7.1 Introduction

A displaced fracture of the olecranon represents a disruption of the triceps mechanism and, as a consequence, the loss of active extension of the elbow. The necessity for surgical repair has been appreciated ever since Lord Lister attempted an open reduction and suture of the olecranon (Keon-Cohen 1966). The methods of surgical repair have varied. Some authors have advocated excision of the fragment or fragments with repair of the triceps aponeurosis (Keon-Cohen 1966). Others have advocated the fixation of the fragment with intramedullary nails, screws, or plates (Weseley et al. 1976). As indications became more clearly defined, resection of the proximal fragment and reattachment of the triceps tendon to the distal fragment was reserved for elderly patients in whom the fracture was proximal to the middle of the trochlear notch (Rowe 1965). Younger patients were subjected to an open reduction and an attempt was made to stabilize the fragments, either with a through-and-through loop of wire (Fig. 7.1) or with a long intramedullary lag screw (Fig. 7.2).

If the olecranon fragment was small, excision usually resulted in a stable elbow with a satisfactory range of motion. If the fragment was large, it became increasingly more difficult to preserve an adequate cuff of the triceps aponeurosis to effect a repair. If the fragment involved more than 50% of the articular surface, instability of the elbow followed resection. Instability was a serious problem because it compromised function, and therefore excision was abandoned as a form of treatment for any but the smallest of fragments.

The methods of internal fixation with the wire loop, intramedullary Rush rod, or an intramedullary lag screw did not provide sufficient stability to allow early motion. The joint had to be immobilized until union occurred. Despite plaster of Paris immobilization, the triceps pull was frequently sufficient to cause displacement (Fig. 7.2). Typically, the fracture gaped dorsally, and frequently some separation of the fragments occurred, which led to gaps in the articular surface and to joint incongruity with consequent compromise of function.

The duration of immobilization and the associated joint disorganization frequently led to varying losses in the range of flexion and extension. The dorsal gaping with displacement of the proximal fragment hindered full extension. Therefore, the loss of extension was often more severe than the loss of flexion. Because the elbow is not a weight-bearing joint and does not transmit such great forces as the knee joint, incongruity does not result rapidly in post-traumatic osteoarthritis. However, if the

Fig. 7.1a,b. A wire loop inserted through the substance of the olecranon (a) is unable to resist the pull of the triceps and brachial muscles against the intact trochlea (b). Gaping of the fracture with varying degrees of displacement, despite protection in a cast, is the usual outcome
patient is called upon to perform heavy work requiring elbow flexion and extension against resistance, then progression of the osteoarthritis and an increase in pain and disability are to be expected.

In 1965, the AO group published the *Technique of Internal Fixation of Fractures* (Müller et al. 1965), which introduced tension band wiring as the most effective method of internal fixation of olecranon fractures. Their experiments showed tension band wiring to be six times stronger than any other fixation technique. By using this technique, it was therefore possible to forgo the application of a plaster fixation and to begin active movement soon after surgery. At 4–6 weeks, the olecranon fractures were usually sufficiently healed to allow the patient full function. The rate of malunion or nonunion was extremely low, as was the degree of residual disability.

### 7.2 Methods of Evaluation and Guides to Treatment

The indication for surgery is displacement, which represents a disruption of the triceps mechanism and loss of active extension of the elbow. If the fracture is undisplaced, the surgeon must determine whether the triceps aponeurosis is intact or not. With an intact triceps aponeurosis, a patient is able to extend the elbow against gravity without causing any displacement of the fragments. Such a fracture is stable, will not displace under the influence of physiological forces, and requires only symptomatic treatment. If any doubt exists as to the continuity of the triceps aponeurosis, the elbow should be examined with the aid of an X-ray image intensifier. Any degree of displacement on full flexion signifies damage to the triceps aponeurosis and suggests the need for either immobilization in extension or surgery.

The diagnosis is simple. Typically, the patient gives a history of having fallen and of not being able to use the elbow. The olecranon is very painful, swollen, and bruised. The exact diagnosis is established on an appropriate anteroposterior and lateral radiograph (Fig. 7.3). The anteroposterior view is more useful for an overall examination of the elbow to exclude other injuries, but the olecranon itself is obscured in this view. It is the lateral projection that gives a clear view of the olecranon. If there is any doubt as to the degree of comminution or articular surface depression, lateral tomograms or CT should be requested in order to obtain an accurate definition of the fracture.

### 7.3 Classification

#### 7.3.1 Intra-articular Fractures

##### 7.3.1.1 Transverse (21–B1.1)

This simple articular fracture occurs at the deepest point of the trochlear notch (Fig. 7.4). It is an avulsion fracture and results from a sudden pull of both the triceps and brachialis muscles. It may also result from a direct fall on the olecranon itself, although that usually results in some degree of joint depression in association with the fracture.

Complex fractures that result from a direct force, such as a fall, frequently have comminution and depression of the articular surface (Fig. 7.5).