

Section of Surgery

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Practical Surgery [*Abridged*]

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Amputation of the Lower Limb for Ischæmic Disease

The advent of arterial surgery has produced two sets of circumstance in which amputation for ischæmia may be required, each of which is governed by different principles.

Major Amputation for Severe Ischæmia

First is the age-old problem of major amputation for severe ischæmia in the face of inoperable vascular disease or after arterial surgery has been attempted and failed. The principle here is to choose a level in the limb at which primary healing will occur, which will provide the optimum prosthetic function. To date there is no reliable test for assessing levels of viability, so this decision must be made on clinical grounds alone: the level of the most distal remaining pulse is still the best guide; if it is at common femoral level, then a mid-thigh amputation should be done; below-knee or trans-metatarsal section should only be considered in occlusions distal to a palpable popliteal pulse. There are, of course, exceptions to these rules but the decision to undertake a distal type of amputation in the face of high arterial obstruction must only be made after careful clinical assessment in individual cases.

Certain technical considerations apply in all major amputations for ischæmia. Extreme care should be taken to avoid unnecessary trauma in handling the flaps and tissues of the stump; tourniquets are probably best avoided; drainage when required should be by an unfixated suction drain which can be removed in the early post-operative period without disturbing the main dressings. If viability is doubtful, we avoid using skin sutures and prefer to bring the flaps together with adhesive strips (Rothnie & Taylor 1963).

Mid-thigh amputation in patients with obliterative disease of their peripheral arteries may be complicated by gas gangrene: in a bedfast patient the perianal bacterial flora extends distally to include the thighs, and anaerobic bacteria can be recovered constantly from the skin of this area. Antiseptics, including iodine, applied to the skin are ineffective against these spore-bearing organisms. Contamination of the amputation wound with clostridia is therefore likely and the ischæmic nature of the primary disease may favour the development of gas gangrene. Prophylaxis against this complication should be carried out with soluble penicillin (500,000 units) administered six-hourly.

After major amputation, the functional result depends on the ability of the patient to use an artificial limb and, in this respect, the limb-fitting surgeons are currently advocating several changes in traditional techniques. The first is the employment where possible of a myoplastic technique (Dederich 1963). For an above-knee section this entails cutting long skin flaps and dividing the thigh muscles close to their insertion, well distal to the level of bone section: opposing muscle groups in anteroposterior and mediolateral planes are then sewn together at normal tension over the bone ends. This technique increases the muscular power of the stump and also provides better control of the prosthesis.

The second innovation is the recommendation, by the limb-fitting surgeons, of the through-knee amputation with preservation of the femoral condyles and patella: the resulting stump is end-bearing and rehabilitation is much quicker, especially in the elderly patient, compared with the traditional mid-thigh amputation. A word of warning is necessary, however, when considering the through-knee amputation in patients with gross vascular disease. In our experience, ischæmic necrosis of the long anterior flap occurs relatively frequently and in a series of 27 through-

knee amputations, revision to a mid-thigh amputation was necessary in 6 patients and healing was delayed in a further 6 patients; primary healing occurred in 15 patients. There was no correlation between failure to heal *per primum* and the degree of patency of the profunda femoris artery as revealed by arteriography. In peripheral vascular disease the through-knee amputation cannot be fully equated with a mid-thigh section on the basis of primary healing. Mention must also be made of the current trend towards the immediate post-surgical fitting of prostheses. A trial is being conducted at Queen Mary's Hospital, Roehampton, in which a simple weight-bearing prosthesis is fitted to the stump at the completion of the operation; then progressive ambulation can be started as early in the post-operative period as the condition of the patient permits.

Salvage Amputations after Successful Reconstructive Arterial Surgery

Arterial surgery can rescue about half the limbs afflicted with severe ischæmia (Taylor 1964). In many of these limbs, complete necrosis of digits or portions of the forefoot will have occurred before reconstructive arterial surgery is undertaken. This problem is different from that posed by major amputation in untreatable severe ischæmia: the blood flow to the extremity has been restored by arterial surgery, so amputation or excision is only required to rid the now viable extremity of tissue that has suffered irreversible change during the pre-operative period of ischæmia. The gangrenous areas are usually confined to the toes or forefoot although occasionally patches of superficial necrosis or ischæmic ulcers in the lower third of the leg will require attention. Two principles underly this type of excisional surgery: (1) Excise only that tissue already necrotic. (2) Ensure epithelialization as early as possible in the post-operative period, i.e. local amputations should usually be done concomitantly with the arterial operation.

The first principle implies that formal amputations at traditional sites should rarely be done. It is usually possible to decide on the demarcation line between surviving and irreversibly necrotic tissue at the time of arterial surgery but, if there is doubt, the position will become clear within seventy-two hours of revascularization. This demarcation line should be the precise level of excision: portions of digits or of the forefoot may be excised solely on the basis of 'excise what is dead, leave what is alive'. It is unnecessary to fashion formal flaps; toes can be amputated by a simple guillotine excision, forefoot and other defects covered by immediate split-thickness skin grafts. Each salvage amputation becomes an *ad*

hoc exercise. An excellent functional result can be achieved even if only a rudimentary foot stump containing a minor portion of the tarsus is retained.

The second principle, of early excision, is important because the foot may remain stable and useful if complete healing can be achieved even though the arterial reconstruction fails at a relatively early date (Taylor 1962). By contrast, if arterial failure occurs before local healing is complete, then major amputation is usually inevitable.

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An Improved Indifferent Electrode in Surgical Diathermy

The normal diathermy plate electrode, of area not less than 30 square inches, $\frac{1}{32}$ in. thick, has several disadvantages: (1) It is large and cumbersome. (2) It is thick and difficult to bend to fit the patient. (3) To provide good contact it needs a pad soaked in saline, which is messy, which cools the patient, and which eventually dries out.

While these are all disadvantages for use on an adult patient, they are even more so on a baby. In particular the cooling can be a real hazard. Furthermore, radiography during an operation is impossible since the plate completely obscures the patient.

Experimental work: If a smaller electrode is used, it is essential that there is no significant increase in the heating of the tissue under the electrode due to the reduction in cross-section of the path of the current. A number of measurements of temperature rise were made under electrodes of decreasing size on cadaver and rabbit. No significant rise was found down to an area of 1 sq. cm.

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