



## Surgical dislocation of the adult hip

A TECHNIQUE WITH FULL ACCESS TO THE FEMORAL HEAD AND ACETABULUM WITHOUT THE RISK OF AVASCULAR NECROSIS

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**S**urgical dislocation of the hip is rarely undertaken. The potential danger to the vascularity of the femoral head has been emphasised, but there is little information as to how this danger can be avoided. We describe a technique for operative dislocation of the hip, based on detailed anatomical studies of the blood supply. It combines aspects of approaches which have been reported previously and consists of an anterior dislocation through a posterior approach with a 'trochanteric flip' osteotomy. The external rotator muscles are not divided and the medial femoral circumflex artery is protected by the intact obturator externus. We report our experience using this approach in 213 hips over a period of seven years and include 19 patients who underwent simultaneous intertrochanteric osteotomy. The perfusion of the femoral head was verified intraoperatively and, to date, none has subsequently developed avascular necrosis. There is little morbidity associated with the technique and it allows the treatment of a variety of conditions, which may not respond well to other methods including arthroscopy. Surgical dislocation gives new insight into the pathogenesis of some hip disorders and the possibility of preserving the hip with techniques such as transplantation of cartilage.

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In his description of the detailed anatomy of the blood supply to the skeleton and spinal cord, Crock<sup>1</sup> states that: "Theoretically a method is required by which the human hip joint can be dislocated atraumatically in the early phases of disease so that the blood supply of the upper end

of the femur can be preserved. This would open the way for the use of new methods of surface replacement of articular cartilage based on developments in tissue culture and molecular biology. Rather than relying on prosthetic replacement of the hip to treat significant intra-articular pathology, a treatment philosophy based on biologic and physiologic principles could be more routinely used."

Surgical dislocation of the hip is rarely undertaken for reasons other than arthroplasty. Its use has been reported in the treatment of rheumatoid synovitis,<sup>2,3</sup> synovial chondromatosis,<sup>4</sup> pigmented villonodular synovitis,<sup>5</sup> labral tears<sup>6</sup> and in joint debridement.<sup>7-10</sup>

It can be carried out through an anterior, lateral or posterior approach. Epstein<sup>11,12</sup> favoured primary open reduction by the posterior approach for traumatic dislocations. After incising the short external rotators, and releasing the gluteus medius muscle at the greater trochanter, if needed, he reported an incidence of avascular necrosis of 5.3%, as opposed to 18% with the anterior approach. He argued that the latter approach should not be used, since ligation of the ascending branch of the lateral circumflex artery risks further "embarrassment to whatever blood supply remains to the femoral head".<sup>11-13</sup>

Trueta and Harrison<sup>14</sup> showed that there is little or no blood supply to the femoral epiphysis from the lateral femoral circumflex artery, which we have confirmed in our anatomical study.<sup>15</sup> In the treatment of Pipkin fractures, Swionkowski et al<sup>16</sup> compared the anterior and posterior approaches with regard to the blood supply of the femoral head and concluded that with the anterior approach there was no iatrogenic avascular necrosis, a shorter operating time, less estimated blood loss, and better visualisation of the femoral head. There was, however, an increased incidence of heterotopic ossification.

We describe our technique for surgical dislocation of the hip, which is based on detailed studies of the vascular anatomy of the hip.<sup>15</sup> We have used it routinely since 1992 and now report our experience in 213 cases. In no case did avascular necrosis develop postoperatively.

### Patients and Methods

**Surgical principles.** The blood supply to the femoral head is mainly from the deep branch of the medial femoral

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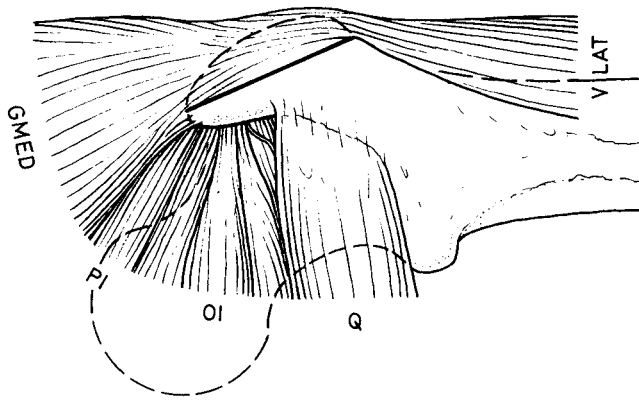


Fig. 1

Diagram showing the line of trochanteric osteotomy for the trochanteric flip. Proximally, the osteotomy exits just anterior to the most posterior insertion of gluteus medius. Distally, the entire origin of vastus lateralis remains on the trochanteric fragment (GMED, gluteus medius; PI, piriformis; OI, obturator internus; Q, quadratus femoris; VLAT, vastus lateralis).

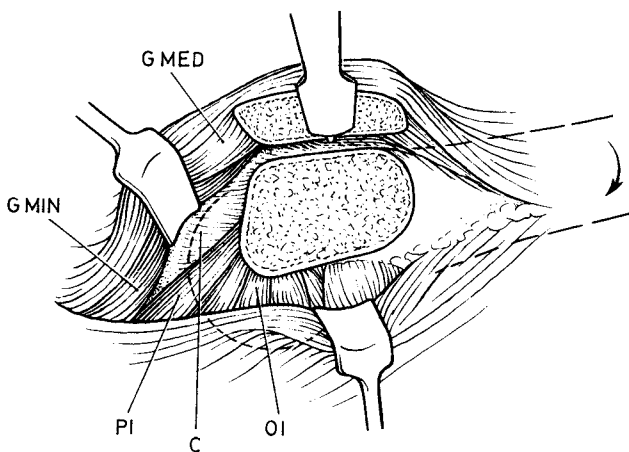


Fig. 2

Diagram showing that in slight flexion and external rotation of the femur (arrow) the trochanteric fragment, including the tendon of gluteus minimus, is flipped over anteriorly. The interval between gluteus minimus and the tendon of piriformis is then developed and gluteus minimus retracted superiorly to expose the capsule (GMIN, gluteus minimus; C, capsule; GMED, gluteus medius; PI, piriformis; OI, obturator internus).

circumflex artery (MFCA).<sup>14,17</sup> During dislocation of the hip, this vessel is protected by the intact obturator externus muscle.<sup>15</sup> Using a trochanteric flip approach<sup>18-20</sup> the hip can be exposed anteriorly, subluxated and dislocated in the same direction, if required, while respecting the integrity of the external rotator muscles. This allows a gap of up to 11 cm between the head and the acetabulum, giving a view of the femoral head of about 360° and a full 360° view of the acetabulum.

**Operative technique.** In the lateral decubitus position, a Kocher-Langenbeck incision<sup>21</sup> is made and the fascia lata split accordingly. A similar exposure is possible with the Gibson approach<sup>22</sup> with posterior retraction of gluteus max-

imus. The leg is then internally rotated and the posterior border of gluteus medius identified. No attempt is made to mobilise gluteus medius or to visualise the tendon of piriformis. An incision is made from the posterosuperior edge of the greater trochanter extending distally to the posterior border of the ridge of vastus lateralis. A trochanteric osteotomy with a maximal thickness of about 1.5 cm is made along this line with an oscillating saw. At its proximal limit, the osteotomy should exit just anterior to the most posterior insertion of gluteus medius (Fig. 1). This preserves and protects the profundus branch of the MFCA, which becomes intracapsular at the level of the superior gemellus muscle.<sup>15</sup>

The greater trochanteric fragment is mobilised anteriorly with its attached vastus lateralis after releasing it along its posterior border to about the middle of the tendon of gluteus maximus. The most posterior fibres of gluteus medius are also released from the remaining trochanteric base. The osteotomy is correct when only part of the fibres of the tendon of piriformis has to be released from the trochanteric fragment for its further mobilisation. With the leg flexed and slightly rotated externally vastus lateralis and intermedius are elevated from the lateral and anterior aspects of the proximal femur. The tendon of piriformis becomes visible by careful anterosuperior retraction of the posterior border of gluteus medius. The inferior border of gluteus minimus is separated from the relaxed piriformis and underlying capsule (Fig. 2). The constant anastomosis between the inferior gluteal artery and MFCA, which runs along the distal border of the piriformis muscle and tendon, is preserved.<sup>15</sup> Care has to be taken to avoid injury to the sciatic nerve, which passes inferior to the piriformis muscle and its insertion into the greater trochanter should be released to avoid stretching the branches of the nerve during dislocation. The entire flap, including gluteus minimus, is retracted anteriorly and superiorly to expose the superior capsule. This is facilitated by further flexion and external rotation of the hip. The anterior, superior and posterosuperior capsule can now be visualised (Fig. 3).

The capsule is first incised anterolaterally along the long axis of the femoral neck since incision in this area avoids injury to the deep branch of the MFCA. An antero-inferior capsular incision is made. The capsulotomy must remain anterior to the lesser trochanter in order to avoid damage to the main branch of the MFCA, which lies just superior and posterior to the lesser trochanter. Elevation of the antero-inferior flap allows visualisation of the labrum. The first capsular incision is then extended towards the acetabular rim where it is sharply turned posteriorly parallel to the labrum reaching the retracted tendon of piriformis. Care must be taken not to damage the labrum.

The hip can now be dislocated; the leg is flexed, externally rotated, brought over the front of the operating table, and placed in a sterile bag (Fig. 4) allowing inspection of

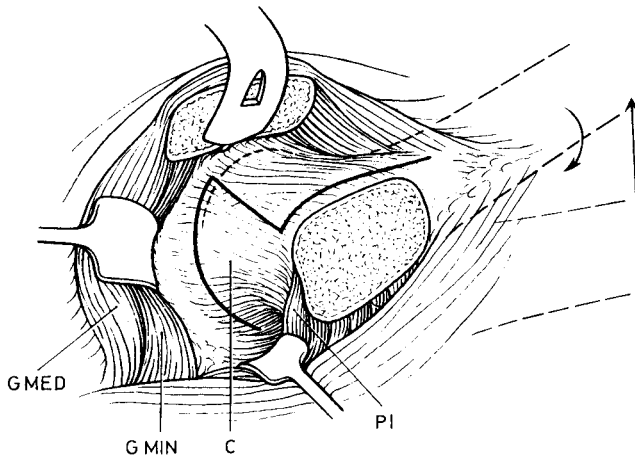


Fig. 3

Diagram showing that for the Z-shaped capsulotomy the femur is flexed and externally rotated further (arrows). All external rotators are left intact.

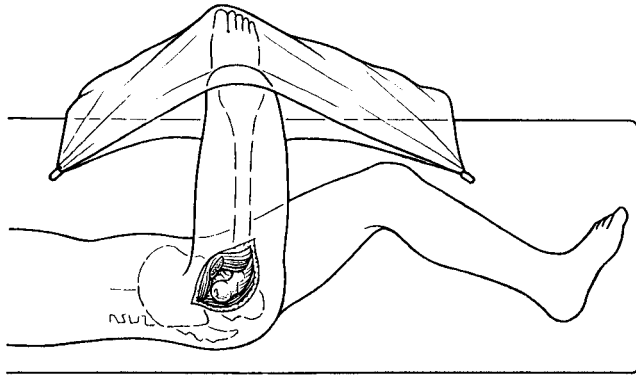


Fig. 4

Diagram showing that for subluxation and dislocation of the femoral head the hip is flexed, externally rotated and the leg brought over the front of the operating table and placed in a sterile bag.

most of the acetabulum. Therapeutic procedures to the acetabulum are difficult and, if required, the anterior dislocation is completed after the ligamentum teres is either torn by further external rotation, or incised. The stump of the ligament remaining on the femoral head may be resected. The foveolar artery, which is frequently patent in the ligamentum teres, is not an important source of blood supply to the femoral head.<sup>17,23</sup> By manipulating the leg, the surgeon now has 360° access to the acetabulum and of nearly 360° to the femoral head (Fig. 5). In hips with scarring from previous surgery or from trauma, it is advisable to inspect the sciatic nerve and free it from adhesions before completing the dislocation.

For a complete inspection of the acetabulum three retractors are used (Fig. 5). The knee is elevated with an assistant applying axial pressure to bring the femoral head posterior to the acetabulum. No retractors are needed for visualisation of the femoral head, the knee being merely lowered to allow the head to rise out of the surgical wound. For its most posterior aspect a blunt Hohmann retractor around the

neck may be useful. The retinaculum protecting the terminal branches of the MFCA to the femoral head is clearly visible on the posterosuperior aspect of the neck as a mobile layer of connective tissue.

The labrum is inspected and probed, and the articular surfaces of the femoral head and acetabulum examined. The hip may be relocated and put through a full range of movement in order to visualise areas of impingement. Available therapeutic options at this stage range from debridement to total hip arthroplasty. The technique may also be used in the treatment of some fractures of the femoral head and acetabulum and is our routine approach for complex revision hip arthroplasty.

A 2.0 mm drill hole made in the dislocated femoral head can document the preservation of its blood supply.<sup>24</sup> Bleeding of the surfaces of the cancellous bone after trimming osteophytes on the periphery of the head are further signs of satisfactory vascularity. A more dynamic profile of perfusion of the femoral head can be obtained during surgery using laser Doppler flowmetry.<sup>23</sup> During the exposure the articular cartilage is constantly irrigated with Ringer lactate solution to prevent drying and alteration in its morphology.<sup>25</sup> Reduction of the hip may easily be accompanied by manual traction on the flexed knee and internal rotation. The capsule of the hip can be repaired, but not tightened since this may create tension on the retinacular vessels leading to a drop in the perfusion of the femoral head, as we have demonstrated.<sup>23</sup> The greater trochanter is reattached using two or three 3.5 mm cortical screws or cerclage wire. When an intertrochanteric osteotomy is undertaken the trochanteric fragment is transfixed by the

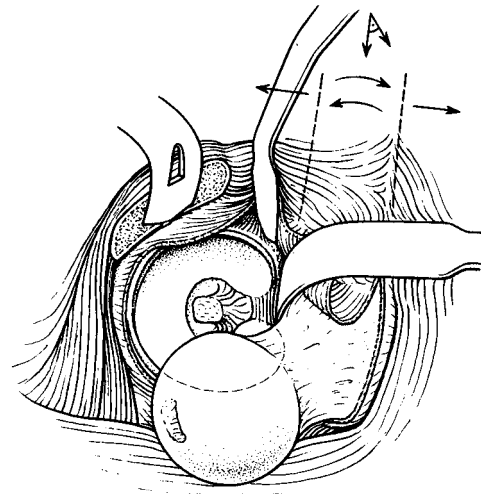


Fig. 5

Diagram showing that for inspection of the acetabulum one retractor is impacted above the acetabulum. One retractor hooks on the anterior rim and a third retractor levers the calcar of the neck against the incisura acetabuli. For inspection of the femoral head no retractors are needed, the knee is lowered and with rotation of the leg (arrows) different surfaces of the head can be visualised.

blade of the fixation plate. Prophylaxis against heterotopic ossification is not routinely used.

The mean length of stay after surgery was five days (3 to 9). There was no special postoperative management apart from self-administered subcutaneous low-dose heparin for eight weeks. The standard rehabilitation programme starting after the first review at eight weeks, included a self-administered abductor protocol. Bicycling and swimming were also recommended.

## Results

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Between 1992 and February 1999 we carried out 213 surgical dislocations of the hip. The indications for treatment were anterior impingement resulting from anterior hypertrophy, an idiopathic non-spherical femoral head or an insufficiently narrowed head-neck junction (164), similar problems produced by the sequelae of epiphysiolysis for Perthes' disease (24), impingement after an acetabular re-orientation osteotomy (15),<sup>26</sup> and other conditions such as pigmented villonodular synovitis, synovial chondromatosis or cartilaginous exostosis (10). We excluded hips in which surgery was converted to a total hip replacement as were those in which the dislocation was carried out in the presence of avascular necrosis of the femoral head. In none of the hips had there been an earlier traumatic or iatrogenic dislocation.

There were 109 women and 104 men with a mean age of 33.5 years (16 to 58). Treatment consisted mainly of joint debridement and improvement of the anterior head-neck offset to achieve clearance, especially in flexion and internal rotation. In 24 hips an intertrochanteric osteotomy was undertaken in addition to the debridement.

The operating time from skin incision to dislocation ranged from 25 to 40 minutes and the mean blood loss was 300 ml. The trochanteric osteotomy usually healed within eight weeks. At follow-up, in hips without intertrochanteric osteotomy the abductor force usually reached M4 and in most it was M5 four to six weeks later after a self-training protocol for the abductor muscles. Protracted rehabilitation of gluteus medius was not related to preoperative weakness, since four patients with preoperative M4 recovered satisfactorily to M5, but to the persistence of considerable pain in 11 hips after operation. There was no hip with permanent weakness of the abductor muscles which we could attribute to the approach, although all those with an additional intertrochanteric osteotomy only recovered normal abductor strength after removal of the osteotomy plate.

In this report of the operative technique no attempt has been made to analyse postoperative pain and return of movement of the hip. Both of these are primarily affected by the underlying disease and the different therapeutic procedures carried out after dislocation of the hip. Most patients, however, had improved movement of the hip and decreased pain and there was no increase in pain or stiffness which could be related to the approach.

The follow-up period ranged from a minimum of two to more than seven years and 30 hips were followed for more than three years. Clinical and radiological examinations were carried out at eight weeks, one year, and every other year thereafter. Standard anteroposterior (AP) and lateral radiographs were obtained at each examination.

We have found no clinical or radiological evidence of avascular necrosis or of changes in the bony architecture of the femoral head, suggestive of necrosis. There have been no postoperative infections.

**Complications.** In two patients a partial neurapraxia of the sciatic nerve was diagnosed after operation; both resolved within six months without residual sequelae. These patients had had previous surgery and scarring around the nerve may have contributed to intraoperative traction or compression of the nerve.

Trochanteric fixation failed in three patients, requiring a second operation.

Heterotopic ossification was seen in 79 hips at follow-up at one year with an overall incidence of 37%. When subdivided according to the classification of Brooker et al<sup>27</sup> 68 were grade I, nine were grade II and two were grade III. The commonest site of ectopic bone formation was at the tip of the greater trochanter. The two hips with grade-III ossification also had formation of new bone at the acetabular rim which caused loss of movement. Both patients had an improved range of movement after excision of the ectopic bone. The incidence of heterotopic ossification decreased as we gained experience of the technique.

Seven patients had a 'saddleback deformity' of the subcutaneous fat due to insufficiency of the subcutaneous sutures at the posterior aspect of the Kocher-Langenbeck incision. Six of these were women and five requested plastic surgery to improve the cosmetic appearance. We have recently modified the Kocher-Langenbeck approach<sup>21</sup> to a more straight Gibson approach<sup>22</sup> in this group at risk, namely women with weak subcutaneous tissue. Although the incision is extended more proximally, the modified approach has helped to minimise this complication.

## Discussion

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The importance of being familiar with the technique of surgical dislocation of the hip for both the diagnosis and treatment of intracapsular pathology is reinforced when considering alternatives to this procedure. The ability to diagnose acetabular labral damage and injury to the articular cartilage of the femoral head and acetabulum is currently limited by the available imaging techniques. Lesions of the anterosuperior acetabulum are often missed, and can only be seen during the operation. We have recently developed new techniques of MRI arthrography, which enable many of these lesions to be assessed better before operation.<sup>28</sup> Nevertheless, extensive labral tears and associated cartilage damage, with its frequent separation from subchondral bone, are difficult to assess. Understanding the

exact underlying pathology without surgical dislocation may be difficult.

Using an anterior (Smith-Petersen) approach the femoral head can be dislocated safely, but inspection of the acetabulum is limited, unless the tensor fascia lata and gluteus medius are extensively detached from their origins. Reattachment and rehabilitation of these muscles are associated with considerable morbidity. Anterolateral and direct lateral approaches<sup>29,30</sup> may allow dislocation of the femoral head, but again exposure of the acetabulum is difficult and incomplete. With the posterior approach, tenomyotomy of the external rotator muscles is necessary, which interrupts the anastomosis between the inferior gluteal artery and the deep branch of the MFCA. The deep branch itself may also be vulnerable,<sup>15</sup> although there have been no cases of avascular necrosis reported after a resurfacing procedure using this approach.<sup>31</sup> Stable reattachment of the external rotator muscles may also be difficult. A classic trochanteric osteotomy or use of the V-shaped myofascial flap<sup>32</sup> allows easy dislocation without detaching the external rotator muscles. Both offer an excellent view of the femoral head and acetabulum. Trochanteric osteotomy requires more care in regard to union, since there is no balancing of the force of gluteus medius by vastus lateralis; the myofascial flap approach needs special attention until the resutured soft tissues have healed.

The omega lateral approach<sup>33</sup> is designed to preserve the functional continuity between gluteus medius and vastus lateralis and offers a similar exposure to the approach described here. It has the advantage that no fixation device is needed for reattachment of the muscle unit, but the presutured strong posterior portion of gluteus medius is at a higher risk during postoperative hip movement than is screw fixation of the greater trochanter. All approaches which leave the greater trochanter intact are associated with greater difficulty in separating and mobilising gluteus minimus from its attachments to the capsule, since the tip of the trochanter overlies the most critical part of its insertion.

Avascular necrosis of the femoral head is the most significant complication of dislocation of the hip. After traumatic dislocation, it is the result of an extraosseous, and probably extracapsular, injury to the nutrient vessels.<sup>34</sup> Its development is also dependent on the severity of the injury to the hip<sup>11</sup> and the duration of the dislocation.<sup>35</sup> Traumatic posterior dislocations have a higher incidence of avascular necrosis than anterior dislocations.<sup>11,35</sup> Surgical dislocation as described here produces an anterior dislocation using low-grade controlled trauma. The time of dislocation is much shorter than the six-hour limit which is thought to be critical after traumatic dislocations.<sup>36</sup> All external rotator muscles are left intact and, therefore, protect the MFCA.<sup>15</sup> Intraoperative monitoring of perfusion of the femoral head is possible. Although it may be argued that bleeding from a drill hole in the femoral head after dislocation does not exclude the possibility of subsequent avascular necrosis, a high correlation has been shown between this and the

presence of a viable head in a study on fractures of the femoral neck.<sup>24</sup> More recently, we have used laser Doppler flowmetry with a probe placed in the superior aspect of the head to monitor the perfusion throughout the procedure. The findings in 32 hips, which are subject of a separate publication,<sup>23</sup> show that there are dynamic changes in perfusion throughout the procedure, but that the oscillations of the perfusion return to initial values soon after the head is reduced and the leg brought to a normal position.

The most useful postoperative assessment of the perfusion of the head would be by MRI, but this method is hardly applicable for routine screening. In the four hips in which it was used to re-evaluate the hip in patients with persistent symptoms, it did not show intraosseous changes suggestive of necrosis. Using standard radiographs, necrosis of the femoral head is usually evident within one year, although after traumatic dislocations it may develop as late as two to five years after injury.<sup>37</sup> To date, with a follow-up period of two to seven years, we have not observed the development of radiologically evident necrosis or corresponding changes of the bony structure.

There are concerns about the long-term sequelae of dividing the ligamentum teres, which has nerve endings similar to the cruciate ligaments of the knee.<sup>38</sup> Although we did not detect any adverse effects, we are aware of the potential loss of proprioception. We try therefore to undertake therapeutic procedures with subluxation rather than dislocation.

Although some investigators have reported good results using arthroscopy of the hip in the diagnosis and treatment of intra-articular pathology such as labral tears, loose bodies, and early osteoarthritis,<sup>6,39-43</sup> the technique is difficult. Simultaneous assessment of movement of the hip and debridement is not possible. Furthermore, complications such as nerve traction palsies, foot or perineal pressure sores, and iatrogenic damage to the articular cartilage of the joint<sup>41</sup> have limited the acceptance and use of this procedure.

The technique of surgical dislocation presented in our study allows visualisation of the femoral head of almost 360° and complete access to the acetabulum. With more experience, subluxation of the head, preserving the round ligament, is sufficient for many pathological conditions. By surgically dislocating the hip using the technique described, intra-articular surgery can be carried out safely, without the limitations and difficulties inherent in hip arthroscopy or arthrotomy without dislocation. Iatrogenic injury to the cartilaginous surfaces of the femoral head and acetabulum is minimised. More importantly, surgical dislocation is a technique which in the future may allow the possibility of preserving the hip by, for instance cartilage transplantation.

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