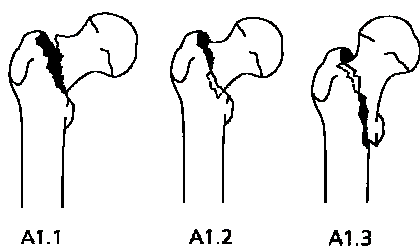




Dynamic hip screw (DHS) - Indications

A1 Fractures in the trochanter region, simple pertrochanteric



A1.1 Along the intertrochanteric line

A1.2 Through the greater trochanter

A1.3 Extending distal to the lesser trochanter minor

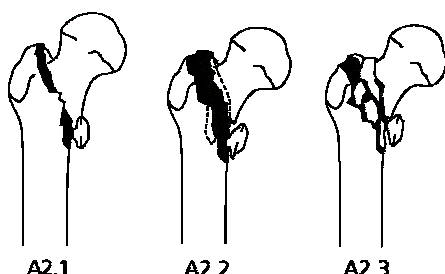
Group A1 includes simple two-fragment fractures.

Subgroup A1.1 includes fractures that end medially just above the lesser trochanter.

Subgroup A1.2 includes all two-fragment fractures with wedging of the calcar into the distal fragment.

Subgroup A1.3 comprises fractures in which the lesser trochanter is attached to the head and neck fragment.

A2 Fractures of the trochanter region, comminuted pertrochanteric



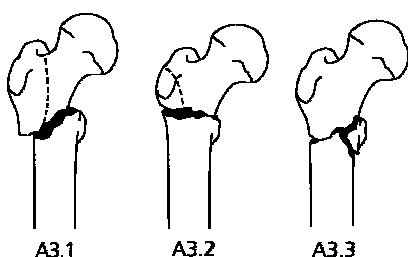
A2.1 With one intermediate fragment

A2.2 With several intermediate fragments

A2.3 Fracture extending more than 1 cm below the lesser trochanter

The A2 fractures extend over two or more planes of the medial cortex. They are classified according to the number of fragments and degree of comminution (AO type 31 – A2.2 and A2.3).

A3 Fractures of the trochanter region, intertrochanteric



A3.1 Simple, oblique

A3.2 Simple, transverse

A3.3 Comminuted

Fractures through the lateral cortex characterise group A3. There is often an undisplaced fracture separating the greater trochanter from the head and neck fragment.

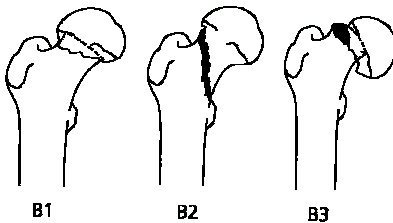
Fractures of subgroup A3.1, so-called reverse fractures, run from lateral and distal to medial and proximal to the lesser trochanter proximal des Trochanter minor.



Fractures of subgroup A3.2 are genuine intertrochanteric fractures.

Fractures of subgroup A3.3 are really A3.1 fractures with an additional fracture of the medial cortex including the lesser trochanter with variable extension into the subtrochanteric zone.
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B Femoral neck fractures



Femoral neck fractures are intra-articular in nature.

- B1 Subcapital fractures with minimal displacement
- B2 Transcervical fractures
- B3 Displaced subcapital fractures

The blood supply of the femoral head can be injured and different degrees of severity of avascular necrosis can develop depending on the position of the head fracture. Those forms are called stable subcapital, rarely transcervical fractures in which the head and neck connection is preserved by wedging (B1). In most transcervical fractures, partial contact between the fragments is preserved but a gap is visible in the cranial part of the fracture (B2). The third group includes all displaced subcapital fractures (B3). Fractures of this group have the worst prognosis.



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Operative preparation

Patient's informed consent

The following complications can occur with the DHS technique:

- Wound infection (incidence between 1.8 % and 4 % with deep and superficial infections).
- Haematoma and seroma (incidence about 4 %)
- Nerve injury (injuries of the femoral nerve and sciatic nerve are extremely rare).
- Thrombophlebitis, embolism.
- Reoperation (incidence between 2 % and 11 %, usually because of incorrect primary position of the implant or because of postoperative implant failure or migration).
- Pseudarthrosis in about 4 % and femoral head necrosis as a late complication in about 2 % of all cases. However, both complications are largely independent of the implant system.
- Limitation of hip movements (periarticular ossification).
- Implant removal after one to one and a half years at the earliest (usually not necessary in elderly patients).

Operative preparation

Diagnosis and operative planning using a radiograph of the pelvis and a lateral view of the injured hip. Preparation of the usually elderly patients (66.4 % are over 70 years) according to the usual rules, including laboratory tests, ECG and chest X-ray, internal medicine consultation if necessary. The operation can be performed on an extension table. Planning with preoperative sketches of the operation is recommended.

Instruments and implants

- Standard internal fixation instruments
- DHS/DCS basic instruments
- Kirschner wires 2.5 mm diameter(230 mm long)
- Various Hohmann retractors
- Implants



Anaesthesia

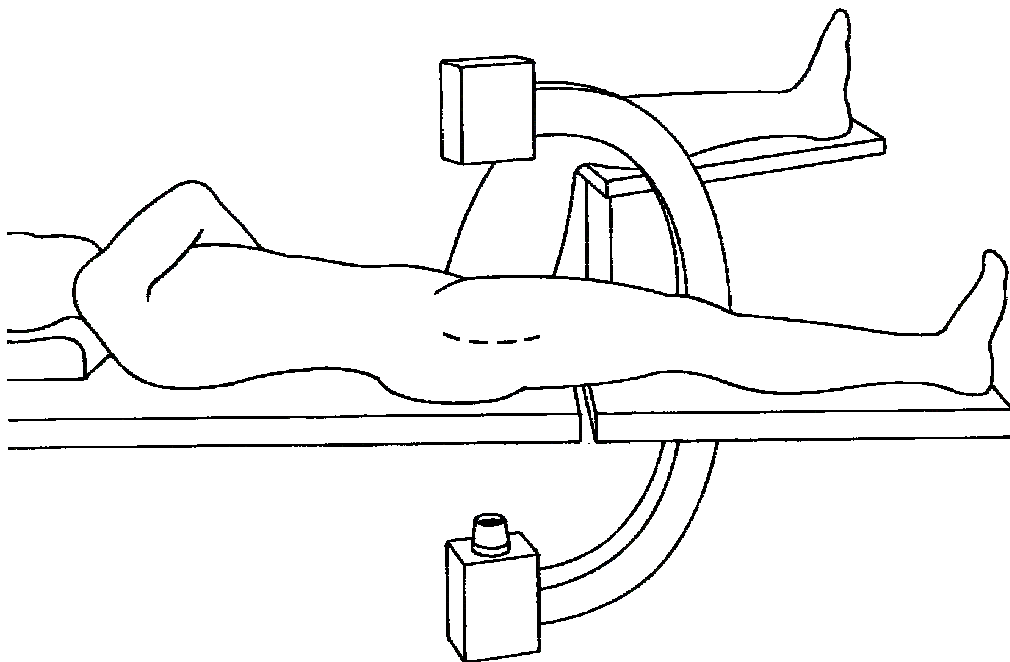
In the extensive AO patient documentation, general anaesthesia was employed in 40 % and epidural or spinal anaesthesia in 57 % of cases.

Positioning

Supine position: push the patient to the edge of the X-ray-permeable operating table with both legs on extension rails. Ensure that no excessive pressure or traction is exerted on any part of the body.

The fracture is reduced by traction, abduction and internal rotation prior to disinfecting the patient.

As intraoperative X-rays through the hip are required in both the a.p. and lateral planes, the surgeon must ensure before the operation that both views are possible and that the pictures are of acceptable quality.





DHS standard operative technique

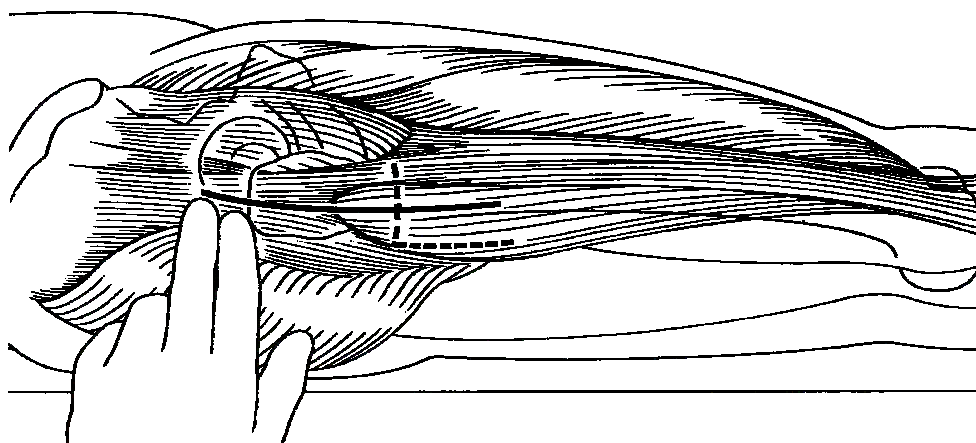
Draping

After disinfecting the skin drape the patient with adhesive U-film following the manufacturer's instructions.

The adhesive U-film allows free movement of the image intensifier and guarantees sterility throughout the entire operation.

Approach

Straight lateral skin incision about 15 cm long, beginning two finger breadths above the tip of the greater trochanter.



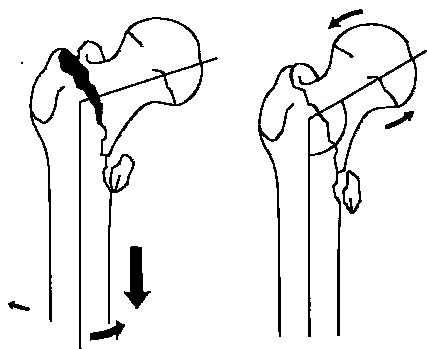
Split the iliotibial tract longitudinally from the tip of the trochanter distally.

Push the vastus lateralis muscle anteriorly, dividing it dorsally from the intermuscular membrane, if necessary cutting it slightly in the region of the innominate tubercle. Expose the proximal shaft of the femur with minimal elevation of the periosteum.

The alternative L-shaped division of about 1 to 1.5 cm of the vastus lateralis proximal to the femur is also possible but is more traumatic. Insert Hohmann retractors anteriorly in the region of the proximal femur.



DHS standard operative technique



Further reduction and temporary fixation

Reduce the fracture by flexion, longitudinal traction, abduction and internal rotation. Carry out initial fixation with Kirschner wires as described below. The position of these wires must not interfere with the correct placement of the DHS/DCS screw and the DHS plate.

Inserting the Kirschner wires

To fix the antetorsion of the femoral neck, a Kirschner wire is advanced anteriorly through the femoral neck. Using the corresponding DHS angled guide (No. 10.152.01) with T handle, the wire is hammered lightly into the femoral head. With unstable fractures, several Kirschner wires are inserted in the femoral head from lateral to medial for temporary stabilisation of the reduced (and valgusised) fragments. This allows an axial check with the image intensifier without loss of reduction. Before reaming the screw hole the Kirschner wires that lie in the probable radius of action of the DHS triple reamer are removed.

Determining the entry site of the DHS/DCS screw

The entry site depends on the position of the screw. Its angle can vary from 135° to 150° and can be located at a corresponding distance of 2.5 cm to about 6 cm from the innominate tubercle. Attach the DHS angled guide. If the bone is hard, the lateral cortex is drilled with the 2.0 mm diameter spiral drill and the DHS/DCS guide wire with threaded tip is inserted into the subchondral bone. The guide wire runs about 6 mm proximal to Adam's line in the postero-inferior quadrants of the femoral head. The thread at the tip of the guide wire prevents it from sliding out accidentally. The guide wire remains in place throughout the entire internal fixation.

A = 2.0 mm diameter wire to determine the angle of anteversion

B = 2.5 mm diameter guide wire with threaded tip

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Image intensifier control

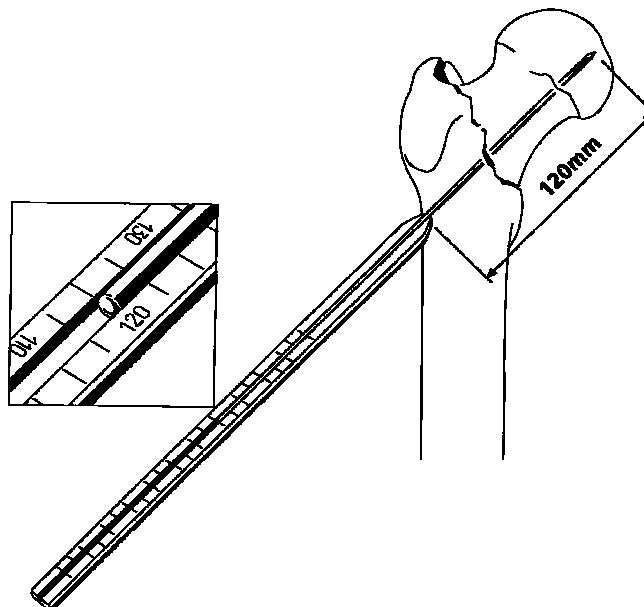
Check the position of the guide wire with the image intensifier in both the anteroposterior and mediolateral planes.

Measuring the length

Push the DHS/DCS measuring device (No. 10.100.01) over the guide wire. Read the length of the guide wire inserted in the bone directly (e.g. 120 mm).

Subtract 10 mm from the length measured with the DHS/DCS measuring device (No. 10.100.01), e.g. 120 mm - 10 mm = 110 mm and adjust the setting of the triple reamer to correspond.

Remove the antetorsion Kirschner wire as soon as the guide wire is placed correctly.





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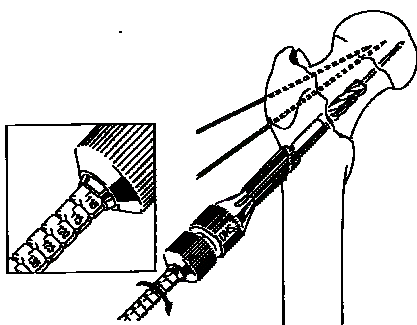




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Reaming with the DHS triple reamer



Attach the DHS triple reamer (No. 10.320.01).

The hole produced in one operation has three different diameters: one for the screw, one for the plate cylinder and one for the junction of plate and cylinder. The depth of drilling can be adjusted in 5 mm steps. The three elements of the DHS triple reamer are so designed that incorrect assembly is not possible.

Important:

In order to avoid unintentional rotation of the femoral head during reaming, secure temporary fixation of the femoral head with wires is strongly recommended.



Reinserting the guide wire:

If the guide wire is removed by accident, it is essential to insert it again. Otherwise, it is easy to place the DHS/DCS screw incorrectly, particularly in osteoporotic bone.

To reinsert the wire, the DHS/DCS centring sleeve (No. 10.340.01) is pushed into the drill hole and a DHS/DCS screw is placed backwards in the sleeve. The guide wire can now be placed in its original position again.

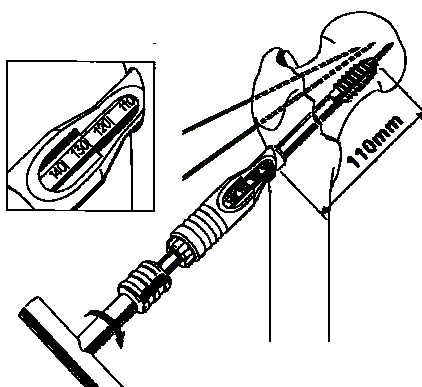


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Tapping the thread

Remove the DHS triple reamer. Attach the DHS/DCS centring sleeve (No. 10.340.01) to the DHS/DCS tap (No.10.315.05) and mount the handle (10.300.01) on the tap. Tap to the predetermined depth.



Caution:

Tap only in dense hard femoral bone. Do not tap in osteoporotic bone.





Inserting the DHS/DCS screw

Assembly:

In order to be able to screw in the DHS screw, the coupling screw (No. 10.350.01) must first be coupled with the inner thread of the DHS screw through the cylindrical guide shaft (No. 10.310.02). The cams and grooves on the guide shaft and DHS screw must engage correctly. The DHS screw is screwed into the femoral head together with the coupling screw with the long centring sleeve (No.10.340.02) over the DHS/DCS wrench (No. 10.310.01). When the zero marking in the window reaches the upper semicircular edge of the centring sleeve that points towards the femur, the end of the screw has reached the lateral cortex.

This means that the tip of the screw is still 10 mm from the joint. In osteoporotic bone the screw can be screwed in 5 mm further. The handle of the screw wrench must be parallel to the femoral shaft at the end of this procedure (vertical position).

Otherwise the DHS plate cannot be pushed over the screw.

The plate can be pushed over the laterally flattened shaft of the DHS/DCS screw only in this position. The DHS/DCS wrench must not be used for fracture reduction as it would not withstand these bending forces.





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Attaching the DHS plate and then impacting it

Loosen and remove the DHS/DCS centring sleeve (No. 10.340.02) and DHS/DCS wrench. Push the DHS plate onto the femoral shaft until it touches the lateral cortex.

Loosen the coupling screw (No. 10.350.01) and remove the cylindrical guide shaft (No. 10.310.02).

Remove the guide wire with a reverse motor.

Drive the plate into the prereamed channel with the DHS/DCS impactor (No. 10.330.01).

Screw the DHS plate to the femoral shaft.

Drill neutral holes through the plate holes with the universal drill guide (No. 10.502.45) and the 3.2 mm diameter spiral drill (No. 2.904.08).

Fix it with 4.5 mm cortical screws of appropriate length.

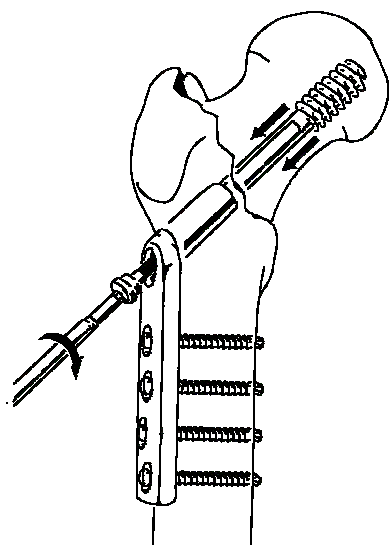






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DHS standard operative technique



Using the DHS/DCS compression screw

Compression of the fragments can also be achieved with DHS/DCS compression screws. Particular caution is needed with osteoporotic bone to prevent the DHS/DCS screw thread in the femoral head from coming out.

Wound closure

After a radiographic check of the result, suction drains are inserted in the region of the fracture and beneath the fascia. Irrigate the wound liberally and reattach the vastus lateralis to the innominate tubercle. Closure of the vastus fascia is optional. Suture the fascia lata with interrupted sutures. Complete closure with interrupted subcutaneous sutures and a continuous nonabsorbable intracutaneous suture.

Postoperative treatment

Besides general measures such as thrombosis prophylaxis and breathing exercises, place the leg in a padded splint with the foot of the bed raised. Place padding under the knee. Do not use compression bandages but check the suction drains regularly and remove them 48 hours after the operation at the latest.

Commence isometric exercises, tensing the quadriceps muscles and the small gluteal muscles and flexion and extension of the foot immediately.

Commence weight-bearing from the second postoperative day with a walking frame and with forearm crutches from the fourth postoperative day depending on the patient's condition. It is important that the patient increases loading as far as the pain threshold. Freedom from pain normally occurs after two to three weeks. With stable internal fixation, full weight-bearing can usually be achieved within six weeks. Routine radiographs after two, six and twelve weeks. Final review after twelve months. Implant removal after twelve months at the earliest. In elderly patients the implants are often not removed at all.



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Implant removal

After removing the DHS plate, the DHS/DCS wrench is secured to the end of the DHS/DCS screw with the coupling screw. The following should be noted in order to avoid damage to the instrument or implants: Never use the DHS/DCS wrench for integrated insertion technique and the coupling screw to remove the implant.

The DHS/DCS wrench and the coupling screw must fit the DHS/DCS screw precisely. Tighten the coupling screw firmly.

Surgical features

Before reaming the femoral neck, it is essential to check that the 2.5 mm diameter guide wire for the DHS/DCS with threaded tip is in correct position as there is only a limited possibility of subsequent correction. Kirschner wires inserted to aid reduction should be removed from the immediate vicinity of the triple reamer before reaming. When reaming, ensure that the triple reamer slides easily over the guide wire and that no bending forces are transmitted through the triple reamer to the guide wire (ensure that the weight of the motor is carried). Bending the guide wire can result in an incorrect position of the hole in the



lateral cortex and thus of the plate, which can lead to splitting of the greater trochanter when the plate is fixed. If the guide wire and triple reamer are bent, both the instrument and the guide wire can break. If the hole in the lateral cortex is not made with the correct angle it must be enlarged with a drill or rongeur so that the plate cylinder sits perfectly in order to prevent the lateral cortex from breaking. It is better if the plate cylinder has some play in the hole in the bone. If the guide wire becomes loose during reaming, it must immediately be inserted again carefully in the correct position.

The commonest mistakes are poor fracture reduction and incorrect position of the DHS/DCS screw, most often in the weak anterosuperior quadrants of the femoral head, with subsequent joint penetration, especially when the bone is osteoporotic.

Screwing in the screw repeatedly can lead to hollowing of the femoral head and unstable internal fixation. It should be noted that the screw makes up about 10% of the volume of the femoral head. Tightening the plate at the wrong angle leads to avulsion of the greater trochanter, which then has to be reattached (e.g. with the DHS trochanter stabilisation plate). If the guide wire is placed too close to the calcar, the subsequent reaming of Adam's line can destroy the medial support.