

## CAUTION:

The commonest cause of a problem and delay in the rehabilitation of amputees is a poorly fashioned amputation stump.

Make every effort to preserve the nerve supply to the heel pad. There are two main nerves to retain — medial and lateral, so dissect the calcaneum from the skin flap in the periosteal plane — under the skin of the bone itself.

### Below-Knee Amputation

The level will be one hand's breadth (the patient's hand!) below the tubercle of the tibia. You cannot amputate above the level of insertion of the patella tendon, without the patella tendon the knee is effectively lost.

If the tibia has been fractured, the amputation does not need to be at the level of the fracture; it will heal and so continue to aim for maximum length.

If there is a lack of adequate skin for closure of a below-knee amputation, certain techniques can be used to preserve the knee joint and avoid doing a higher amputation primarily. These are slightly different from the conventional technique of below-knee amputation, but will allow a greater opportunity to complete the closure.

- Excise the remaining proximal end of the fibula and the whole lateral compartment. This will leave a thin stump.
- Skew the flaps so that the scars are not over the end of the stump, and look for long posterior flaps which can come forward to cover the front of the stump as well.

If there is any doubt as to whether the amputation at that level will survive, preserve the knee as an initial step, even if it has to be covered with a split skin graft. You can send it on, or revise the stump later.

If there is a loss of skin, split skin grafts can be used, but not on any areas which must carry weight — over the patella tendon, the anterior tibia or the popliteal fossa. The very end of the stump will not be bearing weight in a prosthesis, because the weight is carried on the sides of the tapered stump.

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### Through-Knee Amputation

This is an end-bearing stump, and there must be no scar over the condyles which will carry the weight.

1. Do not use split skin graft at all here — it will break down, and it will become clear that the patient would be better off with an above-knee amputation.
2. Arrange the flap to bring the scar off the condyles and into the notch between them. If you take 10mm off the condyles you will form a large surface for weight distribution, thus assisting end-bearing and socket fit.
3. Should the patella be excised? This is a matter of judgement, and you should discuss with the prosthetist, if possible.

### Above-Knee Amputation

Requires a myoplasty — which is sewing muscle to muscle over the stump to stop retraction of muscle and thinning of the stump.

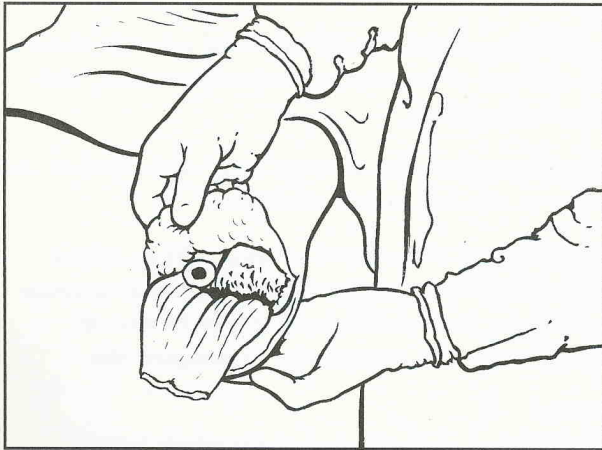


Figure 24a. Preserving a muscle flap to cover the bone end.

1. Suture the quadriceps to the hamstrings, and
2. Cut the adductor longus muscle attachments to bone to produce a long tongue of muscle which can be brought over the end of the bone and sutured to the abductor muscles on the lateral side.

Avoid flexion deformity of the knee.

Try to maintain the correct position of the knee with splinting and physiotherapy. If there is more than 15° flexion, it will be very difficult to fit a prosthesis.

Should flexion deformity occur, however, try to achieve a straight joint by manipulating under general anaesthesia with full relaxation, then apply a plaster cast to maintain extension.

This will need to be well padded with wool or foam over the three points which take the pressure — the patella, the end of the stump and the front of the thigh.

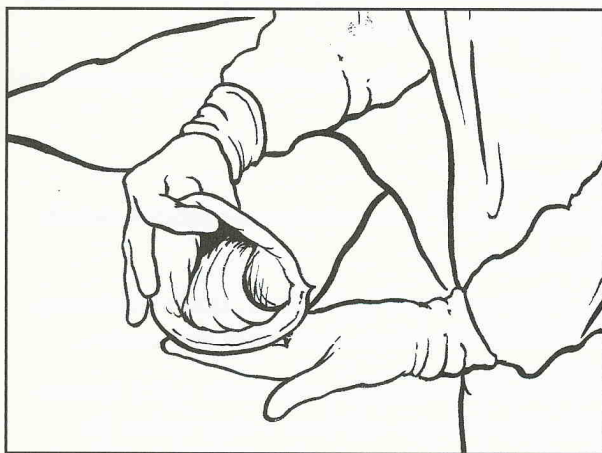


Figure 24b. Covering the bone end with a muscle flap.

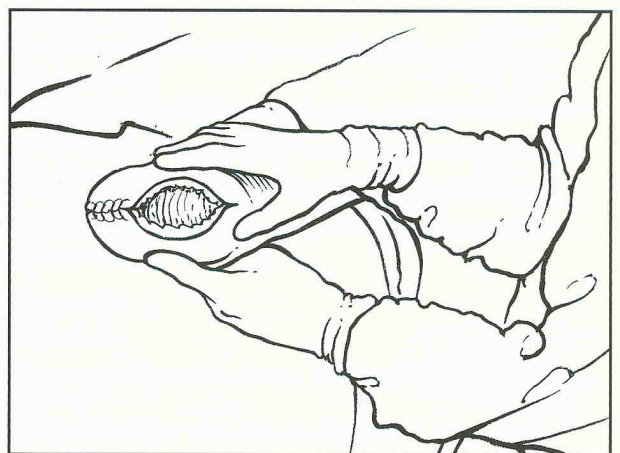


Figure 24c. Partial closure of stump to allow drainage.

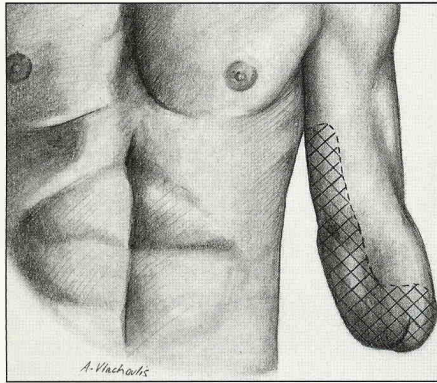


Figure 25. Diagram of best areas to preserve sensation on upper limb.

### Shaping an amputation stump for optimal fitting of a prosthesis

- Surgery: The aim should be to achieve a firm tapered stump covered by healthy skin
- Post-Surgical Care: Continuous pressure bandaging is recommended if suitable bandages are available. Many centres in Africa do not have elastic stump bandages, however, and even crepe bandages may be difficult to obtain.

### UPPER LIMB

1. Preserve whatever length you can, for example disarticulate at the wrist, always provided that you can bring muscle over the end of the bone.
2. Skin cover is not a difficulty — split skin grafts are quite applicable, but split skin will not appreciate touch sensation and will be thin and easily damaged.
3. Therefore arrange split skin to cover areas which do not have to take pressure or shear, will not need to end bear or be required for grasping.
4. Try to preserve skin with sensation over the end of the stump (particularly if disarticulated at a joint) and on the medial aspects of the forearm or upper arm, and also the volar surface of the forearm (what we lean on when sitting at table).
5. Rotate a flap of skin to those places.



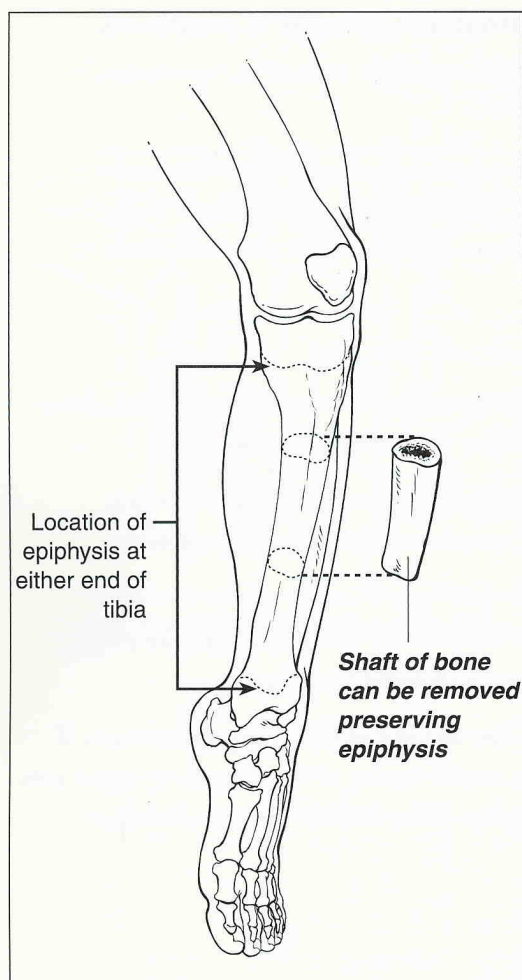


Figure 26. Shortening shaft of bone.

## Amputation in Children

Children are amazing in their ability to rehabilitate and cope with a prosthesis. Do not give up on the attempt to make a limb suitable for a prosthesis.

- Preserve length wherever possible, in both upper and lower limbs. Split skin grafts will survive better in children. If necessary, reconstruction can be done later.
- Preserve growing ends of bones, leaving the epiphysis and the growth plate undisturbed. If amputation is performed through the growing area, there is a tendency for bone to overgrow and push up through soft tissue, because the rate of growth of bone in children exceeds that of soft tissues.
- Therefore, where possible, avoid amputation through long bones, and prefer disarticulation at a joint. If the growth plate on the epiphysis can be preserved at each end of a bone you can shorten the shaft itself in the middle.

## Delayed Amputations

It is important to remember that once an amputation has been delayed beyond 72-96 hours, the patient will become increasingly resistant to the idea of losing the limb. One is then often faced with a situation where repeated surgery is carried out for recurrent sepsis and other problems, until the patient finally requests an amputation several months or years down the line.

Where resources are very limited, it may be worthwhile making a final decision about the viability and potential function of the limb within the first few days and to counsel the patient accordingly, so as to avoid unnecessarily lengthy and expensive treatment, where an early amputation would have resulted in more effective and prompt rehabilitation.

## MANAGEMENT OF THE CONTRA-LATERAL (LESS DAMAGED) LIMB

Some patients will sustain landmine injuries to both lower limbs or a combination of upper and lower limbs, and these injuries may require amputation of one or more limbs.

Rigorous debridement (removal of foreign material and non-viable tissue) is a necessary part of management of these injuries, but often it is not quite clear, early in the management, which tissues are viable and which will be non-viable.

In a case where several limbs are injured, therefore, and the aim is to conserve at least one of the lower limbs to reduce the ultimate disability, the debridement should be a little more conservative than when one limb only is injured.

The limb which is less severely injured should receive “extra-careful” attention to preserve it.

The following guidelines may be useful:

### **Where There Is a Combination of Fracture and Vascular Injury**

The correct sequence of management of such a limb is as follows:

1. If the ischaemic time has been accurately documented, and is less than 2 hours, the fracture should be fixed first by whatever means are applicable to that particular bone, (see recommendations below) and then the vascular repair done second.
2. If there is no accurate documentation, or if the ischaemic time exceeds 2 hours, the vessel should be shunted, (see description below), the fracture fixed, and the vascular repair performed later.

The reason for this is to avoid damage to the vascular repair during manipulation for fixation of the fracture.

3. If the surgeon is unable to perform a vascular repair but can refer the patient to another centre within 24 hours, it is sensible to shunt the vessel, fix the bone and then transfer the patient.
4. If transferring the patient is not a viable option due to local or logistic circumstances, the vessel should be tied off, the fracture fixed, a distal fasciotomy performed in all cases, and the limb observed over the next 24 to 48 hours. The further management will depend on the viability of the limb after this period of time — it may well require amputation, but this may be at a more distal level than that of the original injury or fracture.

Note: ALL limbs in which a vascular repair has been done **MUST** have a protective fasciotomy if the delay before repair has been more than 2 hours.

### **Vascular Shunt**

1. A shunt will maintain arterial perfusion in a limb with a damaged major artery while the bony fractures are stabilised.
2. The shunt may be kept in place by simple ligatures or by a snare on each end of the vessel.

Leave several centimetres of shunt within each end of the artery so that the blood pressure does not expel the shunt. A short shunt can also be dislodged by the orthopaedic surgeon during fracture fixation. Therefore allow for redundant shunt length by creating a loop of several centimetres between the ends of the artery.

### **NOTE:**

**ALL limbs in which a vascular repair has been done **MUST** have a protective fasciotomy if the delay before repair has been more than 2 hours.**



## Vascular Repair

The best, cheapest, and most readily available material is an autologous graft harvested from the Saphenous vein. If the vein is too narrow, one can create a shorter but wider graft by using the "Panel graft" technique.

1. Harvest a length of vein at least double the required length;
2. Cut this into two equal segments each of which is then split along its length, and the 2 pieces joined side to side along their long edge;
3. The resultant flat "panel" is then formed into a tube. This will yield a graft which is half the length but double the diameter of the original vein harvested.

**A fasciotomy is a deep and long incision which cuts through skin and the tough fascia membrane covering muscle to release pressure within the muscle sheath.**

## FASCIOTOMY

Indications: Fasciotomy should be considered for any limb which is:

- Not well perfused — pale, cool, with decreased capillary refill;
- Swollen and tense to palpation;
- Causing pain out of proportion to the injury;
- Has had a vascular repair.

Some of these signs and symptoms — for example, pain in a severely injured patient — can be extremely difficult to evaluate objectively.

A good principle is that if one has thought of doing a fasciotomy — it should be done! There is much less to lose by doing an unnecessary fasciotomy than by delaying it and losing a limb.

If a fasciotomy is to be done in the lower limb below the knee, a 4-compartment fasciotomy is advocated.

This makes use of two incisions to open all four compartments of the lower limb. The Antero-lateral incision will access the anterior and the lateral compartment while the postero-medial incision will allow release of the deep and the superficial posterior compartments.

A subcutaneous fasciotomy which divides the deep fascia while leaving the skin intact is seldom adequate, as the skin is often a contributing layer to raised intra-compartmental pressure. A fasciotomy should therefore include the skin as well as extend the full length of the compartments in question: for example, knee to ankle.

In the thigh, a fasciotomy should include both the medial and the lateral aspect of the thigh, as a single incision will not adequately decompress all the compartments.

**A good principle is that if one has thought of doing a fasciotomy — it should be done! There is much less to lose by doing an unnecessary fasciotomy than by delaying it and losing a limb.**