In 1990 an estimated 1.3 million fractures of the hip occurred worldwide, a figure which is expected to double by 2025 and to increase to 4.5 million by 2050. Approximately half of these fractures will be intracapsular. The average age of these patients is about 80 years and 75% are female.

**Terminology.** The term ‘intracapsular fracture’, synonymous with cervical fracture, refers to fractures of the neck of the femur occurring within the capsule of the hip. Fractures which involve the articular surface of the femoral head should be considered separately. The terms ‘sub-capital’, ‘transcervical’ and ‘medial femoral neck’ cause confusion and should be avoided. Extracapsular fractures occurring in the trochanteric region will not be considered in this article. Fractures at the base of the neck or involving its lateral part, although possibly partially intracapsular, should be treated as extracapsular injuries.

**Pathology.** The blood supply of the head of the femur arises from three sources, namely the retinacular vessels within the capsule, through the medullary cavity and from the artery of the ligamentum teres. After an intracapsular fracture, the viability of the head is dependent on the extent of damage to the retinacular vessels and the limited ability of those from the medullary cavity and the artery of the ligamentum teres to revascularise the ischaemic bone.

**Complications of healing.** A number of complications may occur after an intracapsular fracture. Nonunion refers to failure of the fracture to unite. The same term is also conventionally used in reported results of the complications of healing in those fractures which show redisplacement after treatment. Other terms for this complication include redislocation and pseudarthrosis. Avascular necrosis and late segmental collapse refer to the changes which occur in the femoral head as a result of ischaemia. The occurrence of complications in healing of the fractures is dependent on the stability of the fracture, the security of the internal fixation and the extent of damage to the blood supply of the femoral head.

**Investigative procedures.** Techniques which have been used to attempt to predict the viability of the femoral head include arteriography, intraosseous venography, measurement of the intraosseous pressure, the Coomassie Blue test, the Kiton Fast Green test, tetracycline labelling, oxygenation of the femoral head, bone isotope scintimetry, and, more recently, MRI. To date, none of these methods has been shown to be a reliable predictor of viability and cannot be recommended for routine clinical practice.

**Radiological classification**

The most commonly used radiological classification is the grading of Garden. Repeated studies of intra- and inter-observer variations have shown that this classification is only accurate for dividing fractures into those which are undisplaced (grade I and II) and displaced (grade III and IV).

The Pauwels classification is based on the angle of the fracture line to the horizontal. The more vertical fractures will have a greater shearing stress across the surfaces of the fracture. A summary of previous clinical studies of the Pauwels system showed that any differences in the complications of fracture healing related to the angle of the fracture were inconsequential. The recently devised AO classification of intracapsular fractures has been found to have no clinical relevance other than for the division into displaced and undisplaced.

Some clinical studies have reported that the fractures which are based more proximally are at a higher risk of nonunion, while others have failed to find a relationship. Any association between the level of the fracture and complications in healing is not sufficiently accurate for clinical use. Posterior comminution of the calcar may increase the risk of potential problems, although the results of clinical studies on this topic have been conflicting.

The Singh index as a measure of osteoporosis has no clinical value in predicting union.

The main radiological predictor of nonunion is the degree of displacement at the site of the fracture, but unfortunately there is no succinct method of defining this. At present therefore the only relevant radiological characteristic is whether the fracture is displaced or not. This
division into two categories is the only classification for intracapsular fractures which has been shown to be reliable clinically and to have an acceptable degree of both inter- and intraobserver variation.\textsuperscript{1,17} Un undisplaced fractures customarily include those which are impacted and they may show angulation on the lateral radiographs. There may be confusion regarding the classification of intracapsular fractures which are minimally displaced\textsuperscript{13} and they are best considered as akin to an undisplaced fracture.

**Treatment**

**Undisplaced fractures.** The conservative treatment of undisplaced and impacted intracapsular fractures has been well described.\textsuperscript{25} This involves a period of bed rest until the acute pain subsides followed by gentle mobilisation. The risk of nonunion is approximately 5\% to 10\% after internal fixation as opposed to the more variable reported results of 15\% to 60\% with conservative treatment.\textsuperscript{25,27} Internal fixation is therefore customarily recommended after which the patient may be mobilised without restriction.

**Displaced fractures.** The debate as to whether the femoral head should be retained or replaced continues. Consequently, the displaced intracapsular fracture has been termed the ‘unsolved fracture’. Misinformed teaching, tradition and ignorance have perpetrated numerous myths about what influences the fracture healing. These inaccuracies are then used to justify local preferences in treatment as opposed to evidence-based principles derived from the careful appraisal of clinical studies. The arguments for the different methods of treatment are summarised in Table I.

Besides the displacement of the fracture, the next most important factor in determining treatment is the patient’s age. Opinions differ as to the categorisation of ‘young’ and ‘elderly’. In chronological terms ‘young’ is approximately 65 to 70 years of age, but a more appropriate definition may be the distinction between those patients who are house-bound or institutionalised and those who are not.

For those aged less than 50 to 60 years preservation of the femoral head is paramount. With increasing age the arguments against arthroplasty diminish since the life expectancy of the patient becomes less than that of the arthroplasty and the functional demands on the hip are less. The incidence of nonunion increases progressively with age, while symptomatic avascular necrosis is less common in the elderly.\textsuperscript{19,23,27} The limited number of randomised trials comparing internal fixation with arthroplasty has produced conflicting results, with some favouring internal fixation and others arthroplasty. The results from a more recent randomised trial\textsuperscript{26} suggest that both methods of treatment produce comparable final outcomes. Internal fixation is associated with a marginally lower mortality but at the expense of an increased rate of readmission and re-operation. Both approaches are acceptable and surgeons must choose which method is best in their hands.

**Medical condition influencing treatment.** Specific co-morbidity may tip the balance in favour of internal fixation. The presence of chronic sepsis, such as leg ulcers or an indwelling urinary catheter, is not an absolute contraindication to arthroplasty, but may lead the clinician to favour internal fixation. Patients may continue to take warfarin or similar anticoagulants if closed reduction and percutaneous internal fixation are used.

An intracapsular fracture associated with marked arthritis of the hip is uncommon. When it occurs a total hip replacement is generally indicated. A pathological fracture secondary to either a tumour or Paget’s disease may be treated by internal fixation but carries a greatly increased incidence of complications in healing. Arthroplasty is therefore usually appropriate. Patients with metabolic bone diseases, specifically those secondary to chronic renal failure or hyperparathyroidism, and those with rheumatoid arthritis are at an increased risk of nonunion.\textsuperscript{27} In my view, displaced intracapsular fractures in these groups of patients should generally be treated by a cemented arthroplasty. The patient’s gender, mental state, weight or degree of osteoporosis (by any measurement) have not been shown to be predictive of complications in fracture healing.\textsuperscript{19,23} These factors therefore should not influence treatment.

<table>
<thead>
<tr>
<th>Table I. Differences between internal fixation and arthroplasty.</th>
<th>The figures for the percentage of complications are taken from Parker and Pryor\textsuperscript{27} and Lu-yao et al\textsuperscript{27}</th>
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</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td><strong>Internal fixation</strong></td>
<td><strong>Patient retains their own femoral head</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Less surgical trauma in initial operation</strong></td>
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<tr>
<td></td>
<td><strong>Mortality and morbidity may be slightly reduced</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Lower risk of wound sepsis (up to 1%)</strong></td>
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<tr>
<td><strong>Arthroplasty</strong></td>
<td><strong>Lower rate of reoperation (6% to 18%)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Risk of nonunion (10% to 20% in the young, 20% to 35% in the elderly)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Risk of avascular necrosis (10% to 20%)</strong></td>
</tr>
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<td></td>
<td><strong>Risk of fracture around the implant (1% to 2%)</strong></td>
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<tr>
<td></td>
<td><strong>Increased rate of reoperation (20% to 36%)</strong></td>
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<td></td>
<td><strong>More extensive operation than internal fixation</strong></td>
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<tr>
<td></td>
<td><strong>Higher risk of deep infection around the implant (3%)</strong></td>
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<tr>
<td></td>
<td><strong>Higher risk of superficial wound infection (5% to 15%)</strong></td>
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<td></td>
<td><strong>Risk of dislocation incurred (2% to 5%)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Risk of fracture around implant (1% to 3%)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Later risk of loosening of the prosthesis (2% to 10%)</strong></td>
</tr>
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<td></td>
<td><strong>Later risk of acetabular wear (4% to 20%)</strong></td>
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</tbody>
</table>
Timing of surgery. In an undisplaced intracapsular fracture any delay from the time of the fracture until the operation will not influence healing provided that the fracture does not displace. In displaced fractures, a delay of more than one week will generally make closed reduction impossible and if preservation of the femoral head is essential, open reduction, possibly supplemented by a pedicle bone graft to the neck or an osteotomy, should be planned. The consequences of shorter delays in operation as regards the overall state of the patient are contentious. There is possibly a progressive increase in the risk of complications in fracture healing with time from the injury, and a delay of even a few hours may perhaps be detrimental. At present this is an area in which firm conclusions cannot be made.

Clinical studies have indicated that surgery should preferably be undertaken within 48 hours of injury, in order to lessen the risk of the complications of recumbency. If internal fixation is being undertaken for a displaced intracapsular fracture it should be within this period and for young patients even less delay is desirable.

Femoral head tamponade. After an intracapsular fracture, bleeding from the site of the fracture may be confined within the joint capsule. The pressure of this haematoma may rise to such an extent that it impedes blood flow in the femoral head with consequent ischaemic damage. Pressures as high as 320 mmHg have been reported for undisplaced fractures when the joint capsule is intact. In displaced fractures the capsule may be torn thereby decompressing the injury.

Decompression of the haematoma by needle aspiration or capsulotomy has been shown to reduce intracapsular pressures and improve blood flow in the femoral head as assessed by scintimetry. Because of the small numbers of patients in these studies the authors were not able to demonstrate that aspiration of the hip leads to a reduction in the incidence of complications in healing. It can be argued that routine aspiration of the hip at the time of internal fixation is worthwhile, but at present there is insufficient evidence to justify capsulotomy.

Internal fixation. This allows the patient to retain their own femoral head. The operation is normally shorter since the fracture is generally reduced closed, and the implant may be inserted percutaneously. Noteworthy improvements in the results of internal fixation have occurred in the last 20 years with better radiography, understanding of the reduction of the fracture and positioning of the implant.

Many different implants have been devised, most consisting of either screws or pins, possibly supplemented by a side plate. Valid comparisons between implants can only be made within the context of randomised trials because of the differences in the selection of patients within case series. A summary of these studies indicates that screws seem to be better than pins. The sliding hip screw has a similar incidence of complications in healing to that of multiple parallel screws, but requires a more extensive surgical procedure to insert. There is no firm evidence to indicate which design of screw is preferable, or if two, three or more screws are best.

For displaced fractures closed reduction is recommended. At present there is inadequate evidence to justify open reduction, which is only indicated when a satisfactory position cannot be obtained by closed means. Closed reduction is achieved, using the fracture table and an x-ray image intensifier, by first applying gentle longitudinal traction while screening in the anteroposterior view. After this the fracture is reduced further by internal rotation of the foot, while screening in the lateral view. This is the most important component of reduction of the fracture and full internal rotation is often necessary. The aim should be to achieve an anatomical or slight valgus position of the femoral head on the anteroposterior view. A varus position must be avoided. On the lateral radiograph, the femoral head, neck, trochanteric region and shaft should lie in a straight line.

The lower screw should be placed just superior to the calcar, with the tip in the subchondral bone close to the joint line. This gives a three-point fixation of the femoral head, calcar and the lateral cortical bone. The second screw is placed centrally on the anteroposterior view and touching the inferior cortical bone of the calcar on the lateral radiograph. If a third screw is used, as is customary in the United Kingdom, it is probably best placed centrally on both views. After operation, mobilisation should be unrestricted, although for the younger patient, aged less than 50 to 65 years, in whom preservation of the femoral head is paramount, a period of partial weight-bearing may be advised, until the fracture shows radiological evidence of healing.

Arthroplasty. Three different types of arthroplasty are available, namely a unipolar hemiarthroplasty, a bipolar hemiarthroplasty or a total hip replacement. The arthroplasty may be fixed with cement. Comparison between different types is difficult except in randomised trials because of variation in the selection of patients, surgical technique, follow-up and in the reporting of outcomes.

The Moore and Thompson prostheses are the most extensively used hemiarthroplasties for which there are abundant reports of case series, but no adequate comparative or randomised studies. A bipolar hemiarthroplasty has the potential advantage of reducing the risk of acetabular wear for patients with a life expectancy of more than five years. For those aged over about 80 years, or who are inactive, the bipolar joint is probably of little benefit. This latter prosthesis has the disadvantage of being more expensive and although the rate of dislocation is similar to that for a unipolar hemiarthroplasty, closed reduction may not be possible.

Studies of total replacement arthroplasty for fractures of the hip have been restricted to younger, fitter patients. Both the rate of dislocation of about 11% and the long-term incidence of revision are higher than when the procedure has been used for osteoarthritis. The reason for this may be the greater range of hip movement and impaired structure of the bone in patients with fracture of the hip com-
pared with those with osteoarthritis. Until further evidence is available total hip replacement should be reserved for fractures associated with osteoarthritis of the hip, pathological fractures with acetabular involvement and for revision after complications following operation for fractures.

Should cement be used when performing prosthetic treatment? It gives rigid fixation of the prosthesis, with less pain in the early postoperative period, and in the long term a reduced rate of revision because of loosening. The operation, however, is more prolonged and technically demanding, and there is a small risk of cardiovascular collapse occurring at the time of insertion of the cement. Until better evidence is available the decision whether to use cement must lie with the surgeon undertaking the operation.

The surgical approaches to the hip usually employed are through either the anterior or posterior capsule. The anterior approach has a lower risk of postoperative dislocation but a greater chance of fracture of the femur during operation when compared with the posterior approach. On balance, the anterior approach should be favoured. Repair of the joint capsule is recommended to reduce the risk of dislocation regardless of which approach is used.

In summary, hemiarthroplasty is the most appropriate prosthesis for most cases. It is not possible to give clear advice as to whether a cemented prosthesis should be used. A bipolar implant is only appropriate in those patients in whom long-term survival of more than five years is anticipated, and it should be cemented in place. Total hip replacement is still of unproven value after fracture of the hip and should be reserved for those specific situations discussed earlier.

**Conservative treatment.** The conservative management of undisplaced fractures has been discussed earlier. Occasionally, ‘no active treatment’ may be appropriate for dis-
placed intracapsular fractures in the very frail, elderly patient who is immobile and has a short life expectancy. Proper nursing care should be given with analgesia as required. Nonunion of the fracture is inevitable and this may cause considerable pain for some months after the injury; weight-bearing or walking is impossible. Therefore, even for the immobile patient, arthroplasty may still be appropriate to alleviate pain and to allow standing for transfers during nursing care.

Summary

The optimum choice of treatment for an intracapsular fracture cannot be based purely on the radiological appearance of the fracture and on the age of the patient. Although these are the main considerations many other factors need to be evaluated for each individual patient. Figure 1 gives a flow diagram which helps to aid decision in treatment.

The intracapsular fracture should not be thought of as the unsolved fracture. Internal fixation is indicated for selected fractures. Some require arthroplasty and for others either treatment can be used. The clinician must assess each of the individual risk factors for healing in each patient, and then decide if the risk of failure of internal fixation is high enough to justify replacing the femoral head with an arthroplasty.

References