67 Femoral shaft injury

67.1 Introduction

It takes considerable force to fracture an adult femur, unless it is affected by infection, osteoporosis or tumour. Therefore, you should look for other injuries, particularly of the pelvis & hip (66.2), as well: palpate the buttocks & the trochanters.

A broken femur is severely painful, and bleeds considerably: count on a loss of >1L. The thigh becomes swollen and may be obviously deformed; there may be an open injury (either from soft tissue wounds, or the bone penetrating the skin). A gunshot wound can obviously easily shatter the bone, and disrupt the soft tissues. Walking is obviously impossible.

In a fall, with the foot anchored, a twisting force may produce a spiral fracture; a direct force may produce a transverse fracture (particularly common in motorcycle injuries).

The leg is often rotated externally (especially in proximal fractures) & may be shortened & deformed. The fracture may be in any part of the femur, though the middle $^1/_3$ is the most common site. There may be a separate triangular ("butterfly") fragment on one side. If there are 2 transverse fractures, the central portion of the femur may become ischaemic.

Follow the ABC routine for major injuries (41.1); you often need to transfuse blood, particularly if the fracture is comminuted. Careful splinting of the leg, for example with a Thomas splint, will minimize blood loss.

Always check the peripheral pulses, and distal sensation.

Take AP and lateral radiographs of the thigh, and of the pelvis & hip.

67.2 Shortening, distraction & rotation in femoral fracture

When the femur fractures, the fragments sometimes overlap, so that the leg becomes shorter. The importance of this depends on the age of the patient, and the degree of shortening.

An adult may have a difference in leg length up to 1.5cm without noticing it. He compensates for a leg ≤4cm shorter by tilting the pelvis. So, if there is already a shortening of 2cm, after a femoral fracture, there may be a leg length discrepancy of 3.5-4 cm. Differences in length >2cm may lead to prolonged back pain.

For a difference ≤1cm, put an inlay-sole in the shoe. For larger discrepancies, especially **if the leg is ≥4cm short or if the patient is symptomatic**, make the adjustment in the shoe sole itself. *Always raise the whole shoe, and not just the heel* to avoid *equinus* in the raised foot.

Distraction is much more serious than shortening, and although a fractured femur may unite even if the ends of the fragments do not touch, it will unite more quickly if they do. Sometimes, even 2mm of distraction between the bone ends will prevent union, *so make sure that nobody adds extra weights to the traction apparatus by mistake!*

N.B. Avoid rotational deformity at all costs, irrespective of the age of the patient. Traction usually corrects shortening, and avoids rotational deformity.

67.3 Perkins traction

Your aim in treating an adult femoral fracture should be to make the bone unite in a good position without the knee becoming stiff.

The indications for internal fixation are outlined already (58.6). Here we describe the classical conservative method, which still gives by far the best results in many complicated situations.

PERKINS TRACTION
Put a Steinmann pin through the upper end of the tibia, and apply enough traction to it to keep the fragments in place, to pull the leg to its normal length, and to correct any angulation or rotation.

Meanwhile, sit the patient up in bed, and start knee exercises as actively as possible, because controlled movement and compression of the bone ends encourages union.

Other advantages are:
(1) the knee does not become stiff,
(2) maintaining the tone of the *quadriceps* muscle,
(3) doing exercises means keeping fit,
(4) avoiding thrombosis and hypostatic pneumonia.

Perkins traction differs from extension traction where the leg is held straight; the patient does not sit up and exercise it.

Perkins traction uses the same simple equipment for all sizes of patient, it prevents knee stiffness more effectively than other methods, and it gives a patient a wide range of knee movement, which is important in societies where people squat. Excessive shortening is rare, and as soon as you can drop the end of the patient's bed, and the knee is being flexed, malrotation of the lower fragment is impossible.

Physiotherapy and nursing care are easy, and after a few days the patient can lift himself onto a bedpan. Most patients spend 6-8wks in traction, followed by 2wks, exercising their legs over the end of the bed, and then 2wks more on partial weight-bearing. They are out of hospital in 8-10wks with at least 90° of knee movement, and without noticing that the injured leg is 1-2cm shorter.

Also, importantly, if there is also a tibial fracture (70.1,2), you can treat whilst the femur is in traction.

INDICATIONS FOR PERKINS TRACTION

(a) In the pelvic region: vertical fractures of the pelvis with upward displacement of one fragment.

(b) In the hip region: undisplaced, incomplete fractures of the neck of the femur (67-1A), all intertrochanteric fractures (67-1B) and those subtrochanteric fractures in which the contraction of the iliopsoas has not flexed the upper fragment so much as to bring it seriously out of line with the shaft (67-1C)

(c)In the femoral shaft region: all adult femoral shaft fractures, including overlapped, double, spiral, comminuted and open fractures, and fractures with severe soft tissue injury (67-1D)

N.B. Perkins traction is particularly well suited to comminuted fractures.

(d) In the knee region: those supracondylar factures in which the lower fragment has not been too severely flexed by the contraction of gastrocnemius (67-1E) and all condylar fractures of the femur, except those in which a condyle has rotated completely (67-1F).

CONTRA-INDICATIONS TO PERKINS TRACTION

(a) In the hip region: All complete fractures of the femoral neck (67-1G), displacement of the proximal femoral epiphysis (67-1H), subtrochanteric fractures with severe flexion of the proximal fragment (67-1I)

(b) In the knee region: Supracondylar fractures with marked flexion of the distal fragment (67-1J), displacement of the distal femoral epiphysis (67-1K) and fractures of the condyles in which a fragment has rotated completely (67-1L)

(c) All children whose tibial epiphyses have not united: *the pin may damage the epiphyseal plate*.

(d) Arthritis or stiffness of the knee, which will make exercise impossible without moving the fragments excessively.

(e) Non-union treated by other methods.Perkins traction gives good results if you persist with it, and follow the details carefully. The secret of success is to start periods of 10-30mins active exercise several times a day from the 3rd day onwards. This early movement is critical. It is the callus formed during the 1st 10 days that determines the outcome. Most failures are due to not starting exercise early enough, or not doing it vigorously enough. Patients need to be coached into exercising their knees. If you have more than one such patient, let them do their exercises together, so that they can encourage one another. *Quadriceps* exercises by themselves *are not enough to achieve satisfactory union*.

Make sure all your team understand the principles of Perkins traction. Setting up and managing it are not difficult and medical assistants soon learn to manage it most competently.

EXERCISES IN THE 1st 10 DAYS ARE CRITICAL

There are several less satisfactory conservative alternatives to Perkins traction. They are:

(1) Böhler-Braun traction (70-10) takes longer to achieve union, and because it does not allow active knee exercises, the *quadriceps* atrophies, and the knee usually stiffens, unless it is carefully exercised daily. *Use Bohler-Braun traction only for extensively displaced supracondylar femur fractures*.

INDICATIONS & CONTRA-INDICATIONS TO PERKINS TRACTION

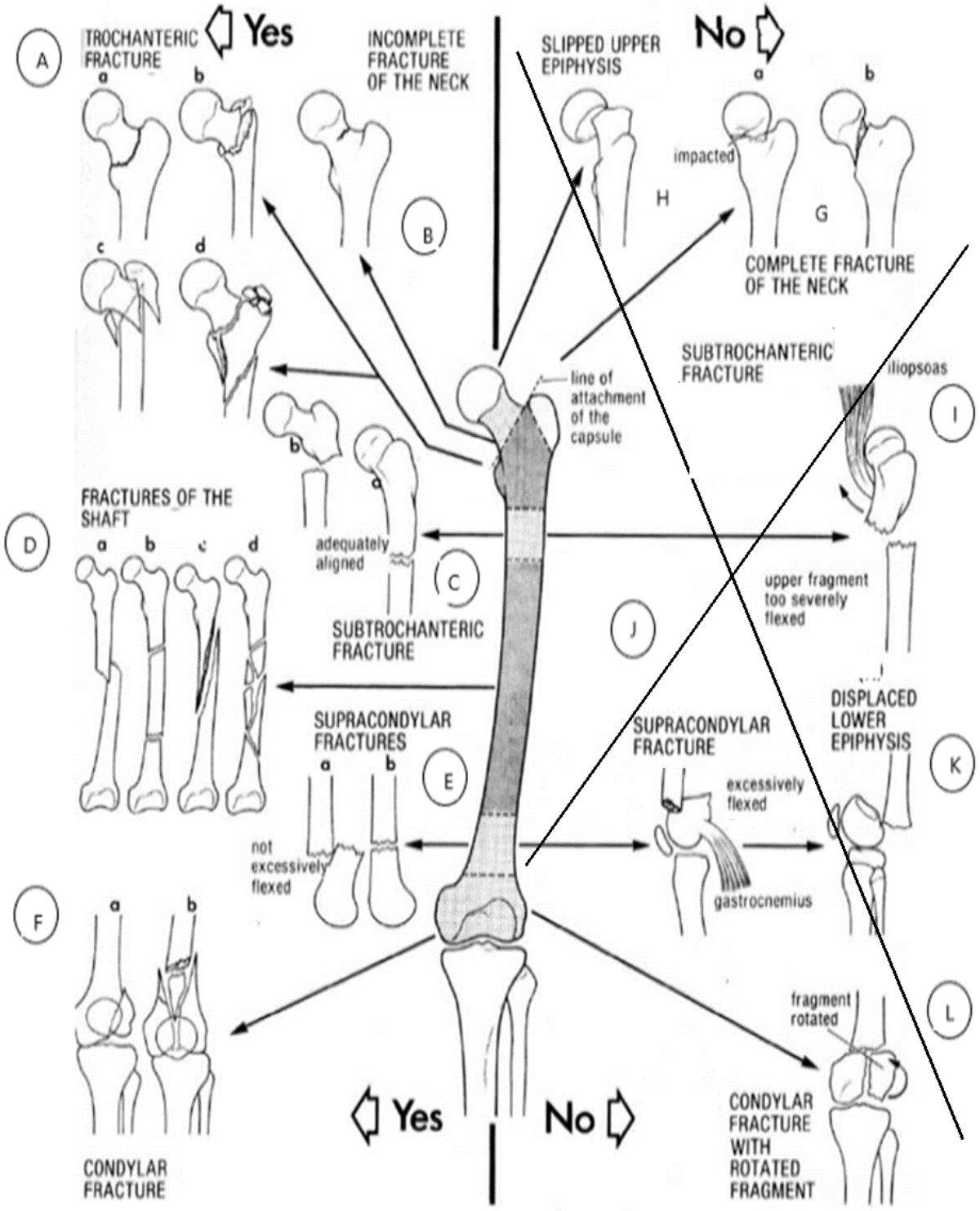

Fig. 67-1 Indications for Perkins traction: A, incomplete femoral neck fracture. B, inter-trochanteric fractures. C, subtrochanteric fractures. D, femoral shaft fractures. E, supracondylar fractures, not excessively flexed. F unrotated condylar fractures.
Contra-indications: G, complete femoral neck fractures H, slipped upper epiphysis. I, malaligned subtrochanteric fracture. J, flexed supracondylar fracture. K, displaced lower epiphysis. L, condylar fracture with a rotated fragment. *Kindly contributed by Peter Bewes & John Stewart*

(2) Thomas splints are excellent for first aid, and for treatment during the first few days, *but not for definitive treatment*. They too will stiffen the knee, and may cause pressure sores in the groin. They also make nursing more difficult.

(3) A hip spica results in prolonged disability and seriously stiffens an adult knee. It may also cause excessive shortening.
One disadvantage may be that Perkins traction lengthens a patient's stay in hospital, and increases the pressure on scarce beds.

CONVERTING A BED

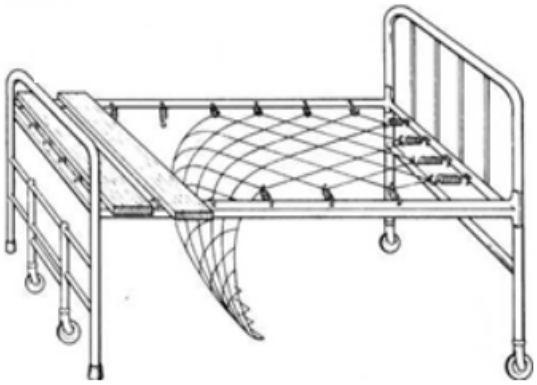

Fig. 67-2 CONVERTING AN ORDINARY BED for Perkins traction. *Kindly contributed by Peter Bewes.*

EQUIPMENT FOR PERKINS TRACTION
(1) An ordinary hospital bed from which the lower springs have been removed or tied back (67-2). You may have some broken beds you can use, and you may find it convenient to convert several beds for Perkins traction permanently. Ideally, these beds should have large castors so that you can wheel the bed to the X-ray department with traction *in situ*.
(2) Use a mattress in 2 parts, or let the lower $^1/_2$ hang down.
(3) Put fracture boards across the lower half of the bed.
(4) Blocks to raise the foot of the bed 25-50cm.
(5) A sharp, thick (4mm) Steinmann or Denham pin. Sharpen it on a grindstone regularly.
(6) Thomas pin mounts or a Bohler stirrup. *Don't use an unmodified Bohler stirrup*: it will rub on the skin, or the rope will get in the way of the skin, so convert it into 2 Thomas pin mounts by cutting and bending it (67-3C).
(7) Picture or orthopaedic traction cord.
(8) Weights of 2 & 5kg. These can be bags of sand, or bricks.
(9) A set of pulleys to fix to the foot of the bed. These are not essential, and the cords can, if necessary, pass directly over the rail at the end of the bed, preferably over a cylinder of old X-ray film rolled round the rail. If the lower rail is too low, consider reversing the bed, and using the rail at its head.

PERKINS TRACTION

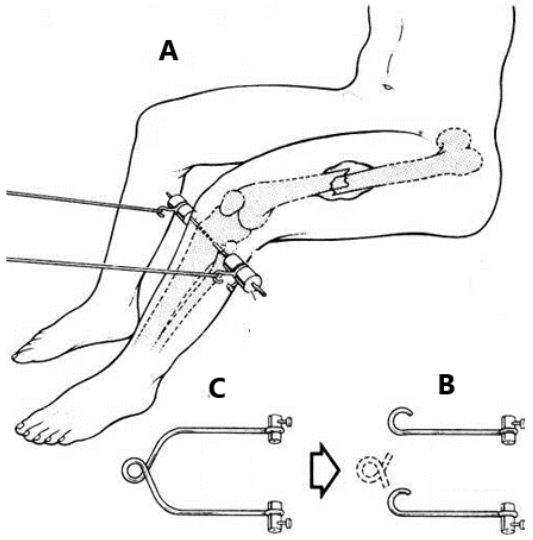

Fig. 67-3 Perkins traction. A, place a Steinmann pin perpendicular to the tibial shaft 3cm distal to the tibial tubercle. B, attach 2 Thomas pin mounts (better than C, Böhler stirrups, which you can cut in two if necessary)

INSERTING THE PIN Do this in the theatre, or in a treatment room off the ward, using LA (59-14,15).

INSERTING A TIBIAL PIN

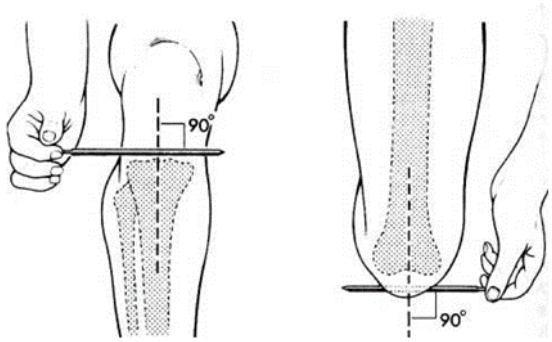

Fig. 67-4 INSERTING A TIBIAL PIN. Make sure the alignment is perpendicular (90^0) in both planes. *Kindly contributed by Peter Bewes.*

SETTING UP PERKINS TRACTION Apply weights to each end of the pin. Apply traction equal to $^1/_7$ the patient's weight. A man needs 10-14kg (5-7kg on each end of the nail) and a small woman perhaps only 7kg. Raise the foot of the bed 4cm/kg. You will find 25cm blocks useful. If possible, pass the cords over pulleys, and make sure they clear the toes.

CAUTION! The cords must pull equally on each end of the pin (59-14). Put a folded towel or small pillow under the fracture to give the femur the correct degree of anterior bow.

The movement of a pin in the bone promotes infection. So try to stop it moving, by using low friction swivels, and, if possible, a Denham pin which you can screw into the tibia, rather than a Steinmann pin. Another precaution is to *make sure that traction is applied equally and at right angles to the pin*. *Make sure the cords join through a pulley or a ring attached to the weight.*

Another way of preventing movement of the pin is to incorporate it in a below-knee cast. Watch carefully for pain, but only if the patient complains should you window the cast, and look at the skin round the pin. *Once a pin has become loose, a cast is useless.*

RADIOGRAPHS IN PERKINS TRACTION
The need for radiographs to adjust traction varies with the site of the fracture. *Don't remove the traction to get a picture!*

In a fracture of the proximal femoral 1/3, get a lateral radiograph while in traction. Face the X-ray tube into the inner thigh, with the cassette above the crest of the ilium. If the proximal fragment is sharply flexed, '90-90 traction' (67-5) will be more appropriate than Perkins traction.

90-90 TRACTION

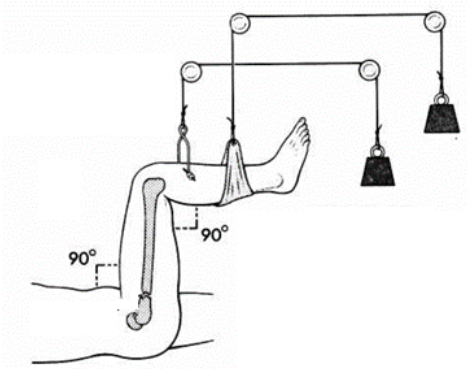

Fig. 67-5 90-90 TRACTION is ideal for subtrochanteric fractures.

In fractures of the distal 1/3, including supracondylar fractures, get a radiograph to make sure the distal fragment is not excessively flexed. If it is, see 68-14.

If the fracture is elsewhere in the femur, a lateral radiograph is not essential, but an AP one is useful to see excessive overlap persists, or the fracture is too distracted (there is a gap between the bone ends).

If you cannot get any radiographs, measure both the legs from the anterior superior iliac spines to the medial malleoli, to make sure are the same length (66-3).

If necessary, adjust the traction weights and the elevation of the foot of the bed, to let the bony fragments overlap c.1cm. *A little overlap is safer than a little distraction.* Overlap ≤2cm is acceptable.
Check the leg length daily for 2wks, and adjust the traction as necessary.
N.B. After 2wks, the fragments will have started to stick together so that further adjustment will be more difficult, and need more weight. After a month it may be impossible.

If the fracture is comminuted, a little overlap is even more important.

CAUTION! (1) *Don't apply excessive traction*, because bone ends far apart cannot unite. This is particularly important if there are multiple fragments. (2) Less traction is needed after the 1st 2wks, so reduce it as necessary.

MAINTAINING PERKINS TRACTION

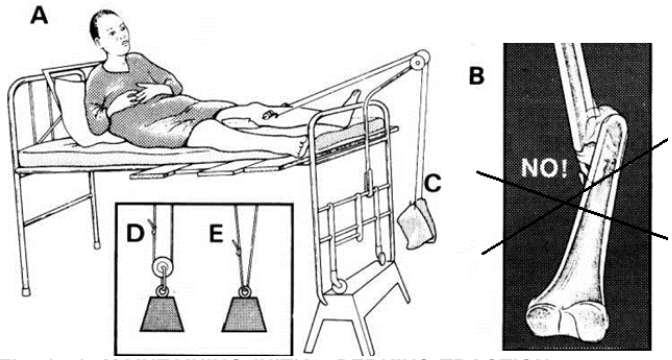

Fig. 67-6. MAINTAINING INITIAL PERKINS TRACTION. A,B,C, inadequate traction caused malunion: *entirely avoidable!* D, E types of weights & methods of hanging them. (You could also use water bottles filled to a specified volume) *Kindly contributed by Peter Bewes.*

EXERCISES
Start these as soon as possible, preferably by the 3rd day. Remove the fracture boards from the lower half of the bed, push down the mattress, and allow flexion of the knee. Replace the boards on completion of the exercises.

Encourage bending and straightening the knee. To begin with this will be painful. Minimize the pain by using a mild analgesic for the first few days, and hold the heel and allow flexion of the knee against resistance, then allow extension of the leg freely. Help is needed, but at the end of 1wk, unassisted flexion & extension should be possible. Give encouragement by explaining that the exercises will soon be painless.

To begin with allow exercises for 10-30mins at least three times a day. Encourage longer and more vigorous exercises of the leg each day, till ≥2h/day.

In fractures of the upper femoral $^{1}/_{3}$, a radiograph may be necessary to confirm adequate union. Elsewhere, they are not really necessary. Often, clinical union will seem well advanced, when there is only a mass of callus on the radiograph. Obtain images at 4, 6 & 12wks.

Follow a strict routine:
(1) Make sure your nurses understand that these regular periods of exercise are an important nursing routine.
(2) Check the leg length daily for 2weeks, and then weekly until union is complete. Reduce traction as necessary.
(3) Measure the legs soon after traction has been set up, and adjust it accordingly. Rotation will correct itself as soon as flexion of the knee reaches 90°.
(4) Check the knots daily.
(5) Each week, examine the fracture site for palpable callus, and look for the signs of union:
  (a) No tenderness over the fracture.
  (b) No fracture angulation possible.
  (c) Full flexion possible without support.

CAUTION! (1) *Don't test for union by asking to lift the straightened leg from the hip*, because this will angulate the fracture site.
(2) Resist the temptation to apply a cast in order to secure an early discharge.

ENCOURAGING LEG EXERCISES

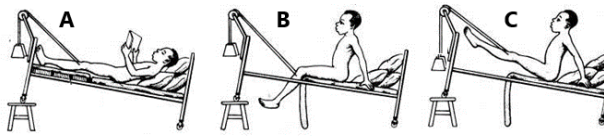

Fig. 67-7 ENCOURAGE LEG EXERCISES. This is the secret of successful Perkins traction. A, lying comfortably. B, flexing the knee when the lower part of the mattress is folded down. C, extending the leg using the weight to help. *Kindly contributed by Peter Bewes.*

Removing traction too early is worse than leaving it on too long. *Don't decide in advance, or fix a day to remove it*.
When there are definite signs of clinical union, usually at 6-10wks, remove the weights and continue exercises with the knees over the side of the bed, and the pin still in the tibia.
If you were right, and the femur has united, the range of movement will increase progressively.

If there is pain at the fracture site and the range of movement decreases, the femur is not yet adequately united. Put back the traction.

If pain or bowing of the femur occurs, keep traction longer, until the fracture is stable and the pain disappears.

If you are uncertain that union is satisfactory, continue traction, but with reduced weights.

If you are certain that union is far advanced, remove the pin, but keep the patient in bed for 2wks more and exercise the legs over the side of the bed. When flexion to 90° is possible, try to obtain further flexion in the prone position.

WEIGHT-BEARING AFTER PERKINS TRACTION
After 2wks of exercises without traction, examine the patient again. Get a radiograph without allowing weight-bearing (so use a wheelchair). If there is radiological union & the range of knee flexion is good, start protected weight-bearing with crutches (66-1).
Start by allowing the leg on the ground only to provide balance.

CAUTION! Help the patient out of bed carefully. If union is weak, the leg may re-fracture as soon as walking starts!

If there Is no radiographic callus at 4wks, suspect delayed union. Check to make sure that: (1) there is no distraction (if so, reduce the weights), (2) there are no fragments of avascular bone (if so, he will need to be in traction much longer), and (3) there is no interposed soft tissue. Fortunately, non-union is rare, provided you maintain the exercises!

When walking is safe on crutches, allow him home, but insist that exercises continue there. Most patients can be discharged with their fractures clinically united at 8wks. This period is shorter in younger and longer in older patients. Transverse and oblique fractures take longer than spiral.

When the time taken to achieve clinical union has doubled, the crutches can be discarded and full weight-bearing started. Any violent exercise (*e.g. football)* for the next 12months is not advisable. Alas, teenagers are particularly liable to re-fracture a femur.

DISTRACTION IS MORE SERIOUS THAN OVERLAP

Intramedullary nailing is the ‘gold standard’ for femoral shaft fractures, but ‘gold standards’ are for ‘golden hospitals! There are strict criteria necessary to do any internal fixation, *e.g.* the possibility of using the SIGN nail system (58.6).

Your interventions should be quick, easy to perform and with as little physiological stress on your patient as possible. Traction or an external fixator should always be your preferred choice for these patients. In these settings the most important goals are: preservation of limb length and acceptable alignment of the fracture.

Rotational control, and an anatomical fracture reduction can be obtained later, after the acute presentation and should not be your main focus in the acute setting.

In case the fracture is open, your options depend on the type of fracture:
(I) Low energy injury, a wound <1cm, no contamination, a simple fracture and intact soft tissue coverage.
(II) Moderate energy injury, a wound <10cm which you can easily close, little contamination, a minimally comminuted fracture, and intact soft tissue coverage.
(III) High energy injury, a wound >10cm or deep, severe contamination and soft tissue loss.

For types I & II, *immediate* intramedullary nailing is an option, if the criteria of 58.6 pertain.

For type III, an external fixator is a better option in the acute setting, because of a high infection risk and the need of additional soft tissue intervention.

Within 2wks following the accident, you will need to decide whether you prefer to treat your patient with an external fixator to the end, or if you prefer to convert later on to a Perkins traction.
There is no simple answer to this question, and you should take multiple factors into consideration: the need for additional soft tissue intervention, how good your wound care is, the length of hospital stay, the amount of external fixator sets available in your hospital, the complexity of the fracture pattern, the presence of infection, and costs sustained.
In any case, you will need to decide which treatment type you will apply for the full treatment within the initial 2 weeks. During this period, you can still control rotation and limb length shortening by Perkins traction or by adapting your initial external fixator construction.

After 4wks, you can replace the Perkins traction by a hinged cast brace (67.4) if the fracture is adequately consolidated and if home conditions allow for adequately care.

67.4 Cast-bracing

Cast-bracing is useful after at least 4-6wks of Perkins traction. *Don't use it as an alternative to Perkins traction just to liberate a bed earlier in the ward*. You will then risk slowing down recovery, with a high risk of non-union, malunion and rotational deformities.

INDICATIONS
(1) fractures of the mid femoral shaft or distal femur,
(2) a control radiograph at 4-6wks shows a progressive bony callus,
(3) the patient understands that *weight-bearing on the affected leg is not allowed*,
(4) there is sufficient family support to take care of the patient at home
(5) the patient agrees to continue *quadriceps* and knee mobilization exercises at home, as when under Perkins traction

CAUTION! The total duration of treatment is not shortened by cast-bracing. Treatment and non-weight bearing should still be 8-12wks.
A cast-brace consists of two cast cylinders, one for the tibia and one for the femur, connected by 2 hinges. These should be solid enough to be used for this purpose, and should be easily available from any local hardware store. They are re-usable, and can be used for >1 patient.

KNEE BRACE IN EXTENSION

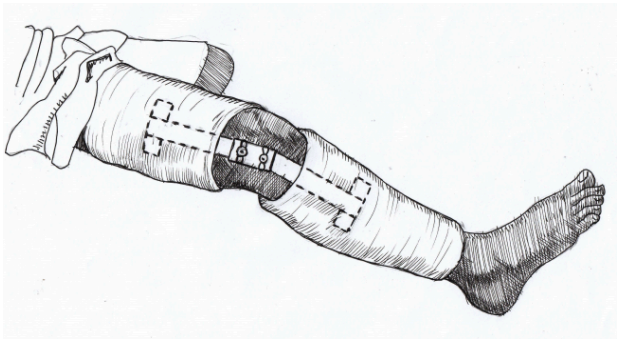

Fig. 67-8 KNEE BRACE IN EXTENSION

Before discharge, teach the patient how to walk with crutches. If he has never done this before, it can take a day or two before he feels confident enough to leave the hospital. Teach him step by step, and support him throughout the process, to avoid him bearing weight accidentally on the affected leg.

Review him weekly or 2-weekly until full consolidation of the fracture. Take radiographs at the same intervals as for the regime with Perkins traction.

KNEE BRACE IN FLEXION

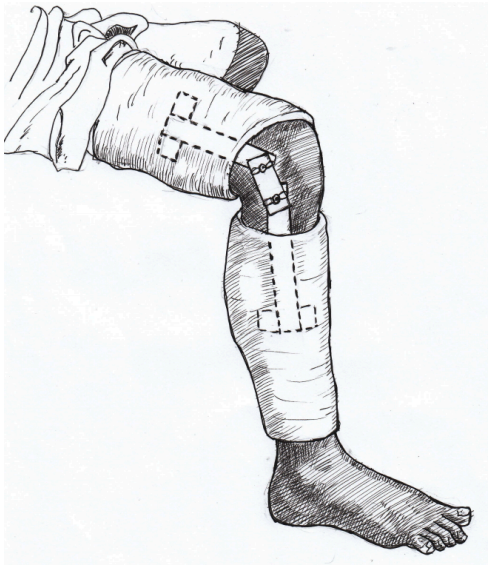

Fig. 67-9: KNEE BRACE IN FLEXION, showing hinges

ADVANTAGES
(1) earlier discharge from hospital and freeing up a bed,
(2) earlier return home
(3) psychologically beneficial

DISADVANTAGES
(1) risk of inadequate care at home,
(2) risk of too early weight-bearing
(3) follow-up consultations may be a logistical burden

67.5 Stabilization with external fixation

Read the general indications and contra-indications for external fixation (59.5). The only real indication in femoral injuries is in the open fracture. *Don't use it as a definitive treatment for closed femoral fractures*.

PLACING AN EXTERNAL FIXATOR FOR A FEMORAL FRACTURE (GRADE 3.2)

You will need all the basic external fixator equipment (59.5), a mobile Xray C-arm, and GA. You do not need a traction table or a Steinmann pin. Manual traction by an assistant should be sufficient.
Place the patient supine, disinfect the whole leg, and drape it. Mark sites for the pins, which should be as close as possible to the fracture site, without being in the fracture itself.
Decide at which angle you will place your pins, make a stab incision through the skin and dissect the muscles carefully until you reach the femur.

Put in the pins under direct vision using the C-arm. Reduce the fracture and attach bars to the pin, using a simple frame, if possible, or with 2 parallel bars
.

SAFE ZONES FOR PIN INSERTION
Always aim to insert the pins on the anterior or anterolateral side of the femur. Where exactly you place the pin, and where the safe zones are, may differ slightly.

(a) In the proximal $^1/_3$ of the femur, use an anterolateral approach and aim the pin towards the greater trochanter. This way you avoid both femoral nerve and the femoral artery anteriorly, as well as the sciatic nerve posteriorly.

SAFE ZONE FOR PROXIMAL FEMUR PINS

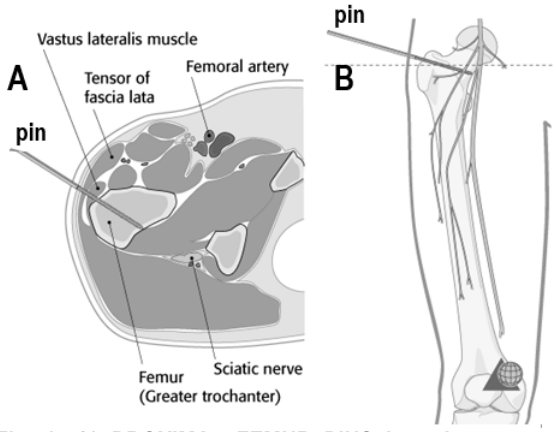

Fig. 67-10 PROXIMAL FEMUR PINS into the greater trochanter.

EXTERNAL FEMUR FIXATION

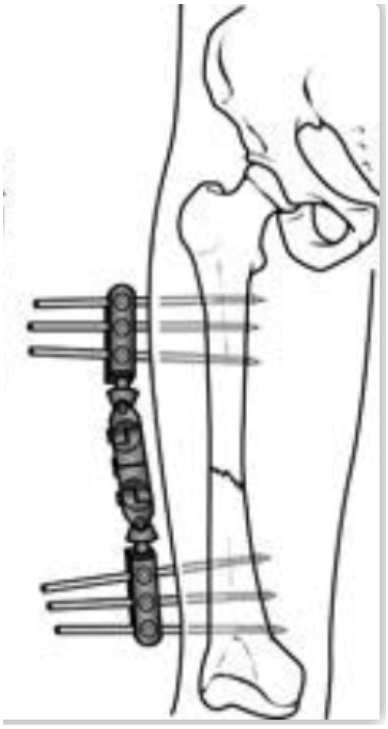

Fig. 67-11 EXTERNAL FIXATION OF THE FEMUR

(b) In the femoral mid-shaft, use an anterolateral approach at an angle of c.45°. This way the pin enters the thigh between the *vastus lateralis* and the *rectus femoris* muscles, where they will give less friction and less pain to the patient.

SAFE ZONES FOR MID-SHAFT FEMUR PINS

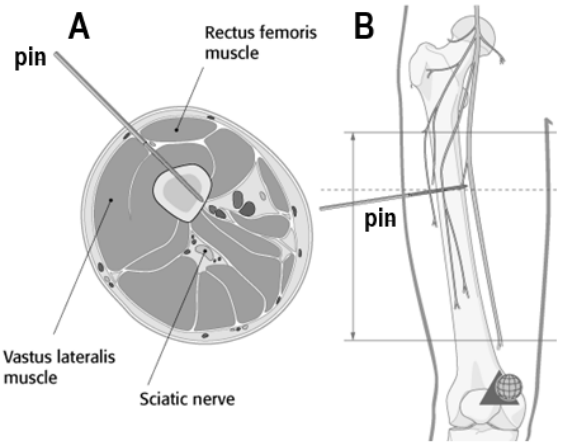

Fig. 67-12 MID-SHAFT FEMUR PINS between the *rectus femoris* & *vastus lateralis* muscles.

In the distal $^1/_3$ of the femur, there are less soft tissue structures to worry about. Use a lateral approach at an angle of c.30°, avoiding most of the *vastus lateralis* muscle. *Here a frame is too posterior & interferes with the bed mattress.*

SAFE ZONE FOR DISTAL FEMUR PINS

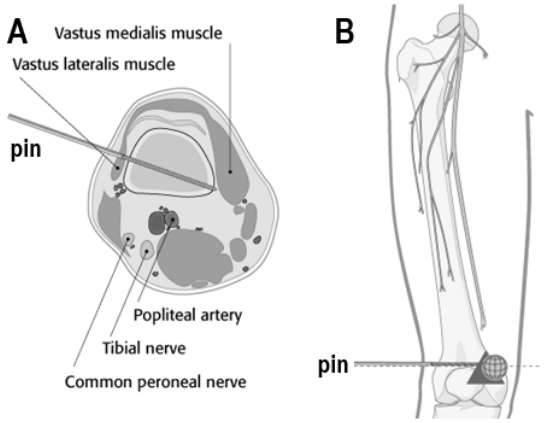

Fig. 67-13 DISTAL FEMUR PINS. Use a lateral approach.

67.6 Difficulties with femoral fractures

DIFFICULTIES WITH A FRACTURED FEMUR

If there is an open fracture, treat as for any other open fracture (58.13). Perform a rigorous wound toilet, and get the fragments into the best position you can. Unless a fragment is completely loose, leave it in place.

Provided the periosteum remains, the bone will reform. Keep the leg in traction to approximately its normal length. *Don't close the wound for 3-5days.* Either close if by delayed primary closure, or by delayed skin grafting. Then start exercises.

If the leg is pulseless and cold, the femoral fragments have probably injured the femoral artery. Apply traction which may dislodge the fragments or reduce swelling and allow the circulation to return. If after 3h, this doesn't occur, explore the artery and, if necessary, repair it (49.4f). If you don't, you may have to amputate the leg later.

If the bone ends are >1cm apart, see if this is end-to-end, or side-by-side. The former may fail to unite. If you are using traction, reduce the weights. There may be soft tissue between the bone ends preventing reduction, then try manipulation.

Fragments separated side-by-side by <1cm is still acceptable. Early active movements may promote callus formation across a gap of 2cm, but if there is >1 cm, manipulate the fragments under anaesthesia until you can feel them grating.

If the site in the tibia where the traction pin is normally inserted is injured or infected, insert the pin more distally, or through the distal femur, as in 90-90 traction' (68-14).

If a pin becomes loose and its track infected, you may have inserted it in an unsterile manner, or allowed the drill to get too hot, so that it has killed the bone around it and formed a ring sequestrum. Infection is usually not serious if you diagnose it early and don't neglect it. But it can be a catastrophe, because osteomyelitis may result and infect the knee. This is more common in older patients with soft bones, because the pin pulls through the bone.

Prevent this disaster by inspecting the pin track daily, and removing the pin if there is pain or any sign of redness or loosening. Either put the pin in again lower down, through healthy skin, or apply skin traction, or traction on a Böhler-Braun frame with the pin through the lower end of the tibia, or the calcaneus (70.11).

If the whole of the proximal end of the lower leg becomes inflamed, *don't reintroduce the pin.* Don't put it in higher up, because you will infect the knee joint.

If an infected pin track heals over but the bone remains tender, open up the track and curette it.

If a pin track is infected >1 month, get a radiogram of the tibia and look for a ring sequestrum round the track of the pin, which needs excision.

CAUTION! Remove a pin immediately it becomes loose.

If a pin track infection has already infected the knee joint, immediately incise & drain the knee through incisions on either side of the patella. Irrigate the joint, administer antibiotics and splint the knee in a windowed plaster cylinder until the infection has settled.

If you don't have a Steinmann or Denham pin, use sterilized bicycle spokes.

If there is a femoral & tibial shaft fracture in the same leg, under GA, put in the Denham pin, and then reduce the tibial fracture. Apply a below-knee cast to maintain this reduction & incorporate the nail in the cast. Leave enough space behind the knee for it to flex, then treat the fractured femur. Two fractures will divide the leg into 3 sections, so make sure they are all correctly aligned (73-24D). The femur will probably unite before the tibia, so you can then use a patellar weight-bearing short leg walking cast (69.5) on discharge.

If the fractured tibia needs calcaneal traction to reduce it, apply this for a few days first, then insert a Steinmann pin and use Perkins traction.

If, after 16wks in traction, there is malunion, this may be due to: (1) Distraction of the bone ends, caused by too much traction. (2) Interposed soft tissue. (3) Exercises that were inadequate or started too late, or quadriceps exercises that you hoped would be enough. Consider referring him.

If the femur fractures again at the same site, apply Perkins traction again; it will re-unite rapidly. *Don't try internal fixation.* Refracture is rare and usually follows a fall, particularly in a patient who is allowed up too early, or in a youth who plays football too soon.

If the knee becomes painful some years after a femoral fracture, check for angulation of the femur, which disturbs the normal knee mechanics. This requires an osteotomy.

If the knee becomes very stiff, after a supracondylar femoral fracture which is solidly united, stiffness may be due to adhesions around the knee joint. Firm, *gentle* manipulation under GA may restore movement. This may otherwise require restoration of *quadriceps* function.

If, a year after a femoral fracture, there is severe bowing of the femur, there has been premature movement at the fracture site before consolidation. This needs an osteotomy.

If, during the first 2-3days after a femoral fracture, the patient becomes disorientated, drowsy or comatose, suspect a FAT EMBOLISM (44.5), resulting from globules of fat escaping from the injured bone marrow and entering the circulation. Look for petechiae over the chest, in the mouth and in the conjunctivae. Fat in the urine confirms the diagnosis.

If, c. 7-10days after a femoral fracture, the patient complains of dyspnoea, chest pain or haemoptysis, suspect a PULMONARY EMBOLISM (44.7).