



Osteoporotic fracture treatment

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Orthopaedic surgeons frequently have to deal with osteoporotic fractures of the distal radius, hip and proximal humerus. Low bone mineral density is not only associated with an increased fracture risk but also with more fracture displacement and reduction loss. The specific problems and main treatment options for these fragility fractures are reviewed.

Keywords : fragility fractures ; osteoporosis.

INTRODUCTION

The aim of fracture treatment is to restore normal function. Measures taken by surgeons to reach this goal are anatomical reconstruction and fracture stabilisation to allow early mobilisation. Osteoporotic fractures are challenging because they tend to be more displaced (31,75,95) and unstable (13,34,35) than nonosteoporotic fractures. Biomechanical tests showed screw fixation to be less strong with decreasing bone mineral density (BMD) (84,89). In osteoporotic patients this may result in cutting out of screws or plates lifting off the bone, leading to fracture displacement (20).

Solutions have been proposed to improve fracture stability and implant purchase in osteoporotic bone such as hydroxyapatite-coated external fixator pins and screws (53,54) and augmentation with cement, bone grafts or bone substitutes (56). Osteoconductive cements such as calcium phosphate cements have become more popular to increase fracture stability than polymethyl-

methacrylate cements (82). Plates with locking screws provide better fixation in osteoporotic bone, but not all problems have been solved and adaptations in surgical technique are still being proposed, such as hybrid fixation (mix of locking and non-locking screws) (10,18) and far cortical locking (11).

The most frequent fracture associated with osteoporosis is at the distal radius. Hip fractures are in second place and when vertebral fractures are excluded, those at the proximal humerus are in third place (39).

In this review orthopaedic aspects of acute fracture treatment are discussed. However, the orthopaedic surgeon should bear in mind that a patient with a fragility fracture should be referred to diagnose osteoporosis and institute the proper

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treatment, if necessary (48). Medication to reduce fracture risk and non-pharmacological measures can be installed (8,9,16,38).

DISTAL RADIUS FRACTURES

In order to restore normal wrist function, anatomical reconstruction is important in physically active patients. Especially the axial length of the radius and articular congruity should be restored (90). In elderly low-demand patients the outcome is no longer correlated with the radiological result (21,30,96).

Nondisplaced fractures can be immobilised in a forearm cast for four to six weeks. In case of displacement, manipulation and cast immobilisation can be applied. However, elderly patients frequently present loss of reduction and even nondisplaced fractures treated with a cast can end up with more displacement (6,49,60,69). Reduction loss and malunion are correlated with BMD in fractures treated with manipulation and plaster cast immobilisation (13,34,35). In a study without BMD determination, age was the most important factor to predict reduction loss (47).

Stabilisation of distal radius fractures can be achieved with K-wires. The technique is minimally invasive because the pins are introduced percutaneously. Radiological results are generally better with pinning than with plaster cast immobilisation alone (23), but maintaining radial length is not always feasible in elderly patients (32,40,62). Oshige *et al*, showed that loss of radial length was correlated with BMD of the lumbar spine in distal radius fractures stabilized with K-wires (62). After surgical fixation with K-wires, patients with malunion were older than those with an acceptable reduction (33).

Another minimal invasive treatment method for distal radius fractures is external fixation, which can be bridging or nonbridging. Reported complications are pin loosening and infection. The use of hydroxyapatite-coated pins has been recommended in osteoporotic patients because infection rate was less and fixation strength was better than with standard pins (53). In another study, hydroxyapatite coated pins did not yield any advantage compared with other pins, but not all patients had osteoporosis (68).

Since the introduction of volar plates with locking screws, other treatment methods such as external fixation and internal fixation with dorsal plates have become less popular among surgeons (41). Volar plates were initially used to treat distal radius fractures with palmar displacement (Smith's fracture). With angle-stable screws they can also be used for dorsally displaced fractures. The palmar surface of the distal radius is more suitable for plate fixation than the dorsal surface. Other advantages are that mobilisation of the wrist can be started early (74) and loss of radial length can be avoided in elderly patients, which is not always possible with K-wires (62). Good radiological results were obtained in patients older than 75 years after fracture stabilisation with a volar plate with locking screws (61). In a study, including patients more than 50 years old with dorsally displaced distal radius fractures, loss of reduction was less and functional outcome was better with volar plates and locking screws than with percutaneous K-wire fixation (50). Disadvantages are the higher cost of volar plates (78), potential tendon irritation and rupture, and the need for a second operation for plate removal. Loss of reduction can also occur with volar plates with angle-stable screws (3). Complications may be less with the latest type of plates with multidirectional angle-stable screws, double rows of screws and a rounder shape at the distal end of the plate (94).

In osteoporotic patients, impaction of the bone at the fracture site may result in a void after reduction, with secondary loss of reduction. Filling this defect with bone grafts or bone substitutes could improve the radiological outcome but no evidence has been found for a better functional outcome (25).

In conclusion, active patients with operatively treated osteoporotic distal radius fractures may have a better radiological and hence functional outcome, but cast immobilisation usually is sufficient for low-demand patients, in whom anatomical restoration is no longer correlated with function (4,86).

PROXIMAL FEMUR FRACTURES

In the elderly, two main types of proximal femur fractures are distinguished: those including the

femoral neck or intracapsular fractures, and those including the trochanter or extracapsular fractures. About 50% of hip fractures are intracapsular. Patients with extracapsular fractures are older and have lower BMD values in the trochanter area (64,76).

Surgical fixation is the standard treatment for a fracture of the proximal femur (24). It should preferably be performed within the first two to four days to decrease morbidity and mortality (52,77). A second operation may be required because of complications with fracture healing (7,46). Although in clinical studies BMD was not related to fixation failure of femoral neck fractures (29,92), it can be assumed that osteoporosis plays a role, as biomechanical tests provided evidence of a correlation between BMD and implant fixation strength in bone (20).

Intracapsular fractures can be stabilised with cannulated screws (5), a sliding hip screw (17), or an intramedullary nail (91). Displaced fractures have a high risk of nonunion and avascular necrosis after internal fixation (46). To reduce the need for reoperation, total hip replacement (28) or hemiarthroplasty, either unipolar or bipolar (70) is recommended in patients over 70 years of age (43,79). In younger healthy patients, internal fixation should be tried first, but it should be performed within 12 hours of injury to minimize the risk of avascular necrosis (37).

Extracapsular fractures are most frequently stabilized with a sliding hip screw or an intramedullary nail (67). External fixation is a less frequently used treatment option (55). The sliding hip screw is the standard technique because intramedullary nails carry a higher risk of secondary fracture of the femoral shaft. The risk of the lag screw in the femoral neck and head cutting out from the bone is similar with both implants (67). Total hip replacement is another treatment option for trochanteric fractures in a selected group of elderly patients in whom internal fixation would not allow early weightbearing. Hemiarthroplasty is preferred in nonarthritic patients because the dislocation rate is lower than with primary total hip replacement (19). Currently, there is no sufficient evidence that arthroplasty is superior to internal fixation of trochanteric fractures (65).

Various methods exist to improve fixation of osteoporotic proximal femur fractures, such as insertion of polymethylmethacrylate cement and calcium phosphate granules or cement in the fracture area surrounding the implant (45,57). However, currently the use of bone cements cannot be recommended. For intracapsular fractures, the reoperation rate was higher when calcium phosphate cement was used (51) and for trochanteric fractures conclusive evidence for a better long-term outcome is still lacking (45). Hydroxyapatite coated screws and external fixator pins could improve fixation strength in the bone and may prevent lag screw cut-out (54,55). More studies are required to confirm these promising results (66).

PROXIMAL HUMERUS FRACTURES

Proximal humeral fractures can be classified with the system of Neer based on the location and number of displaced bone fragments (58). The severe fracture types with three and four parts are more frequent in elderly than in younger patients (14). Screw fixation strength in the humeral head is less strong in areas with low BMD, such as the superior anterior part (88).

After sustaining a fracture of the proximal humerus, early mobilisation of the shoulder is beneficial for the recovery process. Undisplaced fractures can be treated nonoperatively in a sling or body bandage (26). In patients with a displaced fracture, the choice of treatment will depend upon the fracture type, the age and the individual demands of the patient (44). In younger patients most surgeons will perform an open reduction and internal fixation. In elderly osteoporotic patients there is no consensus which treatment is best (22,80). Immobilization in a sling or brace (27,97), closed reduction and percutaneous fixation with K-wires or screws (36,71), palm tree pinning (42), intramedullary nailing (1), open reduction and wiring, open reduction and plate fixation (93) and prosthetic replacement (12,68) can be performed.

In biomechanical studies plate fixation with locking screws was stronger than with non-locking screws, intramedullary nailing or blade plate fixation (83). However, in clinical studies complications

with this new technique could not be prevented, such as screw cut out, especially in patients more than 60 years old, perforation of screws through the humeral head and loss of reduction (63,81,85,87).

Prosthetic replacement instead of osteosynthesis has been recommended in fractures with a high risk of aseptic necrosis such as in four-part fractures or fractures with splitting of the humeral head (59). The disadvantage of hemiarthroplasty is a poor range of motion of the shoulder (2) and the risk of nonunion of the tuberosity (80). With the reverse shoulder arthroplasty in elderly patients who sustained a fracture, 63 % had radiological signs of loosening of the glenoid component (12).

It can be concluded that there is a lack of randomised comparative trials to find out what treatment is best for displaced proximal humeral fractures in elderly patients (22,26) and conservative treatment still may be a good option (15,72).

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