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Fractures of the lower limb

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John R.W. Hardy

INTRODUCTION

This chapter considers the modern management of fractures of the lower limb. The term *fracture* is defined as a loss of the normal continuity of bone diaphysis, metaphysis, physis, epiphysis and joint cartilage. Trauma is the commonest cause of fracture to the lower limb. Fractures are commonly seen in patients with multiple trauma, in which cases the management of the skeletal injury follows only after the management of life-threatening injury (see Ch. 7). The age of a patient determines the pattern of a fracture and the level of energy required to break a bone (see Ch. 52). In the lower limb, the fracture neck of femur is typically associated with osteoporosis in the elderly woman. Predisposing factors for fracture after a single loading insult depend on the type, rate and magnitude of the force as well as the underlying structural and material properties of the bone. This explains why a fall from standing fractures the femoral neck in an osteoporotic older patient, while a young man's hip survives a single load of the same proportions.

The symptoms and signs of fractures are dependent on the stability of the skeleton after fracture and injury to the surrounding soft tissues. All clinically suspected fractures (i.e. a history of an injury and pain) must be further investigated.

Modern classifications of lower limb fractures consider the patterns of bony injury within each region of the lower limb.[1] This is the AO classification, which divides each bone into three segments, each segment into three types (usually depending on the number of fragments), each type into groups of three (depending on the pattern of fracture), and each group into three subgroups. The pattern of this classification reflects the increasing severity of injury experienced by the bone segment. Management of the fractures of each of the AO segments is considered later in this chapter. The AO classification is not yet exhaustive of all patterns of injury.

Classifications, other than being just the pattern of bony injury, allow the clinician to consider a sensible approach to treatment. Fractures of the lower limb may be classified according to their site, the associated soft tissue injury, the number of fragments and their displacement, and any associated complications.

The prognosis depends on the severity of the injury, the age and general condition of the patient, the restoration of function, the prevention of deformity, and the minimization of treatment complications.

Complications of the lower limb bone fractures are common, as are complications of treatment. The complications that attend the fractures themselves are considered separately. The complications of treatment should be classified into general complications or local complications. Local complications vary, depending on the region of fracture and the method of treatment. Because the optimum treatment depends on the fracture classification, complications of treatments are considered on a regional basis.

THE CLINICAL HISTORY OF LOWER LIMB FRACTURE

A history of pain following injury, regardless of how insignificant the trauma might seem, should always suggest the possibility of a fracture. This is especially true in the elderly with osteoporotic bone. Likewise, a fracture that results from cyclic stress (fatigue) is often missed unless a careful history is taken of the onset, the duration, and the periodicity of the pain. A history of pain in the foot or tibia following long periods of exercise, regardless of the minimal signs present, should always be further investigated by radiographs. The symptoms of fracture in the lower limb may include pain, deformity, and a loss of function.

THE PHYSICAL SIGNS OF LOWER LIMB FRACTURES

The physical signs of a fracture may be surprisingly minimal and depend on the pattern of injury. An undisplaced fracture often allows preservation of function. This cannot therefore be taken as an indication that the bone is intact. The usual signs of fracture include tenderness at the fracture site, swelling, bruising, deformity, and occasionally crepitus of the fractured ends of the bone. Crepitus should not be specifically elicited during the examination process, but it is occasionally discovered. The 'look, feel, move' principle provides a logical order for eliciting signs.

INVESTIGATION OF LOWER LIMB FRACTURES

Radiographs have been the mainstay of investigation since X-rays were developed in Germany by Wilhelm Konrad Röntgen (1845–1923). Röntgen was a physicist who in 1894 published an original paper on the medical use of X-rays; on 7 January 1895, the technique was reported in the London Evening Standard.

A useful adage in the investigation of fractured limbs is the rule of two. This is that two radiographs should always be taken with views at 90° to each other; the radiographs, like the clinical

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Figure 55.3 Use of an inflatable surgical tray to reduce the risks of exposure to theatre staff of 'substances hazardous to health', as recommended by Control of Substances Hazardous to Health regulations.

is superficial, but deep infection can occur and this leads to sequestra at the site of the pin, which may have a ring shape if the dead compressed bone around the pin becomes involved. Screw and plate fixation is probably best avoided in any compound fracture.[27] Other authors would argue that while type II or III open fractures are probably best treated by external fixation,[28] lesser injuries may be either plated, nailed or externally fixed.

MALALIGNMENT AND SHORTENING

No useful definitions exist for malunion. Most definitions relate the condition to imperfect restoration of the premorbid anatomical position of the fracture fragments. In clinical practice the term is reserved for cases in which the resulting deformity is felt to be clinically significant.

The long-term sequelae of malunion are unknown. Deformity is usually cosmetically unacceptable. There is also the belief that if the centre of gravity of the weight of the body is displaced from the centre of the knee or ankle joint then osteoarthritis will result. This is anecdotal. Many a surgeon has seen post-traumatic osteoarthritis after a perfect reduction and restoration of the normal biomechanical axis of the limb.

POST-TRAUMATIC OSTEOARTHRITIS

Injury to joint cartilage and subchondral bone is common following direct or indirect trauma to joints. Even trauma not detectable on normal radiographs can cause subchondral

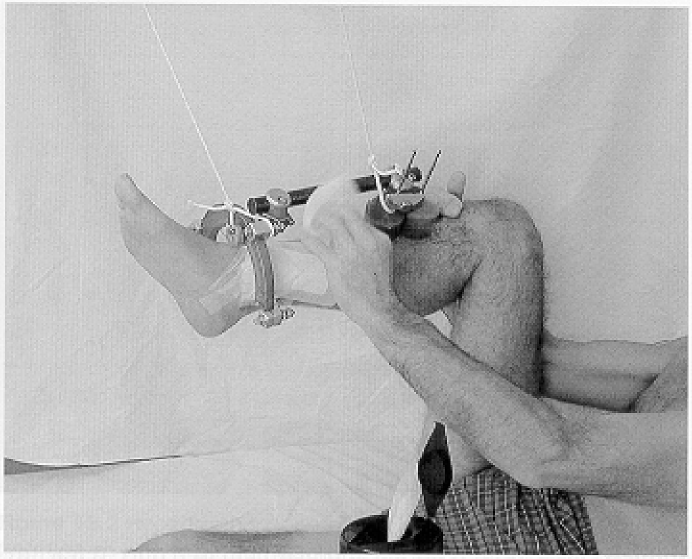

Figure 55.4 Use of external fixation and a Balkan beam to elevate the limb after trauma.

fracture that leads to hastened degenerative changes.[29,30] More obvious irregularities of the joint surface following fracture lead to rapid degenerative changes; these also occur following vascular insult to the subchondral bone, such as is seen after avascular necrosis following intracapsular fracture neck of femur.

NEUROVASCULAR COMPLICATIONS

Neurovascular complications are common following leg injuries, especially after dislocation of the knee. Both nerve and vascular injuries can be direct or indirect. Indirect injury of nerves and vessels from compartment syndrome is often overlooked. Correction of vascular compromise of a limb must take place at the earliest opportunity and takes precedence over the fixation of bone. Compartment syndrome that requires treatment occurs in about 3% of all tibial fractures.

Compartment syndrome

Compartment syndrome is from increased pressure within a muscular compartment, which leads to tissue necrosis. The symptoms are of ischaemic pain out of proportion to the injury, and its early management is by splinting and analgesia. The signs are elicited by passive stretch of the muscles suspected of being involved. The tightness of the compartment and the presence of peripheral pulses cannot be relied on as useful signs. Impaired function of peripheral nerves suggests that the ischaemia is advanced.

Classically, compartment pressures are measured using a slit catheter device. Compartment pressures in excess of 30–35 mmHg in a normally perfused patient suggested the need for open compartment fasciotomy.[31] In patients without

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