal carrying angle at the elbow.

Coxa valga is an increase in the femoral neck-shaft angle (more than 130°), for example, an angle of 170° conforms less to a circle than does the normal angle of 130°.

Genu valgum is also called knock-knee. In this condition, the feet are apart when the knees are together.

Heel valgus is an increase in the normal angle between the axis of the leg and that of the heel, as in the position of eversion.

Talipes calcaneovalgus is an eversion deformity of the foot combined with a calcaneus or dorsiflexion deformity of the ankle.

Hallux valgus is an abduction deformity of the great toe through the metatarsophalangeal joint.

**CLINICAL MEASUREMENT OF JOINT MOTION AND DEFORMITY**

Having learned the meaning of the pairs of clinical terms describing joint motion and de-
For the sake of accuracy you should measure joint motion and deformity using some type of goniometer (Fig. 4.23).

**The Anatomical Position**

The starting, or zero position, for most joints in the human is the *anatomical position* in which the individual is standing erect, the head, eyes, and toes directed forward, the feet together, and the arms hanging by the sides with the palms of the hands facing forwards (Fig. 4.24).

**SUGGESTED ADDITIONAL READING**


As a medical practitioner of the future, your first responsibility to each of your patients will be to determine what the problem or disease is (the diagnosis). This you must determine with great care and accuracy so that you may make the correct start toward the goal of helping your patient because, of course, he or she will have come to you as a medical practitioner primarily to seek help with a problem.

Problem-solving holds a certain fascination for all of us, and who among us is not stimulated by a mystery? The field of medicine affords daily opportunity to solve mysteries and other problems, not only in diagnosis and treatment but also in the many types of medical research. Solving the mystery of a diagnosis is the “detective work of medicine,” and to be consistently accurate, you must emulate that greatest of all detectives, Sherlock Holmes, who constantly demanded: “Data, give me data!” (Fig. 5.1). In the investigation of a diagnostic mystery, you, like Sherlock Holmes, must be keenly interested, inquiring, attentive, alert, observant, perceptive, and skillful in correlating data, or clues, as well as in making logical deductions and conclusions from them. (It is of interest that both the literary creator of Sherlock Holmes and his “model” for the detective were members of the medical profession. Sir Arthur Conan Doyle was inspired to create the fictional figure of the master detective in 1880 as a result of his close association, as a postgraduate medical student, with Joseph Bell, a brilliant Edinburgh physician who was renowned for his remarkable powers of observation and deduction in relation to diagnosis.)

**METHODS OF OBTAINING DATA (CLUES)—THE INVESTIGATION**

Certain musculoskeletal conditions, such as a typical congenital clubfoot, are so obvious that their diagnosis presents little difficulty (as Holmes would say: “Elementary, my dear Watson”). However, other conditions—such as a malignant bone neoplasm in its earliest stages, or symptoms such as progressive weakness in a limb—present diagnostic problems that may require extensive investigation. Thus, not all the methods of obtaining data, or clues, are essential to making every diagnosis, but you must be prepared to use as many as necessary to solve the problem, or mystery, of diagnosis in each patient you see. The investigation to make the diagnosis of musculoskeletal disorders and injuries proceeds in the following order: 1) history taking (symptoms), 2) physical examination (signs), 3) diagnostic imaging (imaging signs), and 4) laboratory investigation (including examinations of various body fluids as well as examination of a specimen, or biopsy, of diseased tissue). Symptoms provide subjective data, whereas physical signs, imaging signs, and the results of laboratory tests provide objective data.

**The Patient’s Story (Clinical History)**

In the current era of dramatic technological advances in a wide variety of diagnostic methods, it is more important than ever to appreciate that in most cases, a carefully and accurately obtained clinical history from the patient or the patient’s relatives (or both) still contributes significantly more to a correct
diagnosis than do the physical examination, diagnostic imaging, and laboratory investigation combined.

As a medical student of the present, you will have many opportunities to obtain the clinical history from patients assigned to you in the wards and outpatient clinics of your teaching hospitals. You will be wise to develop good habits of history taking during these formative years of clinical training; they will serve you well as a medical practitioner of the future.

To obtain a complete and accurate history, you must be a discerning listener and an intelligent questioner. Furthermore, you must have certain attitudes of mind toward your patient, including a sincere and kindly interest in him or her as a fellow human being, compassion, understanding, patience, and tact. Remember that for many persons, consulting a medical practitioner may be an anxious experience. Regardless of their age or level of intelligence, your patients will be quick to sense your attitude toward them, and they will either be put at ease or made to feel ill at ease by it.

Skill in history taking involves an important facet of the broad area of communication with your patients and their relatives. Goldbloom, who has described history taking as “interviewing, the most sophisticated of diagnostic technologies” offers sound advice for the interviewer, such as sitting, rather than standing, making frequent eye contact, taking sufficient time to ask relevant questions and listen to the patient’s concerns, both spoken and, at least initially, unspoken (i.e., hidden agendas). Indeed, the public perception of the medical profession is frequently expressed by the complaint that medical practitioners are too busy to take enough time either to listen or to talk.

In recent decades, global migration has greatly increased the ethnic diversity of the population in most of the world’s developed countries, especially in the larger cities. This phenomenon has created the need for interpreter services in hospitals or at least a system of obtaining a bilingual relative or volunteer to enhance the accuracy of two-way communications between the medical practitioner and a patient for whom there is a language barrier.

Under certain other circumstances (infancy, mental retardation, loss of consciousness), the patient will be unable to tell you the
Important Data in the Patient's History

Preliminary Data

The patient's name, sex, date of birth and present age, occupation, and family responsibilities are the first items of information obtained.

The Presenting Problem or Chief Complaint

The chief complaint is the main symptom, or group of symptoms, that have prompted the patient to seek help and advice. Your opening inquiry about this should not be “What is wrong with you?” because such a question invites the obvious reaction, either silent or expressed: “That is what I have come to find out from you!” A preferable beginning is, “What have you noticed or felt that does not seem right to you?” Having listened to your patient describe the chief complaints in his or her own words, you need to obtain more precise information by asking further questions to determine the following: time of onset, type of onset (sudden or gradual), severity, constancy (constant or intermittent), progression, activities that aggravate it and those that relieve it, relation to any injury or other incident, and any associated symptoms.

Common Musculoskeletal Symptoms or Complaints

The following are the main reasons why a patient with a musculoskeletal condition seeks consultation with a medical practitioner:

1. Pain. By far the most important presenting symptom is pain, and you must inquire about it in great detail with respect to its onset, precise location, character (dull, sharp, burning), severity, duration, factors that relieve the pain as well as those that aggravate it, and its variation with day and night. There is a wide variation from person to person in relation to pain threshold and pain tolerance; the patient who “feels” more pain, or tolerates it less well than the average person, may not be exaggerating at all and requires kindly consideration. Most musculoskeletal pain is aggravated by intermittent local movement and is relieved by local rest; this suggests that during movement, such pain is caused by a sudden increase in either tension or pressure in sensitive soft tissues such as periosteum (movement at a fracture site) or joint capsule and ligaments (movement in a joint). Any such painful movement initiates muscle spasm, which in itself is painful, and this pain is superimposed on the initial pain. Pain that persists in spite of local rest suggests progressively increasing pressure in a closed space, such as occurs with an increasing amount of purulent exudate within the confines of a bone (osteomyelitis) or within a joint cavity (septic arthritis) and also with a progressively expanding bone neoplasm. Pressure on a nerve, or nerve root, produces radiating pain in the sensory area of that nerve or nerve root; the most common example is sciatica, pain radiating down the lower limb in the distribution of the sciatic nerve from pressure of a protruded intervertebral disc on a nerve root. Remember also, the phenomenon of referred pain, the most important example of which is pain felt in the knee (referred to the knee) but arising from a painful lesion in the hip caused by the obturator nerve pattern of hip pain. Neurological lesions may produce alterations in skin sensation, including increased or painful feeling (hyperesthesia), decreased feeling (hyposthesia), or peculiar feeling, for example, “pins and needles” (paresthesia).

2. Decrease in function. Decreased ability to use a body part is also a common presenting complaint (chief complaint) of patients with musculoskeletal conditions. The pa-
tient may be concerned about decreased ability (disability) caused by muscle weakness or fatigue, giving way (instability) of a joint, or stiffness of a joint.

3. Physical appearance. The patient’s chief complaint may be the physical appearance of a deformed limb or limbs (angulatory deformity), twisted limb (torsional or rotational deformity), a wasted limb (atrophy), a short leg (length discrepancy), or a crooked back (scoliosis). He or she may be concerned about the physical appearance of an abnormal way of walking (limp or abnormal gait). Deformities and abnormal gaits are physical signs rather than symptoms, but they may still be the patient’s chief complaint or presenting problem. You must determine when the problem was first noticed, its character, clinical course (getting better, getting worse, or remaining unchanged), and the extent of any associated disability. As with tolerance to pain, patients vary widely in their tolerance, or acceptance, of deformities and abnormal gait. A given deformity or limp may be acceptable to one patient and yet be a source of great concern (and therefore a problem) to another.

Relevant Past History
It is important to obtain a history of previous illnesses, injuries, and related treatment, including vaccinations and operations. The patient may have a tendency to ascribe his or her present symptoms or signs to a specific incident such as previous illness, an injury, or treatment, whereas you may discern that, in fact, the incident merely served to draw the patient’s attention to a pre-existing and previously unrecognized condition.

Functional Inquiry
Patients with disorders of the musculoskeletal system may have coexistent disorders of some other body system, or systems, and hence the reason for inquiring into the function of all systems (functional inquiry). Some of the more important conditions to include are heart disease, diabetes, kidney disease, respiratory conditions, and psychogenic disturbances with either exaggeration or falsification of symptoms. As Sir William Osler stated, “It is important to ascertain not only what kind of disease the person has, but also what kind of person has the disease.” Nevertheless, you should search diligently for an organic explanation of the patient’s symptoms, even though he or she may appear to be “neurotic,” lest you do him or her the injustice of jumping to the wrong conclusion.

Social, Economic, and Work History
Since orthopaedic problems and their treatment frequently extend over long periods, you must obtain the relevant details of the patient’s social, economic, and work history so that the proposed plan of treatment will be feasible for the particular patient.

Family History
Because some musculoskeletal conditions (both congenital and acquired) show a distinct tendency to appear in members of the same family (either in the same or in different generations), it is important to obtain such data concerning relatives by means of a family history.

Physical Examination
More than half the diagnoses in patients can be made on the basis of a carefully obtained, detailed clinical history, and more than three quarters of the diagnoses can be made from the combined data of the clinical history and the physical examination. Thus, these two time-honored methods are still the best combination of diagnostic tests at your disposal. Because of the importance of the clinical history and the physical examination, modern strategies—including epidemiologic and biostatistical methods—are currently being applied to test scientifically the diagnostic validity of the multitude of clinical symptoms and physical signs.

In a sense, the physical examination begins the moment the patient comes into sight. Certain striking features about the patient—body build (habitus), facial appearance (facies), way of walking (gait) as he or she approaches you, or the sitting or lying position if you are approaching him or her (body language)—may
have already provided you with useful clues almost before you have had time to say "How do you do?". Your eager eyes (like those of Sherlock Holmes) will pick out every clue, and by the time the history taking part of the examination is completed, you will have detected many things about the patient (and he or she will have detected certain things about you also). Your attitude of mind toward the patient will be reflected by your methods of examination. A compassionate attitude of mind results in an awareness of the patient's feelings, as well as a respect for these feelings. Therefore, you respect the patient's modesty by ensuring that he or she is appropriately draped. Furthermore, when examining a patient of the opposite gender, you will be wise to have a nurse or other health professional in the examining room, not only as a comfort to your patient but also as a witness. You will always endeavor to be as gentle as possible in your examination so as not to produce unnecessary pain—that is, no more than is absolutely necessary to detect that a certain pressure or movement is, in fact, painful.

Apart from your own common sense and your keen senses of sight, touch, and hearing, the equipment you require for the musculoskeletal examination of the patient is simple (Fig. 5.2). The examination is conducted in systematic order: 1) looking (inspection); 2) feeling (palpation); 3) moving (assessment of joint motion), both active and passive; 4) listening (auscultation) over joints and vessels; 5) special physical tests to elicit or exclude specific physical signs; and 6) the neurological examination.

**Looking (Inspection)**
The patient must be sufficiently exposed so that an important sign is not overlooked. Nevertheless, it is neither necessary nor appropriate to request that the patient remove his or her underclothing when examining the musculoskeletal system in older children, adolescents, and adults. Patients also appreciate the offer of an examination gown as well as the privacy to undress before and dress after the examination.

Confirm your earlier observations of the patient's habitus and facies. Observe the skin (redness, cyanosis, pigmentation) (Fig. 5.3), looking for atrophy, hypertrophy, and scars of previous injury or operation. Look for any deformity (Fig. 5.4), swelling (Fig. 5.5), or lumps (Fig. 5.6). Measure any limb shortening (Fig. 5.7) or atrophy (Fig. 5.8), always comparing the abnormal limb with the opposite limb. If the patient is able to walk, request

![Figure 5.2. Equipment for musculoskeletal examination: stethoscope (1), pocket flashlight (2), skin marker (3), pins and cotton wool (4), tape measure (5), reflex hammer (6), and goniometer (to measure angles) (7).](image-url)
abnormal physical signs that are apparent on inspection are described and depicted in subsequent chapters.

**Feeling (Palpation)**

All patients appreciate a medical practitioner who has a “warm heart”; they also appreciate one who has *warm hands* and furthermore, warm hands elicit less muscle spasm than those that are cold and clammy. By palpation you will obtain data concerning skin temperature, pulse, tenderness, the nature of any swelling (indurated or edematous “pitting”), the characteristics of a lump or mass (consistency, fluctuation, size, relationship to adjacent structures), muscle bulk, and abnormal relationships of bones at their joints (dislocations). With the combination of joint movement and palpation, you will also detect joint crepitus as well as muscle tone.

**Moving (Assessment of Joint Motion)**

*Active movement* of a joint by the patient should be assessed first; it may be *limited* by pain and associated muscle spasm, muscle weakness, ruptured muscle or tendon, joint stiffness or joint contracture, or a bony block. *Passive movement* of a joint by you, the examiner, should be assessed gently; it may be *decreased* for any of the reasons already mentioned (except muscle weakness and ruptured muscle or tendon) (Fig. 5.9) or it may be *increased* as in joint instability caused by a lax capsule or torn ligaments (Fig. 5.10). Abnormal ranges of joint motion, both active and passive, should be recorded. The clinical state of the union of a healing fracture in an extremity can be assessed by detecting the presence or absence of passive motion and pain at the fracture site when a local anastomoly, or torsional, force is applied to the involved extremity.

**Listening (Auscultation)**

Sounds arising from bones (fracture crepitus), joints (joint crepitus), or muscle action (snapping tendons) are sometimes sufficiently loud that they can be heard by both you and the patient without any effort. However, it is often informative to listen to a joint during movement through a stethoscope for more ac-
A. Apparent limb shortening is seen. This boy's right lower limb appears to be shorter than his left; however, they are actually the same length. The apparent shortening is caused by an adduction contracture of the right hip and resultant obliquity of the pelvis (the black dots are on the anterior superior spines). B. True limb shortening is seen. This boy's left lower limb is truly shorter than his right. He is almost able to compensate for this by standing on tiptoe on the shorter side. C. The figure shows a method of measuring true limb length from the anterior superior spine to the medial malleolus. Apparent limb length is measured from the umbilicus to the medial malleolus, with the lower limbs in line with the trunk.

Accurate assessment of the quality and localization of the sound (Fig. 5.11). The stethoscope is also of value in detecting the murmur of a peripheral arteriovenous fistula.

Special Physical Tests
Certain important physical signs will escape detection during the physical examination unless special tests that have been developed for the detection of these signs are carried out. The hip joint, being deeply situated and of complex structure and function, is more difficult to examine accurately than are other joints; therefore, it is not surprising that three of these special tests have been developed to demonstrate specific signs in the hip. Two of these signs are present (the test is positive) in a variety of clinical conditions, and accordingly they are considered now:

- Hip flexion deformity—the Thomas test (Fig. 5.12)
- Ineffecctual hip abduction mechanism—the Trendelenburg test (Fig. 5.13)

Other specific signs are present in one condition only and are therefore more appropriately considered along with a discussion of that condition in subsequent chapters; they will be merely listed at present:

- Instability (dislocatability) of the newborn hip—the Barlow test and the Ortolani test (See Chapter 8).
Figure 5.8. A. The decrease in circumference of this boy's right calf and thigh results from muscle atrophy secondary to paralytic poliomyelitis. B. This figure shows a method of measuring limb circumference. The levels for comparable circumferential measurements should first be measured from comparable bony landmarks and marked.

- Sciatic nerve irritation Lasègue's test (See Chapter 11)
- Torn medial meniscus of the knee—the McMurray test (See Chapter 17)

Neurological Examination
Since many musculoskeletal disorders and injuries are associated with neurological deficits, it is essential to appreciate that the neurological examination is an important part of the musculoskeletal examination. It is of particular importance when there is evidence of muscle weakness or muscle spasticity, involuntary movements of muscle, symptoms of altered skin sensation, incoordination of movement, and loss of balance. The neurological examination includes assessment of the motor system (muscle tone, power, coordination), sensory system (touch, pain, temperature, position sense, vibration), reflexes (tendon reflexes, abdominal reflexes, and plantar reflex) and rectal sphincter tone.

You will learn about the physical examination of the musculoskeletal and neurological systems most effectively from demonstrations given by your own clinical teachers as well as by practice under their supervision. These subjects justify complete textbooks; two helpful ones include two books by Hoppenfeld (one on extremities and spine, the other on orthopaedic neurology) and others referred to in the Suggested Additional Reading at the end of this chapter.

Figure 5.9. Passive flexion of this girl's left knee was limited to 90° as a result of dense adhesions between the quadriceps muscle and the distal end of the femur after a severely displaced fracture at this site.

Diagnostic Imaging
Beginning in the 1970s and continuing through the 1990s, the specialty of what was
formally called diagnostic radiology has been greatly expanded through a number of exciting and dramatic technological advances, including the cross-sectional imaging modalities of ultrasonography, computed tomography (CT) and, more recently, magnetic resonance imaging (MRI), only one of which (CT) involves the use of ionizing radiation. Consequently, to reflect these additional capabilities, radiography departments and departments of radiology in many hospitals are currently designated departments of diagnostic imaging. The modalities of CT and MRI, in particular, have proved to be of immense help in determining the precise location and diagnosis of many disorders and injuries of the musculoskeletal system.

Although the plain films, or radiographs, of conventional radiographic examination are still the most widely used and least expensive form of diagnostic imaging (especially for the initial examination), you will also need to become aware of the indications, merits, and indications of ultrasonography, CT, MRI, and scintigraphy (radionuclide scans of bones and soft tissues). With such a large array of imaging modalities, you will find that personal consultation with an experienced imager is helpful, not only in making the most appropriate choices but also in obtaining the most accurate interpretation of the images.

**Plain (Conventional) Radiography**

Prior to Roentgen’s serendipitous discovery of x-rays in 1895, physicians and surgeons relied on clinical evidence to make a musculoskeletal diagnosis and follow the results of treatment. This revolutionary discovery greatly improved medical and surgical diagnosis and treatment in general, but especially in the musculoskeletal system. It is remarkable that the x-ray filament tube designed by Coolidge in 1913 has been changed little during the ensuing decades.

Examination of the musculoskeletal system by means of x-rays (radiographic examination) is, in a sense, an extension of the physical examination. It might be considered a form of “*internal inspection*” and, as such, it is of extreme value, not only in the accurate diagnosis
Figure 5.12. This figure describes the Thomas test for hip flexion deformity. Top. When the patient is lying supine, a hip flexion deformity can be masked by an increase in lumbar lordosis. Bottom. Passive complete flexion of the opposite hip straightens out the lumbar spine and reveals the true extent of the hip flexion deformity. This boy's hip flexion deformity was caused by the residual effects of a septic arthritis.

Figure 5.13. The Trendelenburg test for an ineffectual hip abduction mechanism is seen in a 4-year-old girl with congenital dislocation of the right hip. Left. When the child stands on her right foot (the side of the dislocated hip), the hip abductor muscles, having no fulcrum, cannot hold the pelvis level, and it drops on the opposite side. The child, in an effort to maintain balance, shifts her trunk toward the involved side. The Trendelenburg sign is also seen in the presence of coxa vara, paralyzed hip abductor muscles and painful conditions around the hip. Middle. The dislocation is not apparent when the child is standing with both feet on the floor (except for the slight shortening of the right lower limb). Right. When the child stands on her left foot (the side of the normal hip) the hip abductor muscles, having a normal function, hold the pelvis level.
of musculoskeletal disorders and injuries but also in following the subsequent course of these conditions. A brief explanation of "x-ray shadows" will make interpretation of x-ray films more interesting and more meaningful. An X-ray film (radiograph or roentgenogram) is studied against a bright light because it is a photographic "negative" rather than a "print." In radiographs, bone appears relatively white (radiopaque), whereas the soft tissues appear relatively dark (radiolucent). The radiographic density of a tissue depends on its thickness as well as its atomic weight. The thicker the tissue and the higher its atomic weight, the more radiation is absorbed and therefore the less radiation "penetrates" the tissue to expose the film, and the whiter it appears. Conversely, the thinner the tissue and the lower its atomic weight, the less radiation is absorbed and therefore the more radiation "penetrates" the tissue to expose the film, and the darker it appears. Fat has the lowest atomic weight of all the solid tissues and therefore appears darkest (most radiolucent) in the radiographic negative. Muscle, cartilage, and osteoid (not yet calcified) have approximately the same atomic weight, which is higher than that of fat, and consequently they are more radiopaque than fat. Bone, however, because of its mineral content of calcium, phosphorus, magnesium, and other minerals, has a much higher atomic weight and is therefore much more radiopaque than the various soft tissues (Fig. 5.14). Furthermore, bone as a structure varies in its radiographic density depending on its thickness or structural density and on its calcification. Radiographically, an abnormally increased density in bone is called sclerosis, whereas an abnormally decreased density is called rarefaction (Fig. 5.15). You will recall from Chapter 3 that the radiographic density of bone clearly demonstrates the altered deposition and altered resorption of the bone as it reacts to abnormal conditions.

Air, of course, is the most radiolucent substance seen in a radiograph and, hence, it appears even darker than fat. Air is expected in the lungs, as is gas in the gastrointestinal tract. Air is also seen in the soft tissues immediately after an open surgical procedure. Air in the soft tissues at the base of the neck, however, signifies surgical emphysema, whereas widespread gas within the soft tissues of an injured part is an ominous sign of an overwhelming
and potentially fatal type of infection that causes gas gangrene (Fig. 5.16).

A radiograph, like a photograph, is only two-dimensional, and a single radiograph represents only one view, which could be misleading. Therefore, a second view (at right angles to the first) is essential so that the structures can be studied from at least two projections—generally from the front (anteroposterior projection) and from the side (lateral projection) (Fig. 5.17). Sometimes additional views are required, for example, oblique projections. The third dimension can best be appreciated radiographically by studying two stereoscopic projections.

**Inspection of a Radiograph**

As in the inspection of your patients, you must also know what to look for when inspecting their radiographs. The following are some of the important features to look for in a radiograph:

- General density of bone—increased or decreased (Fig. 5.15)
- Local density of bone—increased or decreased (Fig. 5.18)
- Relationship between bones—dislocation and subluxation (Fig. 5.19)
- Break in bone continuity—fracture (Fig. 5.20)
- General contour of a bone—deformity (Fig. 5.21)
- Local contour of a bone—internal or external irregularity (Fig. 5.22)
- Thickness of articular cartilage—as reflected by the width of the joint space, or, more accurately, the cartilage space (Fig. 5.23)
- Changes in soft tissues—swelling, atrophy (Fig. 5.24)

You will be wise to inspect, or study, a radiograph as you would inspect, or study, a patient, initially from a distance and then from close range. In this way, your eyes move from the general to the particular and you are less likely to miss an important radiographic clue. Remember also that there may be more than one clue or sign in a given radiograph (Fig. 5.20). Comparison of a limb with the opposite limb, which has already been stressed in clinical examination, is important in radiographic examination if you are in doubt, particularly in children because of the varying appearance.
of epiphyses and epiphyseal plates during the period of growth.

Because plain films do not show the soft tissues (cartilage, muscle, ligaments and tendons) well, special types of radiographic examination may be necessary to depict certain soft tissue outlines. These examinations involve the injection of a contrast medium (either a fluid that is radiopaque or air, which is radiolu-

Figure 5.17. The importance of at least two projections is demonstrated in this figure. A. The anteroposterior projection of the lumbar spine of this severely injured boy reveals relatively little distortion of the spine. B. The lateral projection of the lumbar spine of the same boy reveals a severe fracture-dislocation of the spine. Two projections at right angles to each other are essential.

Figure 5.18. A. Increased local density of bone (sclerosis). The localized area of sclerosis in this boy's tibia is caused by new bone formation as a reaction to an osteosclerotic lesion (an osteoid osteoma) within the bone. In this radiograph, the osteoid osteoma itself (which is only 1 cm in diameter and is actually osteolytic) is obscured by the extensive reaction of osteosclerosis in the surrounding bone of the lateral cortex of the tibia. B. Decreased local density of bone (rarefaction). The localized area of rarefaction in the upper end of this girl's femur results from an osteolytic lesion (a simple bone cyst) within the bone.
Figure 5.19. The relationship between bones is seen in this figure. This child's left hip joint is completely dislocated as the result of a severe injury (traumatic dislocation).

Figure 5.20. This figure shows a break in bone continuity. The displaced fractures of the distal metaphyseal regions of the radius and ulna are obvious. However, there may be more than one clue in a given radiograph. Can you also detect the less obvious fracture? Look at the proximal end of the ulna.
Figure 5.21. This figure demonstrates general bone contour. The varus deformity in this 60-year-old man's right tibia is the result of an old fracture that had been allowed to heal with deformity (malunion).

Figure 5.22. Local bone contour is seen in this figure. A. Internal irregularity of the distal half of the tibia in a child caused by chronic osteomyelitis. B. External irregularity of the humerus in a child caused by an osteochondroma (osteocartilaginous exostosis).

Figure 5.23. The left hip joint of this 14-year-old girl has been the site of pyogenic infection (septic arthritis). Note the decreased thickness of the cartilage space (a more accurate term than joint space) of the left hip compared with that of the normal opposite hip (top), indicating loss of articular cartilage.
tion of the two for a double-contrast examination) into the synovial cavity to detect injuries or other abnormalities of the articular cartilage, fibrocartilaginous menisci, capsule, and ligaments (Fig. 5.25).

**Myelography**
Injection of the contrast medium into the subarachnoid space can detect the protrusions of nucleus pulposus or soft tissue neoplasms extending into the vertebral canal (Fig. 5.26). Such protrusions are more accurately visualized by computed CT combined with myelography or by MRI imaging.

**Discography**
Injection of a radiopaque contrast agent into suspected abnormal intervertebral discs under local anesthesia can help in localizing the par-

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**Figure 5.24.** This figure demonstrates changes in soft tissues. Note the irregular density in the subcutaneous tissues overlaying the tibia. This soft tissue shadow is the result of a recent hemorrhage and consequent hematoma in the subcutaneous tissues.

**Arthrography**
Arthrography consists of the injection of a radiopaque contrast agent or air (or a combination) into a body space. The following are four examples of contrast radiography.

**Figure 5.25.** Arthrograms of the knee using a radiopaque contrast agent are seen. Top. Normal arthrogram of the right knee. Note the smooth wedge-shaped medial and lateral menisci clearly outlined by the dye in the joint. Bottom. Arthrogram of the right knee revealing penetration of the contrast agent into a vertical tear in the medial meniscus (arrow). By means of several oblique projections, the location and extent of the tear can be determined. Arthrography is currently being replaced in major centers by MRI.
bone-seeking radionuclides such as technetium-99m-labeled polyphosphate; its analog, methylene dipophosphate; and others. The resultant "bone scans" reflect changes in the local blood flow in bone as well as the degree of local metabolic activity.

Figure 5.26. This figure shows a myelogram. The descent of the radiopaque medium (ioipentylate; Pantopaque) is completely blocked at the level of the fourth lumbar vertebra by a space-occupying lesion (a neoplasm) within the vertebral canal. Nonionic contrast agents are much more satisfactory for this purpose than previously available oil-based radiopaque media.

ticular disc that is causing the patient's symptoms, not only because the injection into the responsible disc reproduces the symptoms but also because the radiographic pattern of the dye in such a disc is abnormal in that it extends beyond the normal confines of the disc. With the advent of MRI, myelography and discography are rarely performed any longer.

**Sinography**

Sinography consists of an injection of contrast medium into an external sinus to follow the sinus track to its source in the depths of the tissues (Fig. 5.27).

**Scintigraphy**

Since the 1970s, the specialty of nuclear medicine has made great strides in detecting a wide variety of lesions in bone through the use of

Figure 5.27. The radiopaque medium in this sinogram has been injected into a sinus on the lateral aspect of this boy's left thigh. The medium outlines the sinus tract and reveals its connection with the hip joint. The medium also outlines a radiolucent foreign body just lateral to the ilium above the hip joint (arrow); this was a piece of wood that had been driven into the soft tissues at the time of a penetrating injury and traumatic dislocation of the hip. Note also the evidence of destruction of the femoral head resulting from the combination of infection and avascular necrosis.
Scintigraphy has been useful in detecting and localizing a wide variety of lesions, including benign conditions (especially osteoid osteoma), primary malignant tumors, skeletal metastases, early osteomyelitis, infected endoprostheses, and even stress fractures, all of which appear on the scan as an area of increased radionuclide uptake (a so-called hot spot) (Figs. 5.28 and 5.29). In addition, bone scans are useful in detecting avascular necrosis of bone in its early stages, at which time there is decreased radionuclide uptake (a so-called cold spot).

**Plain (Conventional) Tomography**

Plain tomography provides images of a series of sections or slices of the tissues at varying depths from the skin surface. Such sections, each of which is focused at a specific level, are particularly helpful in evaluating abnormalities within high-contrast tissues such as bone—for example, destructive lesions in bone, nonunions of fractures, or the completeness of bony union across an area of arthrodesis (joint fusion). Although plain, or conventional, tomography has been replaced to a large extent by CT scans and MRI scans, especially in larger centers, it still has a place in centers in which these much more expensive modalities are not available.

**Computed Tomography**

During the 1970s in the entire field of diagnostic radiology, CT was by far the most important and most exciting advance since 1895 when Roentgen discovered x-rays. Indeed, ra-

![Figure 5.28](image)

**Figure 5.28.** A. Conventional radiograph of the distal end of the left femur in a 14-year-old boy who had sustained a direct blow to the medial side of his knee 3 days previously and who complained of increasingly severe pain at this site. Examination revealed local tenderness; he also had a fever. This is suggestive of acute hematogenous osteomyelitis (as described in Chapter 10), but it would be too early for any detectable changes in this conventional radiograph, which was interpreted to be normal. B. This scintogram (bone scan) of the distal ends of both femora in this patient is viewed from the front. There is focal hyperemia and increased radionuclide uptake, that is, increased bone activity (a “hot spot”) in the medial part of the distal metaphysis (arrow) of the left femur, which is consistent with the clinical diagnosis of acute hematogenous osteomyelitis.
Figure 5.29. A. This conventional radiograph was taken of the junction of the middle and distal third of the right tibia of a 12-year-old track and field athlete who had recently started intensive spring training and who complained of local pain. There is a suggestion of a hairline stress fracture (arrow), but it is too early to expect to see the fracture clearly or to see reactive new bone. B. The scintogram (bone scan) of this area viewed from behind reveals focal hyperemia and increased radiotracer uptake, that is, increased bone activity (a "hot spot") of the cortex of the tibia at this site (arrow) typical of a recent stress fracture (as described in Chapter 15).
Radiology has entered what might be called "the era of imaginative imaging" as a result of the marvel of radiation physics, electronics, and computer science. By making extensive use of computers to reconstruct images, CT became the first cross-sectioned imaging modality.

The science and technology of CT is advancing at such a phenomenal rate that each successive generation of CT scanners soon becomes relatively obsolete.

CT, through which accurate images of "slices" of the body are generated, ingeniously overcomes many of the limitations of two-dimensional radiography and provides a degree of diagnostic accuracy not previously attainable. Originally limited to computed axial (cross-sectional) tomography and hence the term CAT scan, the technology has now made it possible with reforming to look at coronal, sagittal, and even oblique slices as well. Thus, the current term, computed tomography, is more appropriate.

This sophisticated diagnostic imaging system clearly differentiates between the radiographic densities of various tissues and enables us to see lesions that are not demonstrable by standard radiography and with less radiation to the patient than conventional tomograms use.

In the musculoskeletal system, CT is of tremendous value in detecting the precise site and extent of varied disorders, such as benign and malignant tumors, pulmonary metastases, osteomyelitis, intervertebral disc herniation (CT combined with myelography), spinal stenosis, congenital abnormalities of the spine such as diastematomyelia, and meningomyelocele, as well as torsional deformities of the femur, posterior dislocation of the hip, and complex fractures of the pelvis.

More recently, some of these disorders—including benign and malignant bone and soft tissue tumors, soft tissue compression of the spinal cord by metastases, intervertebral disc herniation, and early stages of avascular necrosis of bone—can be more accurately demonstrated by magnetic resonance imaging (MRI). Nevertheless, CT is still extremely use-

![Figure 5.30](image.png)

Figure 5.30. This figure shows a CT scan of the spine at the midthoracic level in a 14-year-old boy with local pain in his back. Note the radiolucent lesion and the surrounding radiosclerotic area in the lamina (arrow). The diagnosis was an osteoid osteoma (as described in Chapter 14).
ful in the imaging of complex fractures of the spine and the joints of the extremities as well as disc space infections and tarsal coalitions. Examples of CT scans of musculoskeletal tissues are shown in Figures 5.30 and 5.31.

Understandably, a thorough knowledge of the cross-sectional anatomy of the body is essential for the accurate interpretation of the cross-sectional slices of CT scans.

By means of highly sophisticated computer technology, three-dimensional reconstructions can be created from CT scans. Such reconstructions are especially helpful in the preoperative planning of three-dimensional reconstructive orthopaedic procedures, especially for complex problems of the pelvis and hips (Figure 5.32).

Ultrasonography (Ultrasound)

Ultrasonography, or diagnostic ultrasound, which does not involve the use of ionizing radiation, is useful in detecting joint effusions (Fig. 5.33), muscle and tendon injuries, and the precise relationship between the unossified, cartilaginous femoral head and the acetabulum in newborn infants with suspected congenital dislocation or subluxation of the hip (developmental dysplasia of the hip) (Fig. 5.34). Ultrasonography has also been used as a safe, noninvasive method to differentiate between solid soft tissue lesions and fluid-filled cystic lesions (such as a popliteal cyst).

The Doppler phenomenon using ultrasound is an accurate and noninvasive method of assessing arterial and venous blood flow in an extremity. Consequently, ultrasonography is beginning to replace invasive venography for detection of deep vein thrombosis. It is also helpful in assessing the neonatal spine and spinal cord.

Magnetic Resonance Imaging

The development of MRI in the 1980s was another major breakthrough in the field of diagnostic imaging. The most significant advantages of MRI over CT are that it uses nonionizing radiofrequency radiation rather than ionizing radiation. Using a strong magnetic field, MRI provides cross-sectional images with higher resolution than CT, and it produces better images of the brain and spinal cord. It can better differentiate the various types of soft tissue from each other and it can provide physiological as well as anatomical data (especially when used in conjunction with contrast agents and spectroscopy).

Thus, MRI is the most effective diagnostic imaging technique for the demonstration of malignant tumors of soft tissue and bone, internal derangements of joints (especially the
Laboratory Investigation

The fourth source of data that may be required, at least in some cases, to solve the problem of diagnosis is the laboratory examination of specimens of body fluids and tissues. These examinations, or tests, involve hematology, biochemistry, immunology, bacteriology, and pathology. Of the multitude of laboratory examinations available, those of most value in the diagnosis of musculoskeletal disorders are the following:

- **Blood**: Hemoglobin determination, a red blood cell count, a white blood cell count, a stained smear or film of blood, sedimentation rate, blood coagulation studies, uric acid values, and blood culture are performed.
- **Serum**: Serum calcium, inorganic phosphate, alkaline phosphatase, acid phosphatase, and protein values are obtained. Immunological or serological tests include the VDRL (Venereal Disease Research Laboratory) test for suspected syphilis, the human immunodeficiency virus (HIV) test for acquired immunodeficiency syndrome (AIDS) (only with the patient's written consent), the Mantoux test for tuberculosis, and the Rose test for rheumatoid disease.
- **Urine**: The urine's gross appearance is assessed. Determinations of albumin, glucose, cells, casts, calcium, and phosphorus are obtained, and a urine culture is performed.
- **Cerebrospinal fluid**: The gross appearance is assessed as are cerebrospinal fluid pressure and cells. Protein levels are determined and a culture is performed.
- **Synovial fluid**: The gross appearance and cells are assessed. Protein and glucose levels

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**Figure 5.32.** A. This figure shows a conventional radiograph of the hip joints of a 30-year-old woman with residual congenital subluxation of her left hip despite treatment for a congenital dislocation in early childhood. Note the increased distance between the left femoral head and the medial wall of the acetabulum (arrow) compared with that of the right hip. B. This is a CT scan of the hips of the same patient as seen in A. Note the increased space between the left femoral head and the medial wall of the acetabulum (arrow). C. Three-dimensional reconstruction of the hip joints of the same patient seen in A and B. Note the poor coverage of the lateral margin of the left femoral head by the acetabulum (arrow).
Figure 5.33. A. This figure shows a normal parasagittal sonogram of the left hip joint in a 6-year old-boy. The upper arrow indicates the anterior capsule of the hip joint, and the lower arrow indicates the anterior cortical surface of the neck of the femur. The space between the two arrows contains the normal amount of synovial effusion. B. This figure shows an abnormal parasagittal sonogram of the same boy's opposite hip, which was painful. The widened space between the two asterisks is explained by an increase in fluid within the hip joint—a synovial effusion (synovial fluid), a hematrhrosis (blood) or a pycarthrosis (pus). Needle aspiration of the joint is required to differentiate among these three types of fluid.
Figure 5.34. A. This is a normal coronal sonogram of the left hip joint in a neonate. The white dot is over the center of the femoral head. The alpha (A) angle of 65° and the beta (B) angle of 53° are normal and the femoral head is in normal relationship within the acetabulum (i.e., it is in the socket). B. An abnormal sonogram of the left hip joint in a neonate is seen. The white dot is over the center of the femoral head. Note that the head of the femur is dislocated laterally and proximally from the acetabulum (i.e., it is out of the socket).

are obtained, and culture is performed. The analysis of synovial fluid obtained by joint aspiration (arthrocentesis) is of considerable value in the laboratory diagnosis of joint disorders such as septic arthritis; normal synovial fluid contains a total protein content of approximately 1.8 mg/100 mL, with relatively more albumin than globulin, and is relatively acellular (10 to 200 cells/mL, predominantly mononuclear). Synovial fluid from noninflammatory joints is usually clear, has few cells (with a normal distribution), and a low protein content, whereas the synovial fluid from inflammatory joints is usually turbid (from white blood cells or crystals, or both), has many more cells (predominantly polymorphonuclear leukocytes), and a high protein count. In septic arthritis, bacteria may be found, as may a low level of joint fluid glucose. The presence of crystals in "chemical" arthritis can be diagnostic. Monosodium urate crystals are diagnostic for gout and calcium pyrophosphate crystals are diagnostic for pseudogout.

- Abnormal fluids (effusions, exudates): The gross appearance is assessed as are cells. A direct smear and culture are performed. When an organism is grown in culture, further examinations are required to assess its sensitivity as well as its resistance to various antibiotics.
- Body tissues (specimen obtained by biopsy): Bone marrow is usually obtained by either sternal or iliac crest puncture (aspiration biopsy). Bone and soft tissue specimens are obtained either by open operation (open biopsy) or by withdrawing a small piece of tissue through a hollow cannula (punch biopsy). The microscopic examination of these tissues is of particular value in the diagnosis of musculoskeletal neoplasms.
Examples of the role of these various laboratory examinations in the diagnosis of specific musculoskeletal disorders are provided in subsequent chapters.

**Diagnostic Arthroscopy**

Following the lead of urologists, who for decades have been able to visualize the interior of the bladder by means of the cystoscope, in the mid-1960s orthopaedic surgeons developed sophisticated fiber-optic arthroscopes (especially for the knee joint) that can allow more complete visualization of most large joints than can be obtained by an open operation (arthroscopy) of the joint. Indeed, diagnostic arthroscopy has increased the accuracy of diagnosis of internal derangements and other disorders to more than 95%. Although arthroscopy is currently the most frequently performed orthopaedic procedure in North America, it should not be considered a substitute for the clinical history, physical examination, diagnostic imaging, or laboratory investigation.

During the early years of arthroscopy, the orthopaedic surgeon looked inside the joint through the optical system of the arthroscope. Currently, through the use of miniaturized color television cameras, it is possible for the surgeon, as well as everyone else in the operating room, to see the same moving picture of the interior of the joint in color on a television screen (Fig. 5.37).

It is now even possible to perform certain surgical procedures using the arthroscope plus specially designed instruments that are inserted either through the scope or into the knee through a separate portal (arthroscopic surgery). Procedures such as removal of a loose body, partial or total meniscectomy, drilling defects in the articular surface, abrating areas of chondromalacia, and even reconstruction of cruciate ligaments can be performed.

Arthroscopy of the knee and even arthroscopic surgery can be performed under either local or general anesthesia, usually on an outpatient or “day-care” basis, with considerably less morbidity than is associated with open arthrotomy. Because of the inaccessibility of some areas of the knee joint, arthroscopy may have to be combined with double-contrast (air and dye) arthrography in the diagnosis of “problem knees.” Arthroscopy has also been developed for other joints, including the shoulder, elbow, wrist, ankle, and even the hip.

Arthroscopy identifies patients for whom arthrotomy can be obviated; for those patients requiring arthrotomy, arthroscopy makes the planning for such open surgery more accurate. Understandably, diagnostic arthroscopy and arthroscopic surgery are more readily accepted by patients than are open operations, and this accounts, at least in part, for their popularity. As with other such procedures, however, there is a risk of abuse, such as overuse and questionable indications—a risk that has been well stated in the literature by international leaders in the field.

**Antenatal Diagnosis**

Since the mid-1970s, the field of antenatal, or prenatal, diagnosis of congenital abnormalities has expanded dramatically because of the combination of a safe method of amniocente-
3. generation of a cause list
4. pruning of the cause list
5. selection of a diagnosis
6. validation of the diagnosis

If your personal experience is limited, you would naturally wish, in the interests of your patient, to seek consultation with a more experienced colleague.

COMMUNICATION WITH YOUR PATIENTS ABOUT THE DIAGNOSIS

Solving the problem of diagnosis for your patient is just the first of many steps toward the goal of helping them with their problem. Having made a diagnosis of the present situation, you must then consider the future outlook (prognosis) for your patients and be prepared to communicate with them at their level of understanding. They and their close relatives have the right to know (if they wish) just what your diagnosis means in relation to them and their future. How often one hears patients say of their medical practitioner: “He said quite a bit, and used some big words that I could not understand, but he really didn’t tell me anything, and I am confused and concerned.” No matter how brilliant you have been in the scientific aspect of your investigation, it is of little comfort to your patient unless you have developed the art of communication. It is, of course, not only unnecessary, but also unwise, to explain the minutiae of your patients’ diagnosis and treatment to them as though they were medical students or medical doctors. Nevertheless, it is essential that you give them an understanding of their condition and also that you be aware of their particular needs and fears.

Your patients may either fear death from a progressive disease such as cancer, or fear life with a painful, crippling, or disabling condition. They will want and need to know the answers to questions such as “What is wrong with me? How serious is it? Can it be treated? How successfully? What is the treatment? How long will I be away from my home or from my work? What would happen if it is not treated?”

Wilson has written that the medical doctor communicates best when he or she is honest, compassionate, caring, calm, readily available, sensitive and trustworthy.

The practice of medicine is becoming progressively more scientific and this is as it should be because science must always be the basis of medical knowledge. At the same time, however, you must develop the art of communicating with your patients, which, in effect, requires that you acquire a keen and sympathetic awareness of their needs as well as their concerns, for as Sir William Osler stated so clearly “The practice of medicine is an art based on science.”

SUGGESTED ADDITIONAL READING


Keller MS, Harbhajan SC, Weiss A. Real-time su-