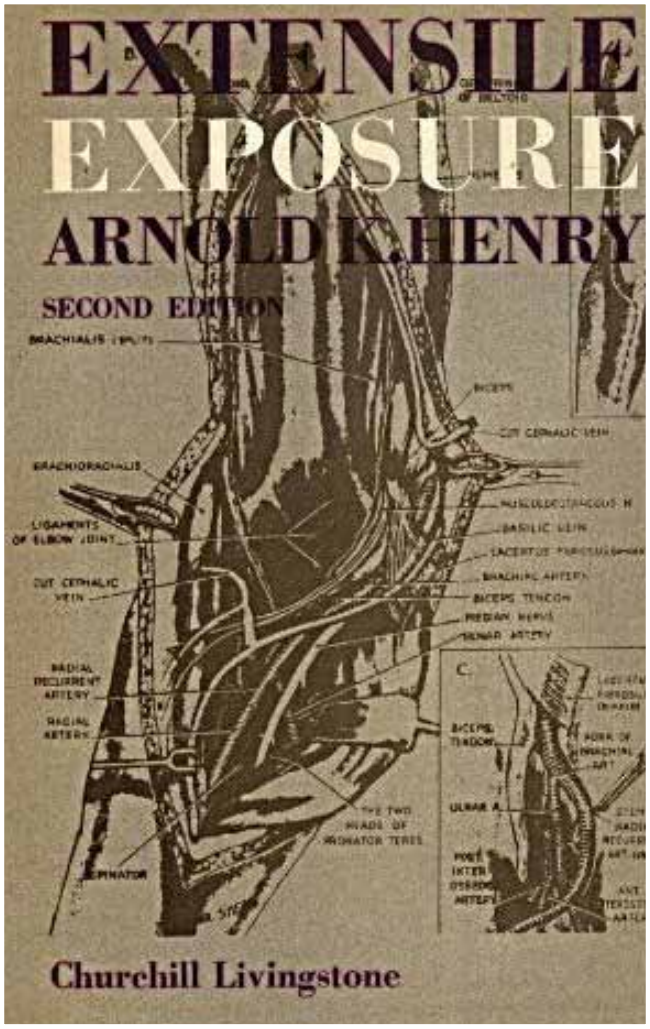
Extensile Exposure

[2nd Edition]



Arnold K. Henry

GLOBAL HELP
Health Education using Low-cost Publications

SECTION IV

EXPOSURES IN THE LOWER LIMB

VESSELS AND NERVES IN THE BUTTOCK

I PUT this first. Of all exposures in the lower limb a method for the buttock was, I found, the principal concern of an experienced majority.

We have been taught to look for the gluteal vessels by splitting gluteus maximus, perhaps because its well-marked grain is almost irresistible. But if we split the grain, we play into the hands of entities that tend to give a narrow, bloody field. The parts are thick ; skin felts with fat, and fat with fascia covering thick gluteal muscle. Then, too, the vessels sprawl on the deep face of maximus, much as they sprawl on the placenta, spreading their arteries (as Bell remarks) " with sudden and crooked angles " ; so they diverge and run *across* the grain ; and here those cursed things of surgery, the veins, are large. These handicaps of mere anatomy grow uglier with wounds : the part becomes " a clotting mass adrip with blood."

In this exposure, therefore, we must spare and see—two things which can be done well only when we lift the lid-like shape of maximus as we might lift the lid nailed on a packing-case. Thus we can either raise the muscle by setting free a pair of sides that meet, and prising up the corner (like Fiolle and Delmas) ; or else (with Stookey)[1] we can set *two* corners free and turn the whole lid back. The plans themselves are simple, but neglect of detail leads to sorry execution.

ANATOMY

The gluteal lid (Fig. 110).—The cover formed by maximus is like a parallelogram whose *shorter sides*—the femoral and pelvic—are almost longitudinal, the one aligning roughly with the femur, the other fixed from ilium to coccyx.

The *longer sides*—cephalic and caudal—are oblique, like the

[1] B. Stookey, *Journal of the American Medical Association*, 1920, **74**, 1380. (In the exposure described below, Stookey's ' question-mark ' has been shifted *forward* to exploit the Fiolle and Delmas drum-head.)

grain of maximus ; the lower side descends across the gluteal fold

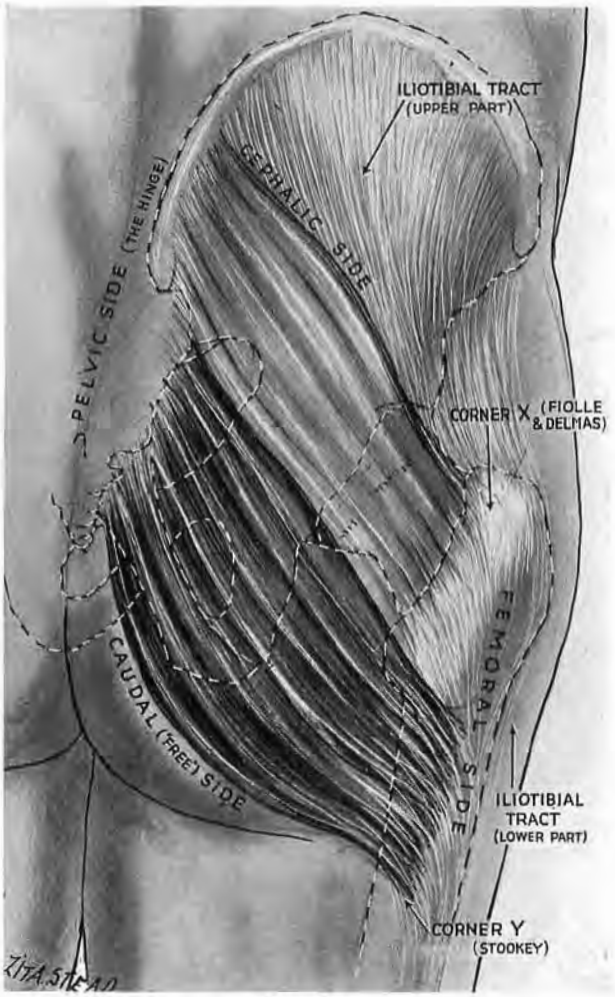


Fig. 110

The gluteal lid or parallelogram

Note its four sides—two long (cephalic and caudal), and two short (femoral and pelvic). *All* the superficial fibres plus the upper half of deep fibres are attached distally to iliotibial tract (see Fig. 111). The lower (deeply shaded) half of the *deep* fibres are fixed to femur. X is the corner to free in order to prise up the lid in the partial exposure of Fiolle and Delmas. Y is the second corner which must be freed with X to let us raise the lid and hinge it back for the complete exposure, after Stookey.

and is (as Boyer notes) the ' free ' side of the muscle—united to surrounding parts by *loose* connective tissue.

Of these four sides two which meet in front—the short femoral,

the long cephalic—need close consideration. All the fibres of gluteus maximus have their distal attachments at the short, *femoral side* of the muscle. These attachments are of two kinds, fascial and bony. The superficial fibres join the part of iliotibial tract which slides on great trochanter; so, too, does the upper half of deeper fibres; the lower half, however, implants itself on bone, marking the back of femur and forming there the distal point of the gluteal parallelogram.

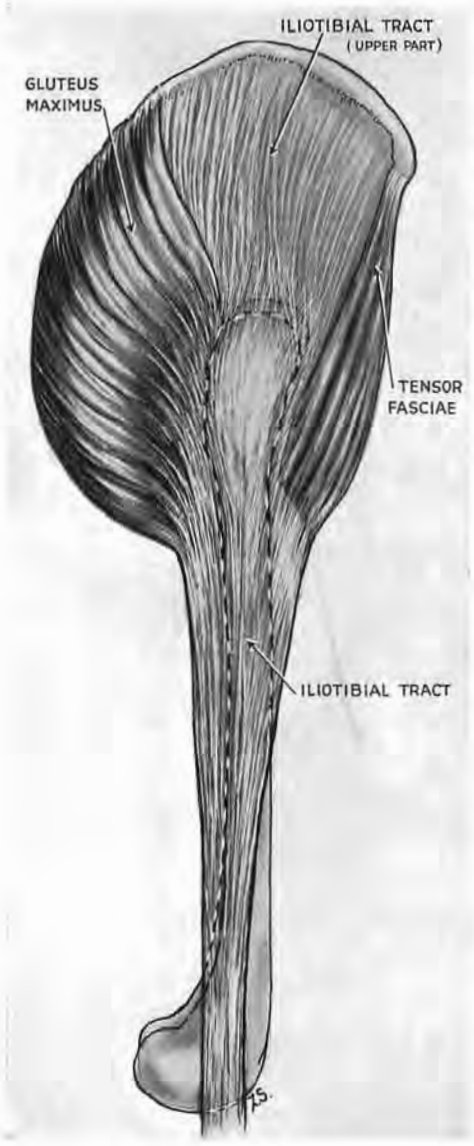


Fig. 111

The 'pelvic deltoid'

The fibrous middle part (formed by iliotibial tract) covers gluteus medius and is stuck to it in front. Behind, near great trochanter where medius slopes inward, the tract covers the muscle like a drum-head (see Fig. 114 A).

The long *cephalic side* that joins with the short femoral is bound, in muscle-sheath relation, to a special piece of tract—the proximal expanse which hides gluteus medius, and occupies the gap between the maximus and tensor muscle. Indeed, we may regard these three (the tensor, tract and maximus) as figuring a pelvic deltoid (Fig. 111) whose middle part consists of fibrous tissue—a useful myth in practice but one condemned by strict morphology.

If we set free these two adjoining sides—cephalic and femoral—dividing their attachments to the tract, we liberate a corner of gluteal lid which we can now prise up. But if we need the widest possible exposure (to reach in comfort, say, the great sciatic) we must unfix a second corner—

the distal piece of maximus that joins the femur. Then every side is free except the pelvic; for (as we know from Boyer) the caudal edge is virtually unattached. And so, with three sides free, we raise the lid.

THE OPERATIONS OF PARTIAL AND COMPLETE EXPOSURE

Position.—The patient lies face down. Take advantage of this position to mark out the points through which the knife will pass: (1) the posterior superior spine of ilium; (2) a point on the crest a handbreadth in front of this; (3) most difficult of all to find, a point midway between the front edge and the back edge of great trochanter. (Be sure you find the front *edge* under the covering wad of tensor belly); (4) a similar point on the femoral shaft level with gluteal fold; (5) a point on the back of thigh midway between ischial tuberosity and the back of great trochanter, just below the gluteal fold (Fig. 112).

The skin incision.—Since it is difficult to know beforehand if our exposure must be full or partial, I shall describe the full incision—a question-mark on the right side, its mirror image on the left (Fig. 211)—and indicate the portion that gives room for *circumscribed* approach.

The ' question-mark ' needs rigorous attention; a lapse will hamper us persistently.[1] Begin first at the posterior superior spine of ilium; carry the knife a handbreadth along the iliac crest. Then cut obliquely down the outer face of hip to reach the top of great trochanter. The knife proceeding distally bisects the outer face of the trochanter and travels down the shaft till level with the gluteal fold; *that* is enough for circumscribed exposure. But, for full access turn the knife in transversely at this level; stop at the midline of the thigh, half-way, that is, between the great trochanter and the tuberosity of ischium. Then cut vertically down the thigh as far as you propose to liberate the great sciatic nerve. The ' question-mark ' should reach but not divide deep fascia.

The posterior cutaneous nerve of the thigh.—The *trunk* of this large nerve (once named the small sciatic) lies in the midline of the thigh just under the deep fascia; *and there it stays*, sending out perforating twigs and coming to the surface only in the calf

[1] It is, for example, remarkably (and ruinously) easy to follow the hinder edge of great trochanter instead of bisecting its outer face—

> " *I told them once, I told them twice:*
> *They would not listen to advice.*"

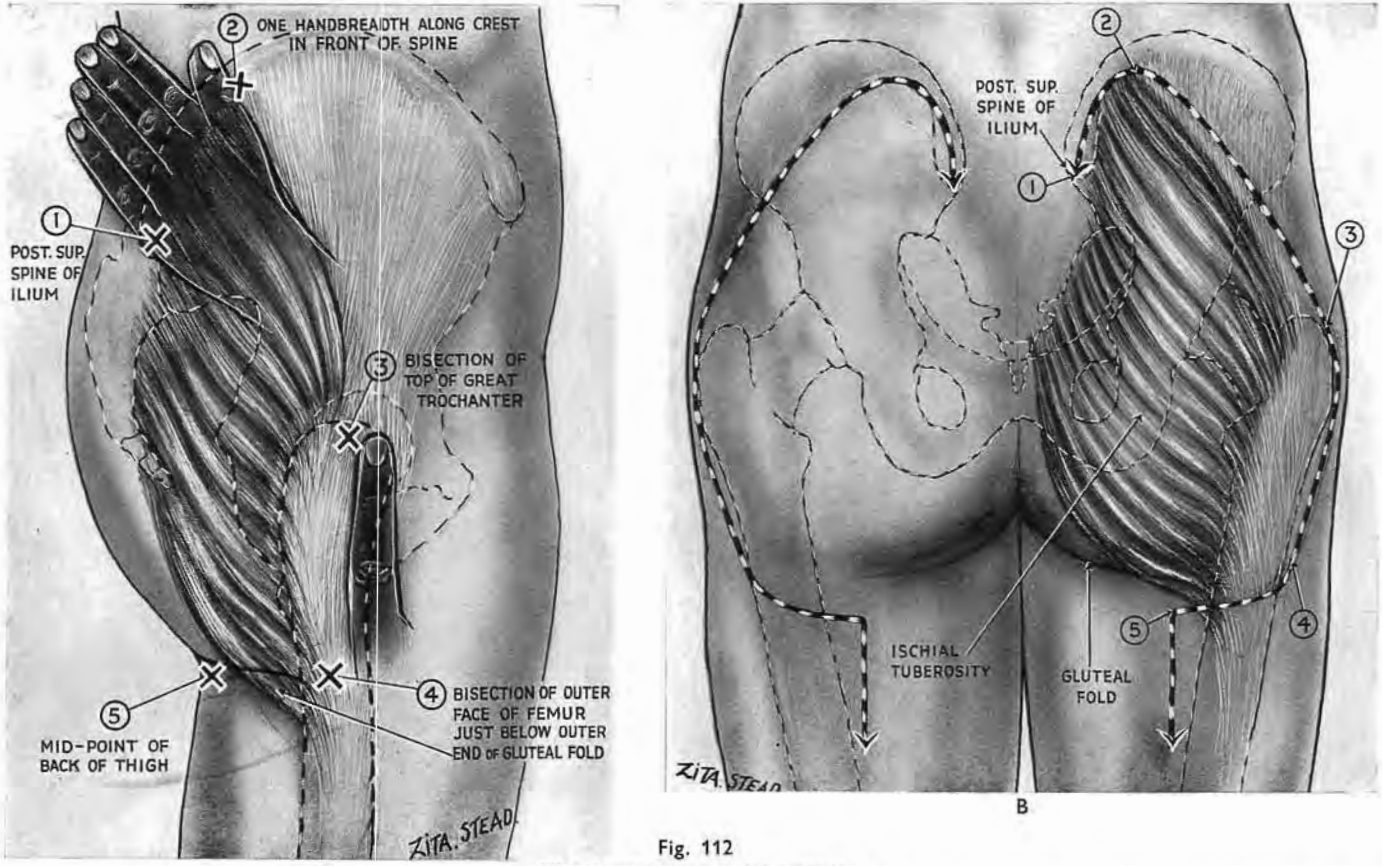


Fig. 112

The 'question-mark' incision

A. Note the five points which map its course. The 'difficult' point (3) is a fingerbreadth behind the front edge of great trochanter. For the partial exposure of Fiolle and Delmas, incision stops at point 4. B shows the full 'question-mark' on the right; its mirror image on the left.

(Fig. 113). This nerve will be imperilled by a full exposure; it clings, ensheathed in fat, to the deep face of maximus, close to the long 'free' caudal edge. So, when the edge is raised, the nerve is cut unless we make a point of finding it *as a first step*, using the *stem* of the 'question-mark'—a method which I owe to Major C. W. Clark of the Canadian Army. His plan works well, for nerve and stem are mesially placed. The nerve, remember, lies beneath deep fascia (and just beneath); so we can find it much more easily than if it lay in superficial fat. Open deep fascia therefore longitudinally and trace the trunk up to the edge of the gluteal lid. When presently we raise the lid and hinge it back, the nerve is easily detached—together with its perineal branch, the *ci-devant* pudendal nerve of Sœmmerring.

Liberation of the adjoining femoral and cephalic sides.—We next set free the shorter, *femoral* side of maximus by cutting down on bone and splitting lengthwise the piece of iliotibial tract that slides on shaft and great trochanter. Our cut accordingly bisects the outer surface of the femur and divides the main (and fascial) insertion of the maximus (Figs. 112, A and 113).

We then proceed to free the long, *cephalic* side of maximus, which, as we know already, is fastened by a sheet of iliotibial tract; and this we must divide. A detail of arrangement makes it well to place the cut correctly.

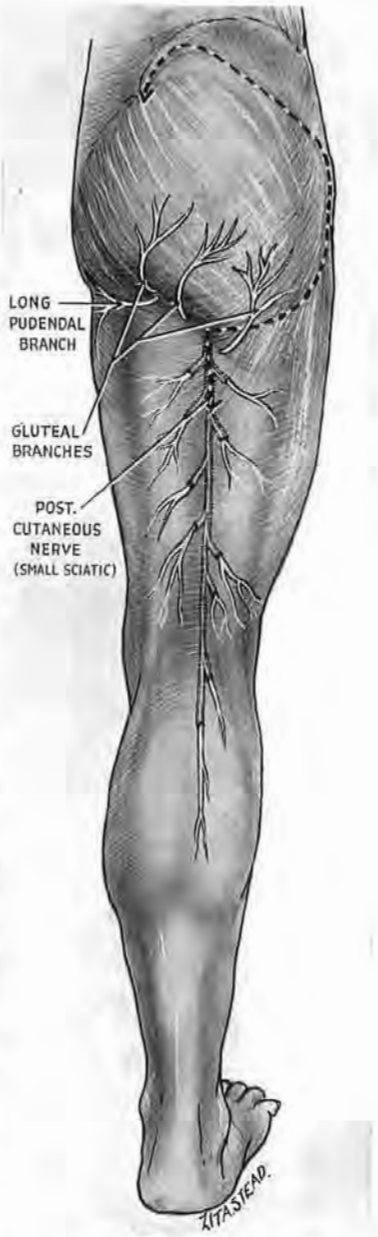


Fig. 113

The posterior cutaneous nerve of the thigh (the small sciatic)

Note its long course under deep fascia. Find it through the *stem* of the 'question-mark,' and thus, with C. W. Clark, protect the nerve (which sticks to the deep face of maximus) *before* you mobilise the caudal edge of gluteal lid.

The useful drum-head.—This sheet of tract (the fibrous portion of the pelvic ' deltoid ') covers the several parts of gluteus medius with different degrees of contiguity. In front, the tract and muscle stick together ; behind, the two are separate. So, when medius is lax, it leaves the hinder piece of tract stretched like a drum-head over it. The opening of this drum-head through a small extension upwards of the cut already made along the femur will let us put a finger in the shallow cavity and use a thumb to grasp the rubbery

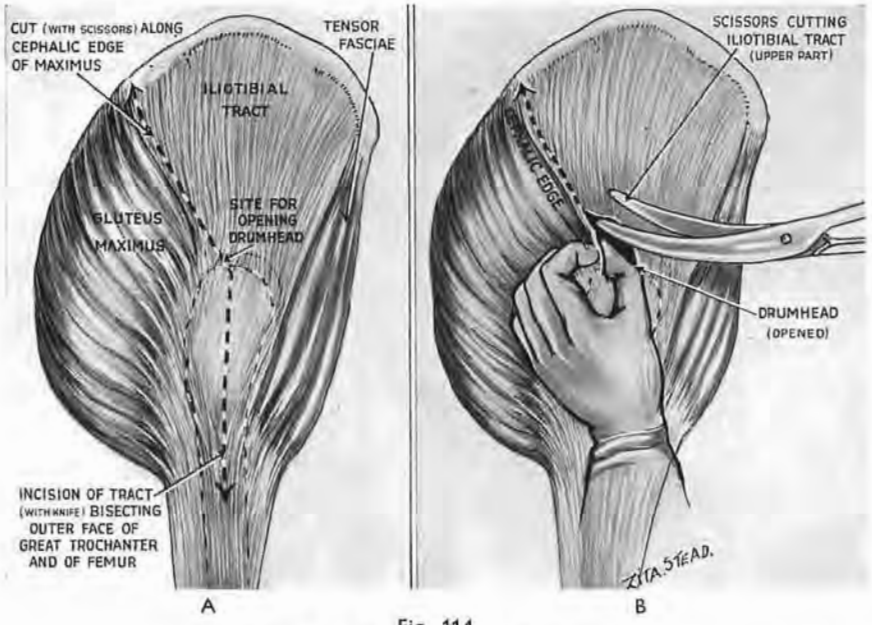


Fig. 114

Line for dividing iliotibial tract

A. The *knife* bisects the outer face of great trochanter and of femur ; it opens the drum-head at the top of the bisection. B. Finger and thumb locate the rubbery cephalic edge of maximus, and *scissors* cut the tract along beside it. Knife and scissors thus detach the *first* corner of the lid (X in Fig. 110) by setting free its femoral and cephalic sides.

transition that marks the meeting-place of maximus and tract. Use scissors to divide the tract along this sloping edge (Fig. 114).

And now with two sides free we raise one corner of the lid and look for structures underneath. That is the method of Fiolle and Delmas. But for fuller view we must set free a second corner.

The second corner of the lid.—We have already found the ' free,' or caudal, edge of maximus along with the posterior cutaneous nerve (once called the small sciatic). Raise both together from the hamstrings. Hook a finger round and then cut through the

thick insertion of maximus to femur ; the muscle there is sometimes vascular and should be pressed between assistant fingers on the medial side of the dividing knife (Fig. 115). Before we turn

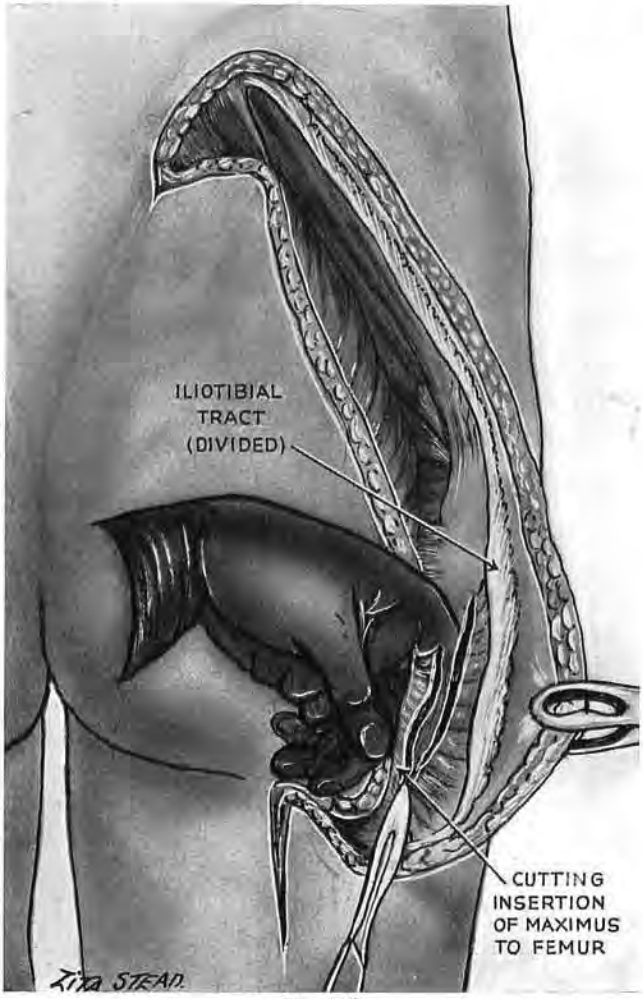


Fig. 115

Freeing the second corner (Y in Fig. 110)
This is done by dividing the fleshy attachment of maximus to femur. Fingers control the proximal extremity which is often vascular.

the muscle over we must see that the posterior cutaneous nerve is finally detached and safe. The whole gluteal lid can then be hinged back on its pelvic fastening, but very gently ; for though the great arterial and venous stems that branch into the lid are favourably placed—close to the pelvic hinge—the veins are always weak, and, in the old, the arteries are brittle.

STRUCTURES UNDER THE GLUTEAL LID

The key and the trap.—There is a key muscle for this region; each main nerve and vessel leaves the pelvis at one or other edge of pyriformis; and as a rule we find this 'key' immediately. Sometimes, however, a deep fold in gluteus medius marks off a neighbouring piece of belly close beside the 'key' (Fig. 116); then a small effort will separate the hinder part of medius into a disconcerting replica of pyriformis. I have twice seen confusion follow this detachment. (The transverse plane grazing the top of great trochanter is at the caudal edge of pyriformis—a muscle sometimes fused above with medius and minimus.)

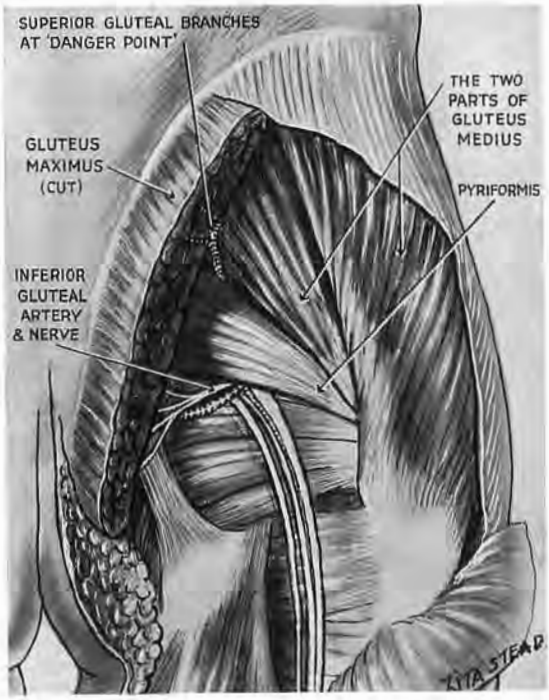


Fig. 116

Pitfalls under the gluteal lid

(This figure is anatomical and is not part of the exposure.)

Note the posterior part of gluteus medius which is sometimes separated off and mistaken for pyriformis, causing complete disorientation. Note also the 'danger spot' where a branch of superior gluteal artery, accompanied by *veins*, spreads into maximus. It lies three fingerbreadths in front of the posterior superior spine of ilium and three fingerbreadths below the crest.

The muscles.—Seven *transverse* muscular parts cross the wound from above down: the hinder piece of gluteus medius, pyriformis, gemellus superior, the tendon of obturator internus, gemellus inferior, quadratus femoris, adductor magnus. The *vertical* muscles seen under the lid are proximal parts of the hamstrings (Fig. 117). A narrow tongue, more deeply placed, and lateral to where the fleshy fibres of maximus insert on femur, is vastus lateralis.

Structures related to the borders of pyriformis.—At its *upper edge* are the superior gluteal vessels and nerve. The nerve runs forward with offsets of the vessels, and is concealed at once by

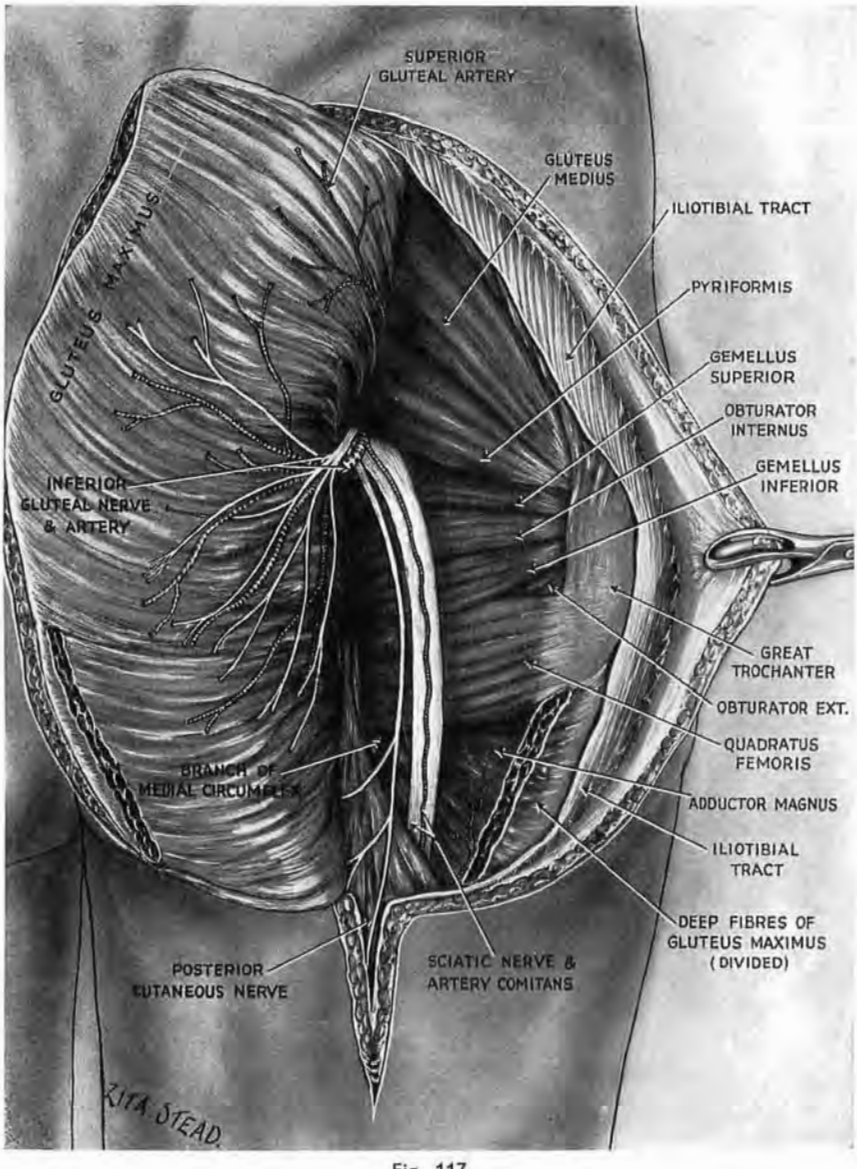


Fig. 117

The gluteal lid hinged back

The exposure is completed except in respect of the subgluteal arc formed by pudendal bundle (see the next figure—Fig. 118). Biceps is left in place to stress the fact that on its way to fibula the sloping belly crosses the sciatic. Therefore in following the nerve prolong the stem of 'question-mark' and mobilise the biceps : raise the belly like a bucket-handle and trace the nerve deep to it. (Only the *infra*bicipital part of sciatic lies between inner and outer hamstrings.)

gluteus medius. The artery and *large* companion veins continue into maximus and constitute a veritable danger spot—three finger-breadths in front of the posterior superior spine of ilium and three below the crest—a point to keep in mind when hinging back the lid.

At the *lower edge of pyriformis* the most superficial structure to emerge is the inferior gluteal nerve whose trunk breaks up at once in branches of supply to maximus and screens the lower gluteal vessels. These last send offsets down beside the structure next in depth—the small sciatic or posterior cutaneous nerve, already seen and spared (p. 183). It lay (before we had displaced it) along the posteromedial edge of the " huge great sciatic nerve "—the one oasis of description Gogarty could find in ' Cunningham ' [1] (Figs. 116 and 117).

Still deeper is the nerve to quadratus femoris—deep to the gemelli group and reaching the *deep* face of its own muscle. Its course is covered by a finger laid beside and lateral to the ischial tuberosity.

The internal pudendal bundle.—This, too, emerges at the lower edge of pyriformis, curving between the great and small sciatic notch, and lying deep and slightly medial to the lower gluteal screen of nerves and vessels—a source of hæmorrhage to think of once gluteals are controlled, and one whereon we might be called to pounce ; which we can do as follows.

FINDING THE SITE OF THE PUDENDAL BUNDLE.—Use the left hand for the right side, and *vice versa*. Abduct the thumb *widely*. Slide the forefinger up across the sciatic trunk and then along the back of the ischial tuberosity. Keep the palmar surface of the finger flat against the bone and let the distal phalanx pass deep to pyriformis, into the great sciatic notch. The finger will advance until the web of the outstretched thumb is stopped against the great trochanter (Fig. 118). Then the tip of the finger, slightly flexed, will press on the arc of the pudendal bundle ; this as a rule sticks fast to its background and will not let itself be hooked without a little blunt dissection.[2]

Thus, after hinging back the gluteal lid, a single rapid movement finds the bundle and allows precise insertion of a tampon

[1] Failure to realise that the long head of biceps slopes across the back of sciatic may cause confusion—especially if we attempt to trace the nerve through insufficient stems of ' question-marks ' (see Fig. 117, and legend).

[2] The bundle, one should know, consists of three parts : pudendal vessels flanked by two nerves. The vessels lie more or less on the tip of the ischial spine ; the internal pudendal nerve is on the inner side of the vessels ; the small nerve to obturator internus (which also gives a twig to gemellus superior) lies on their outer side.

(Mikulicz for choice). This may stop the bleeding, or, at least, will stanch it and give time to reach and tie the parent trunk by means of laparotomy. The pudendal artery can then be found

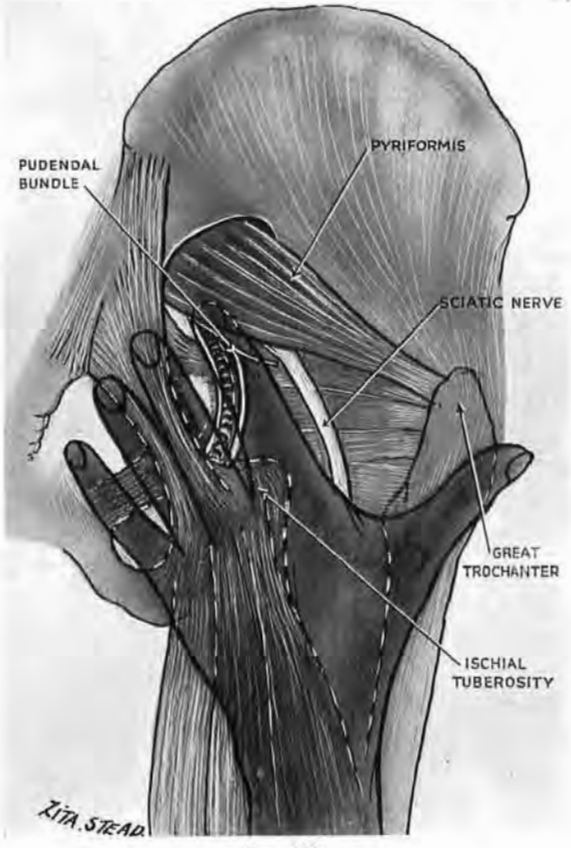


Fig. 118

Finding the pudendal bundle

Using the left hand for the right side and vice versa, the index slides on the tendon-covered back of ischial tuberosity, lengthwise, till the hand is stopped by great trochanter making contact with the web of the outstretched thumb. The tip of index passes *deep* to pyriformis into the great sciatic notch and comes to rest on the pudendal bundle.

extraperitoneally, in the space of Retzius, by means of light traction on the obliterated umbilical artery (p. 168).

Repair.—We must most carefully reconstitute the field of operation—especially the proximal expanse of iliotibial tract. Smooth function here depends on normal interplay of all three portions of the pelvic ' deltoid '—of tensor, tract and maximus. A

hernial defect (with bulging of gluteus medius) may lead to snapping-hip, or to recurring, noiseless subluxation of tract on great trochanter. In either case the consequent imbalance makes and unmakes a postural deformity which certain temperaments are haunted by, and some (however innocent) exploit.[1]

THE ROLE OF GLUTEUS MAXIMUS IN CERTAIN MOVEMENTS

I have been urged (and even begged!) by some to omit the pages relevant to this heading; others, again, write *stet* to them.

A voice, now vanished, has decided me: these pages caught at least the fancy of the late Frederick Wood Jones—who vouched in no way for their accuracy. So far as they go they are, I know, true; but I am also sure that the observations they record were made, by force of circumstance, on too few subjects; they thus suggest the " always " that never happens in anatomy.

I am convinced, however, that certain critics—for two reasons, or even three—rejected them without sufficient pause: they may have been misled, as I have been myself, by palpating a taut hamstring in mistake for gluteus maximus; others have touched the neighbouring upper part of vastus lateralis. Between the Scylla and Charybdis of that lively pair, fingers are easily persuaded to a wrong decision on the *in*activities of maximus.

Another source of error stems from the fact that most of the human guinea-pigs at my disposal in the last war were " of the greyhound breed ": their bellies, however fair, were never round, in Shakespeare's sense—an autonomic state whose lasting upkeep seems to demand a ' guy rope ' contraction of the maximi.

A third and less excusable mistake is to forget that even if we bend a *finger* against enough resistance, almost every scrap of striped body muscle—from neckline to sphincter—contracts; though few can claim to be protagonist.

Other generations, aside perhaps from Leonardo's, knew little of the workings of the large, mysterious bulk of maximus; they called it " abductor," etc., etc. I remember my own surprise when a recumbent subject under test was able to raise his pelvis

[1] Two examples: (1) Gluteus medius hernia (after Ober's operation of fascial division for backache) which caused undue preoccupation with shifting aspects of a great trochanter. (2) A rather simple individual with snapping hip, who drew a useful pension for " recurring *dislocation* " of the joint. A loud click synchronised with three-inch shortening of the limb—apparent, but extremely lucrative.

from the floor *without* contracting either maximus. We are, indeed, still groping.

The following is my grope. It was, I feel, worth making—if only to distract a chief Anatomist of one's time.]

A sitting man cannot raise himself if the part of his body which is in front of his centre of gravity does not weigh more than that which is behind his centre of gravity without the use of his arms.

The sinew which guides the leg, and which is connected with the patella of the knee, feels it a greater labour to carry the man upwards in proportion as the knee is more bent; and the muscle which acts upon the angle made by the thigh where it joins the body has less difficulty and has less weight to lift because it has not the additional weight of the thigh itself. And besides it has the stronger muscles, being those which form the buttock.[1] LEONARDO DA VINCI.

If when you grasp a muscle you can shift it easily from side to side, you may be sure the muscle is relaxed sufficiently to make it—at the moment of your test—unfit to work as a prime mover. That state of idle relaxation is the state of maximus in most of the activities which text-books claim for it[2] (though fingers must be careful not to take for its contraction the *neighbouring* activity of hamstrings).

[1] These are in no way final and decisive statements: each is a *note*—"the shadow of a thought in process of formation."

[2] A pair of these accounts (with comments in parenthesis) appear below. They may, I think, be handled as unfeelingly as fossilised remains: the uncoordinated "actions" of a single muscle are parentless survivals, out of date since the Renaissance.

From Gray's Anatomy, 1942, *28th Edn., p.* 634.—"When the Gluteus maximus takes its fixed point from the pelvis, it extends the thigh and brings it into line with the trunk." [*The muscle is lax during the movement.*] "Taking its fixed point below, it supports the pelvis and the trunk upon the head of the femur, and, so far as the hip-joint is concerned, the maintenance of the erect attitude is ensured by the balanced tone of the Gluteus maximus and the other extensors of the joint, on the one hand, and of the flexors of the joint on the other hand." [*The maximus is absolutely lax in static natural erect positions, but if we spring to full 'attention,' and (in our zeal) incline to thrust the pelvis forward, it thrusts the pelvis forward* (see footnote p. 195),*—a fault that has no part in keeping us erect.*] "Its most powerful action is to raise the trunk after stooping by drawing the pelvis backward." [*The maximus is lax throughout the movement.*] "It is a tensor of the fascia lata, and through the iliotibial tract it steadies the femur on the tibia during standing when the extensor muscles are relaxed." [*See the last comment but one, above.*]

From Cunningham's Text-Book of Anatomy, 1943, *8th Edn., p.* 508.—"The gluteus maximus is mainly an extensor of the thigh and has a powerful action in straightening the lower limb, as in climbing or running." [*Does this imply: when acting from its origin? For presently we find the phrase:* "Acting from its insertion"*—as if to signify antithesis. If the antithesis is meant, the words suggest a retropulsion during climbing, just as they did when used in* 1922 (5th Edn., p. 417).] "Its lower fibres also adduct the thigh and rotate it laterally." [*The fibres meanwhile are relaxed.*] "Acting from its insertion the muscle is a powerful extensor of the trunk when the body is being raised from the sitting

The muscle, for example, is relaxed if we extend the hip; in standing still; in rising from the exercise of touching toes with straightened knees; in leaning back when seated. Tradition has enjoined on maximus the task of moving *back* the femur and the pelvis. These movements in reverse are fortunately absent, else we should never climb the stairs, or leave a seat by voluntary act: gluteus maximus would guarantee that we were damned (like Sisyphus) to lasting retropulsion.

The muscle works quite otherwise. Taking a fixed and distal point in front, at the insertion of the ilio*tibial* tract upon the *front* of the tibia, its action (leaving seats or mounting stairs) helps to effect the raising of the pelvis and the femur *forward*, strapping each to each in such a way as to combine great solidarity with requisite mobility.[1]

The task indeed seems herculean, befitting well the bulk of maximus. But looking closer at the muscle we find the *length* of fibre far too short for the achievement: it measures roughly half the length of the required range of movement, and even maximal contraction could only bring the trunk through less than a quarter of the path it actually travels to surmount the foot.

I think it therefore possible that maximus may work instead like a *supporting* giant—a kind of Atlas—bearing the body's weight with fleshy hands while quadriceps, relieved of strain, procures the movement up and forwards of a mass maintained at every stage in levitation.

What happens when, unaided by our arms, we rise to full height from a chair? Before we leave the seat the trunk tilts slightly towards the knees—a movement due, I think, to iliopsoas, not to rectus femoris. The feet are usually drawn back, and thus reduce the distance which the trunk must go to reach a stable

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or stooping position;" [*But these are movements made in* opposite *directions: the trunk moves forward from the sitting posture; backward from the stooping posture.*]

Perhaps, since 1498, sufficient time has passed to let our text-books try the plan of Leonardo and link the muscles with descriptions of our common *acts*. Their total is, he notes, eighteen—a figure whose correction would do nothing to reduce his genius or evince a trace of it in others.

[1] The *femur* is slung forward as a whole by maximus in virtue of the junction which the lateral intermuscular septum makes with the part of iliotibial tract that constitutes the tendon of maximus. The septum at its inner edge is fixed to linea aspera; its outer edge, as we shall see below (p. 218 and Fig. 136, B), joins with the hinder border of the tract. And so, by way of tract and septum, maximus secures a purchase on the shaft throughout its length.

The 'strap' effect is due to *tightening* of the tract whose pressure on the great trochanter forces the backward-sloping neck to drive and hold the head of femur up against the *front* of acetabulum.

equilibrium. Then both the maximi contract, and—like a pair of hands passed from in front to curve behind the pelvis—begin to lift the trunk and thigh (this last through the iliotibial tract and lateral septum, see p. 218) together forward on the legs. In front the quadriceps conducts the movement. And then surprisingly, while hip and knee are still in flexion, first maximi, then recti, cease to act and leave the *final* straightening of the limb to semitendinosus.[1]

This action of a hamstring may seem strange, because we learn (by rote) to call the hamstrings "*flexors* of the knee." And so they are—provided that the foot is off the ground and quadriceps is lax. But the semitendinosus differs from its fellow hamstrings: it is attached in front of—not behind—the 'centre' for the movement of the knee; its lower tendon curves like fingers round the lever of the tibial shaft. So, when the foot is standing firm, and while the ankle acts as fulcrum, then a contraction of the muscle will pull the top of the tibia *back* and bring the knee to full extension. And you will find that if the trunk is vertical (and therefore does not need the aid of other hamstrings to check a forward plunge), semitendinosus, alone of all the local bellies you can feel, is genuinely taut throughout the movement. It is, in fact, a service-pattern 'muscle of attention'.

A model made in plasticine of the half pelvis seems to throw further light. Let it be flat at first, on the Mercator principle; string it with thread attached like maximus from ilium to coccyx and thence continued into 'iliotibial tract'. Pivot the slab upon its 'acetabulum'; pull the loop forwards, letting your hand sink slowly as it pulls. Almost at once the 'semi-pelvis' tilts. Now mould the plasticine which stands for ilium in close accordance with the bone: make it look backward at its hinder part, and

[1] The sudden laxity of maximus is fortunate perhaps if we consider how the *hyper*active muscle lifts the pelvis nearly to the summit of the arch of opisthotonus produced by strychnine or by tetanus, in gross exaggeration of the movement which a patient makes to let the nurse remove a bed-pan. In this routine event the quadriceps is not protagonist, and maximus, behaving now as a *protrusor of the pelvis*, must put forth all its strength—a thing it rarely does, leaving to other muscles acts it might perform, and working when it must; and then with notable economies of effort.

That is a common character of muscle. A palmar flexion of my wrist against the force of gravity, and made with fingers loose, tightens the tendon of my flexor carpi radialis, which stands out like a ridge. Then, if I close my grip, the radialis ridge goes limp and fades, throwing the work instead upon a broader ridge of finger flexors. A loosening of the grip restores the *status quo*: the radialis juts; the finger tendons fade. And while the order of this devolution fluctuates in wrists which (unlike mine) possess a long-palmaris tendon, the principle remains. No wonder, therefore, that we sometimes note a will to do the minimum and 'pass the buck'; these traits—united with the most unhuman *readiness*—are in the grain of all our striped activity.

splay it out; stagger the 'coccyx' inward from the 'ischium'. Pulling once more you find that a large fraction of the force which made the model nod when it was flat is now absorbed in twisting it: the downward pull instead of causing an immediate nutation begins to turn the slab in such a way that if the plasticine were living bone the pubis would be forced towards its fellow at the symphysis, and ilium would try to wrench itself away from sacrum.

Here—in connection with nutation—our plasticine perhaps illuminates the problem of the deeper caudal piece of maximus affixed to the gluteal mark: the fibres ought, one feels, to pull the upper part of femur *back*. Yet, if we force the thigh to full extension on the trunk, and then as far as it will go behind the buttock, though hamstrings harden, maximus is limp. And, when we rise from chairs, the upper part of femur travels *forward*. (The only backward-moving portion is the lower end—drawn backwards as we saw (p. 195), by semitendinosus when maximus had *ceased* to act.) Possibly these caudal fibres help in countering the forward inclination of the pelvis produced by rectus femoris and upper parts of maximus.

With plasticine (as in the art of surgery) experience may be fallacious; but, as one handles it, a feeling grows that maximus could play a Titan's part—moulding the shape of pelvis, and redoubling special portions of the bone predestined to *withstand* the stress of moulding—a dual part that might be found to mark for anthropologists, the hillman, say, from certain dwellers on the plain. And, if the skull shape alters rapidly with new environment (as Ridgeway thought in 1908, and Boas tried to prove in 1912),[1] may not the shape of pelvis too? Or could a faster change, in favour this time of obstetrics, be got by early training of the muscle?

It seems, perhaps, that Aristophanes was right when (in the *Clouds*) he let his students of astronomy look skyward with their rumps: gluteal muscles bring a host of problems into focus.

The care of convalescent maximi.—A brace of simple rules emerge from these conceptions. The patient, while recumbent,

[1] Sir W. Ridgeway, 1908, *Presidential Address to the Section of Anthropology*, British Association for the Advancement of Science; Franz Boas, 1912, *Changes in Bodily Form of Descendants of Immigrants*, Washington D.C. 61st Congress, 2nd Session, State Documents 64, Document No. 208.

must be *lifted* on to bed-pans in order to prevent the all-out effort of the maximus that goes with a protrusion of the pelvis (see footnote, p. 195). Then, when he leaves the bed, we *lift* him to his feet and keep him on the level. There he may walk (gently and making short steps) with maximi as limp as battle-dress—a gait that we must teach *before* the patients rise. (In normal gait the fibres of the maximus stretch while the moving limb swings past its fellow, till, as we ground the heel, they harden suddenly—a little on the flat, but more and more with rise of gradient. Contracting thus they help the pelvis on to overtake the foot.)

So, in his *early* convalescence, the patient need not use the damaged maximus; and if, as well, we lower him to sit or lie and do not let him stoop, he will not strain its fibre.

THE FRONT OF FEMUR

This (like its brachial homologue) is covered by a half-sleeve of muscle; and whether we explore the back of humerus or front of femur our practice is identical: we look first for a *seam*, then open it to find a deep head coating bone and crossed obliquely by a neurovascular bundle. Accordingly, to reach the shaft in either case we rip the seam, loop the bundle, and split the deep head.

I shall return to these points later.

APPROACH TO THE FEMORAL SHAFT FROM IN FRONT

Exposure of the femur from the outer side was once the fashion: it called for no reflection—the surgeon cut directly down on bone. The inconvenient, unsightly and bloody wound seemed to suggest a price exacted for security, together with a certain disregard of structure. The knife thus used transects the slanting fibres of vastus lateralis, a goal of all four perforating arteries and of the branch descending from the outer circumflex. The patient, too, must lie upon his side, or else the surgeon works at disadvantage.

The method found below [1] respects anatomy, is relatively bloodless, and gives a wide exposure: over twelve inches of the *shaft*—

[1] *British Journal of Surgery*, 1924, **12**, 84.

from small trochanter to the lower end—are easily accessible. We look in comfort on the front and sides of femur; and while the patient still lies flat, we can secure a safe, dependent drainage.

Let us now take up the points of the first paragraph.

The *half-sleeve* consists of the quadriceps, enclosed in fascia; its seam (which shapes the course of our incision) lies between vastus lateralis and rectus femoris—a pair of heads that part towards their origins and form a V-shaped entrance to the sleeve. This entrance will be found a handbreadth distal to the great trochanter, in line, of course, with the incision which runs from anterior superior spine down to the outer angle of patella (Figs. 119 and 120). For further guidance grasp the long and relatively mobile rectus head below the 'spine,' and move the muscle crosswise; the outer margin of the mobile zone will mark the seam (compare p. 115).

The upper part of Fig. 119 shows that we must separate two other bellies—sartorius and tensor fasciæ—a very simple act for those who take the care to mark out incisions precisely. Then when the seam is ripped two structures must be kept in mind before exposing bone—suprapatellar pouch and neurovascular bundle.

The neurovascular bundle.—Coating the femur, when we rip the sleeve, we see a silvery fish-like belly—the deep, investing belly of crureus (or vastus intermedius in B.N.A.). A bundle slopes across its face consisting of the nerve (or nerves) to vastus lateralis plus outer branches (with companion veins) of lateral circumflex artery. This bundle can be found—in providential fat—a handbreadth distal to the great trochanter; and when it has been mobilised and looped up like a bucket-handle, *then* we can split the muscle deep to it and reach the shaft (Fig. 120).

The *suprapatellar pouch* spreads, when the limb is straight, three fingerbreadths above patella. Pouch and bundle are described below in further detail.

THE OPERATION

Position.—With the patient flat on his back, extend the knee on the side of operation; then raise the heel well off the table, relaxing rectus femoris.

Incision.—Divide the skin (and afterwards deep fascia) from anterior superior iliac spine to the outer angle of patella (Fig. 119, B). It is important to make this cut in such a way that we can open fascia *between* the tensor muscle and sartorius.

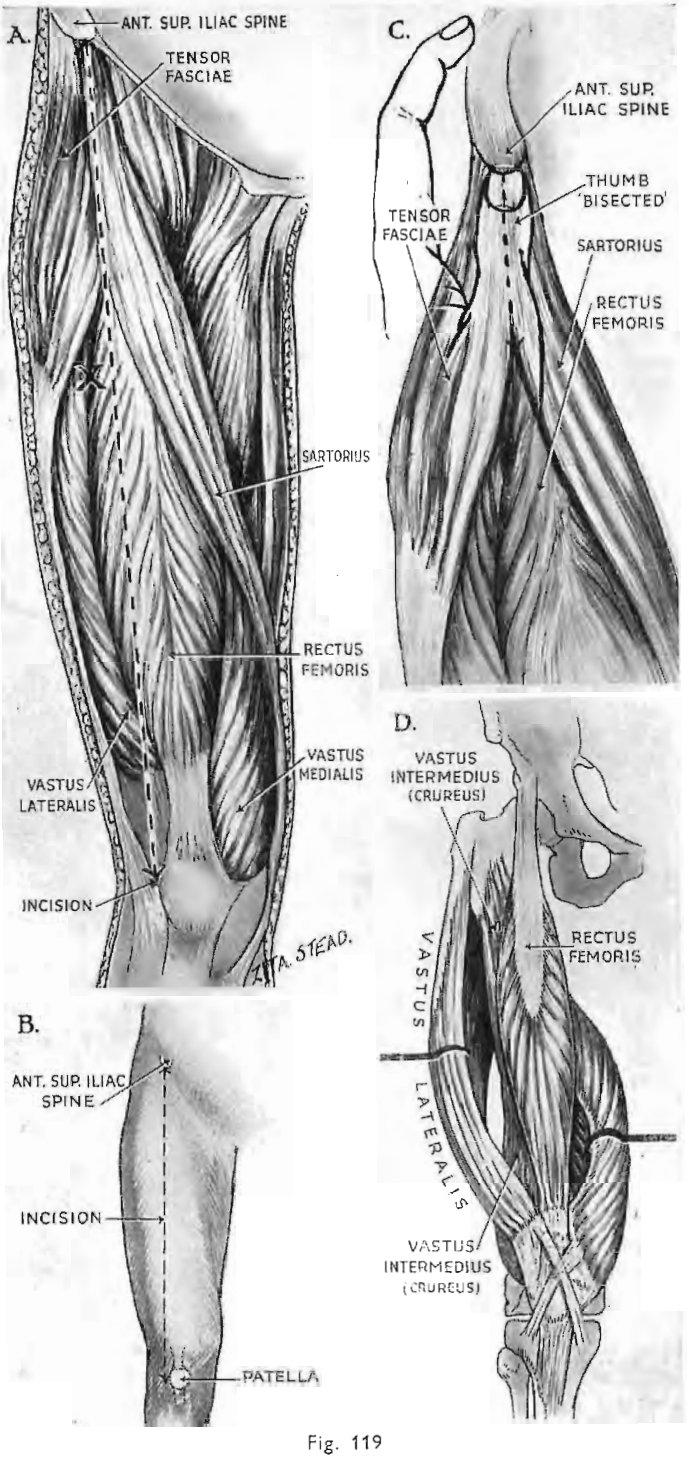


Fig. 119

The quadriceps sleeve in relation to the anterior incision

The cut goes from anterior superior spine to the outer angle of patella—close to the seam between rectus femoris and outer vastus (A and B). Find the entrance, X, to the sleeve one handbreadth below the top of great trochanter (or *two* handbreadths below anterior superior spine). From there the seam rips easily. The common mistake is to make the cut too far out. Avoid this by catching the thumb-nail squarely under the *notch* of the ' spine ' (C). The knife ' bisects ' the thumb and parts sartorius from tensor fasciæ. D (*after* Poirier) shows the segments of the sleeve, and how part of vastus intermedius (crureus) lies *behind* the distal half of vastus lateralis, though these last two are often fused.

Begin exactly at the centre of the very shallow notch immediately below the ' spine.'

It is impossible to find it by approaching from above; feel therefore from below. The thumb does this best, catching the notch with its nail. A cut can then be made as if to split the thumb

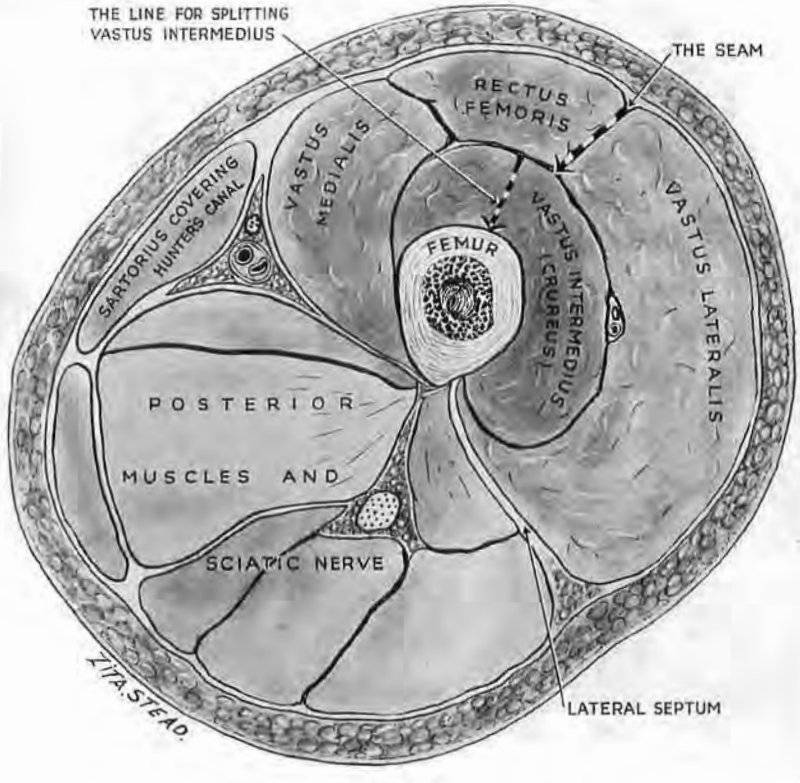


Fig. 120

The quadriceps sleeve in cross-section

Note the position of the seam, which must be ripped, and the line for splitting vastus intermedius—the deep, investing head which coats the femur.

in half (Fig. 119, c). The common error is to choose too lateral a point; the knife strays into muscle and butchery begins.

Planes of cleavage.—The finger finds the V-like interval between rectus femoris and vastus lateralis, a handbreadth distal to the great trochanter; and passing down between the bellies meets with minor vessels, which are caught and cut. More distally the finger will be checked where the vastus fibres join the rectus margin; then we use a knife.

The trilaminar tendon of quadriceps.—A working knowledge

here will let us rip the sleeve still farther down and thus obtain a maximal exposure.

The stout component from the rectus femoris lies in a groove provided by the distal parts of medial and lateral vasti (Fig. 121). Adjacent portions of these vasti, flush with rectus tendon, fasten on its borders and send their deeper fibres of insertion round behind to make a common sheet which cradles it. This interwoven sheet (the second lamina) lies on the third and deepest—formed, of course, by tendon from the vastus intermedius (the part of quadriceps once called crureus).

So, if we wish to mobilise the distal portion of the rectus and

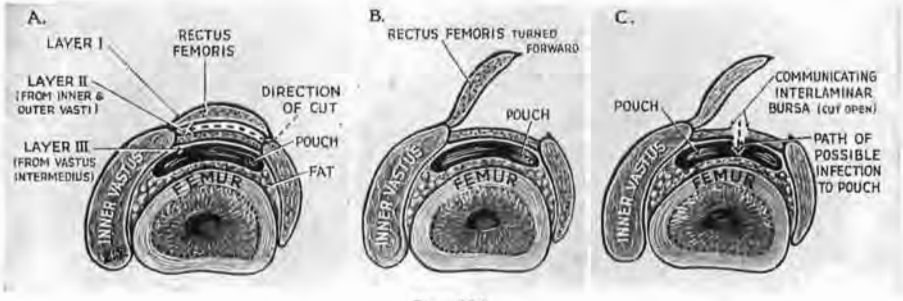


Fig. 121

Delamination and rotation of quadriceps tendon to secure further distal exposure of shaft

A. Divide the edge of rectus tendon from vastus lateralis ; then, with the knife laid flat, detach the *back* of rectus tendon down to patella. This will let you twist the tendon (B)—and, with it, all the rectus—farther forward, exposing more of vastus intermedius *belly*. (In order to avoid the pouch, the splitting of intermedius belly (Fig. 122, A) is checked four fingerbreadths above patella—a point which lies, of course, above the level shown in these pictures.) Note the fat between pouch and bone, which (with the extra access got by delamination) lets us separate the pouch intact and reach the distal limit of the shaft. C. Shows the theoretical risk of delamination in presence of sepsis—if any interlaminar bursa should happen to communicate with suprapatellar pouch.

bare the shaft still farther down, we separate at first the *edge* of rectus tendon from the vastus lateralis ; then, with the knife blade in the frontal plane, we cleave its hinder surface from the vastus sheet and so delaminate the tendon of the quadriceps (Fig. 121, B). After this cleavage we can twist the outer edge of rectus *as a whole* much farther forward and so get extra room to see and split the fish-like, bone-investing belly of the vastus intermedius.

The frontal cut to cleave the laminæ of quadriceps should not be made in presence of infection : bursæ are found at times between the layers, and might (if they were sliced, and chanced as well to join with the synovial pouch) bring sepsis to the knee (Fig. 121, C).

The neurovascular bundle.—Now that the sleeve is ripped the slanting bundle shows, a handbreadth distal to the top of great

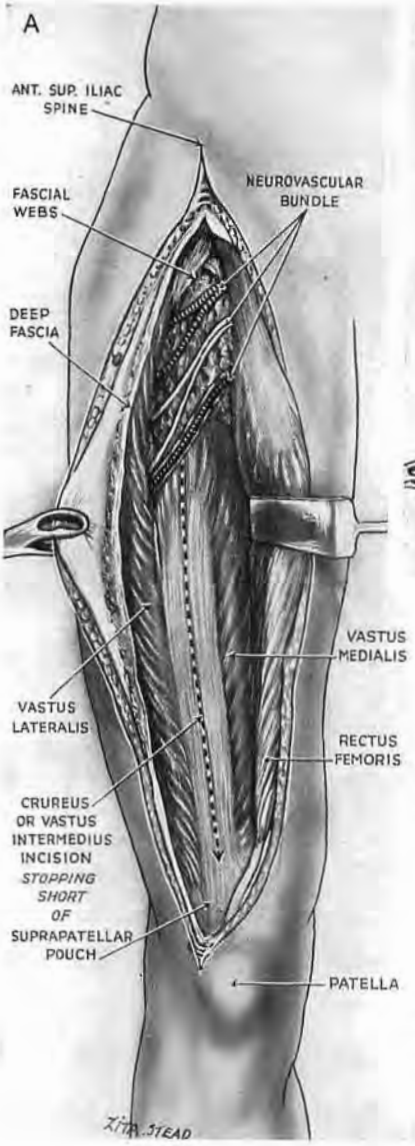
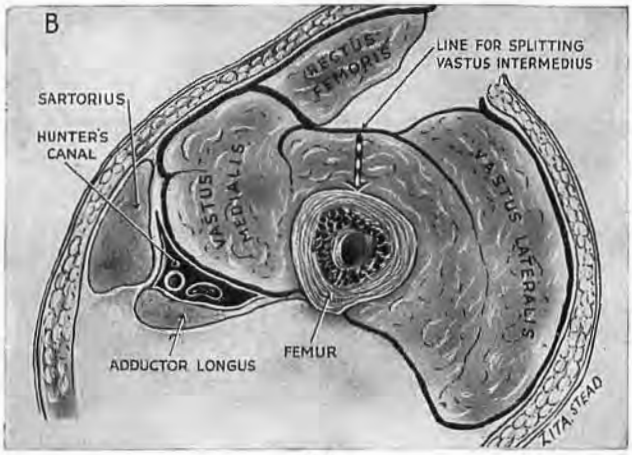


Fig. 122

The neurovascular bundle

A and B. Separate rectus femoris from vastus lateralis which is crossed obliquely by descending branches of lateral circumflex vessels and the nerve to vastus lateralis. Above this, and sometimes separated from it, are transverse circumflex vessels. C. Mobilise the bundle beginning at its distal end. Raise it like a bucket-handle and split vastus intermedius lengthwise ; check the split four fingerbreadths above the top of patella. (Be sure you raise the transverse part of the bundle as well as the oblique.)



trochanter. The nerves and vessels reach the outer vastus and sink into it. Often they spread out fanwise (as in Fig. 122, A) or else divide into quadrants, two or three in number. A thin transparent fascia binds them (with surrounding streaks of fat) to vastus intermedius. The presence of this fat makes mobilising easy. Division of the binding film along the lowest streak will often let us raise the bundle as a whole upon the finger—like a bucket-handle. An upper transverse part is sometimes missed through carelessness; and sometimes quadrants widely separate may need a further opening of the film (Fig. 122, A).

Under this arching 'handle' cut to bone by splitting through the length of vastus intermedius. Watch for sharp bleeding from a vein divided in the upper fibres.

The suprapatellar pouch.—Avoid a penetration of this pouch which spreads three fingerbreadths above the top of patella and therefore check the split through vastus intermedius a trifle higher up (Fig. 122, A).

If we delaminate the tendon of the quadriceps, we can—in case of need—detach the pouch from bone.

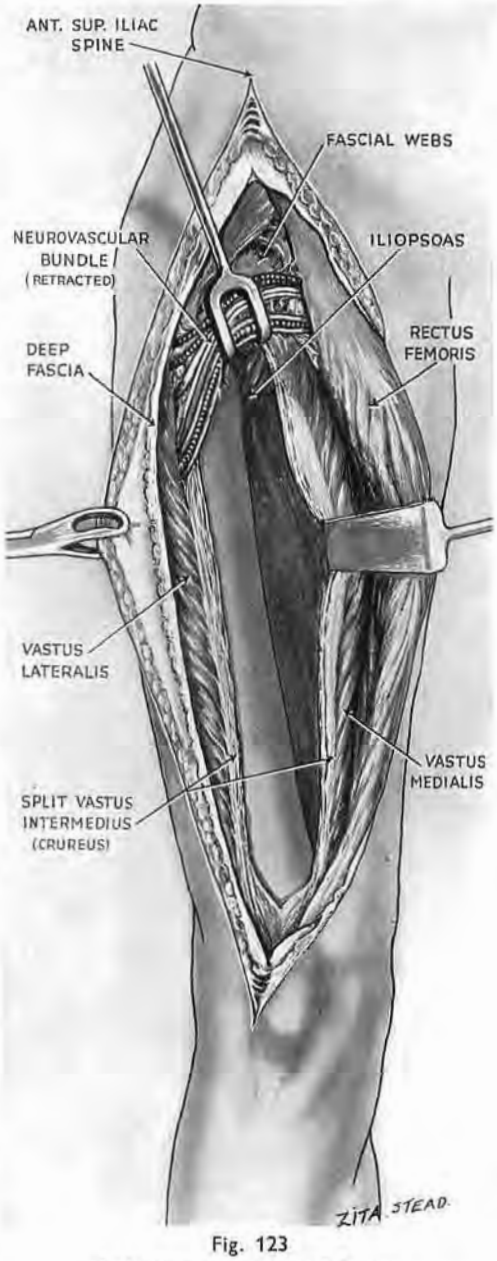


Fig. 123

Anterior exposure of femur

Detach the split vastus intermedius and expose as much of the shaft as you wish.

A broadly bladed osteotome, close against the shaft and moving

distally, will take advantage of the lucky weft of fat that lies between the bone and pouch—a thing to practise first upon cadavers, for round the uninfected knee we should not make too bold with cobwebs.[1] Displace the flaccid pouch towards the joint and so get access to the lower end of shaft.

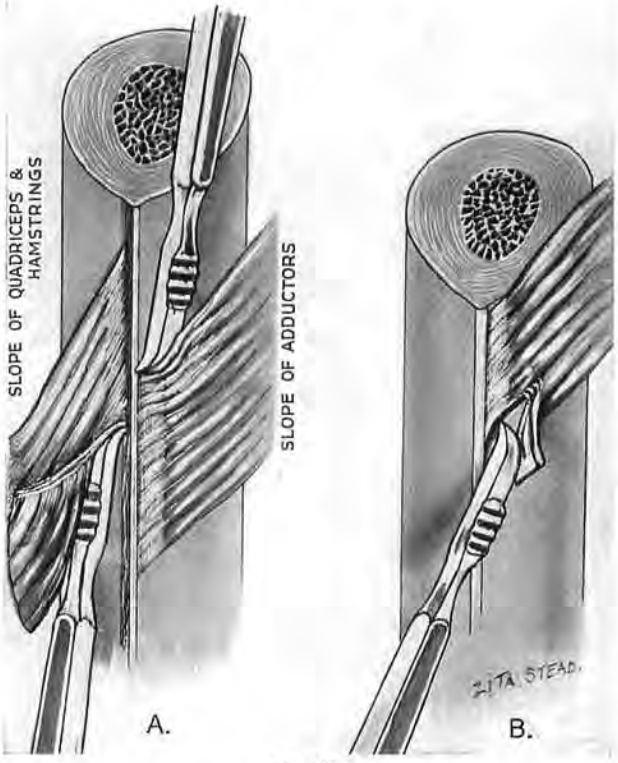


Fig. 124

Stripping the femoral shaft of muscle

A. Work the rugine into the acute or stripping angle which muscular attachments make with bone, *i.e.*, *up* the shaft for all the muscles excepting adductors. Note how the rugine tears into muscle when used in the wrong direction (B) against the obtuse angle.

Retraction of the halves of intermedius will presently reveal a foot or more of shaft—a wide span plus a handbreadth (Fig. 123). But first it must be cleared of muscle.

Stripping the femoral shaft.—The slope of muscle varies : vasti and the short head of biceps travel down *from* the femur ; adductors, *to* the femur. We strip them off most cleanly by working the rugine against the *lesser* angle which the fibres make at their

[1] Attempts at separating pouch from *quadriceps* will nearly always tear the pouch.

attachments—the stripping angle of the muscle. Used in the opposite direction the instrument will tend to leave the shaft and tear the fibres—especially at linea aspera where rugged edge and toughly planted tendon contribute (with the effort they evoke) to sharp and sudden deviations (Fig. 124, B).

Beginning at the inner side detach from linea aspera the origin of vastus medialis, which forms the medial intermuscular septum (Poirier) by working *up* the bone ; then separate adductors in the opposite direction.

On the outer side of shaft the rugine works in one way only—

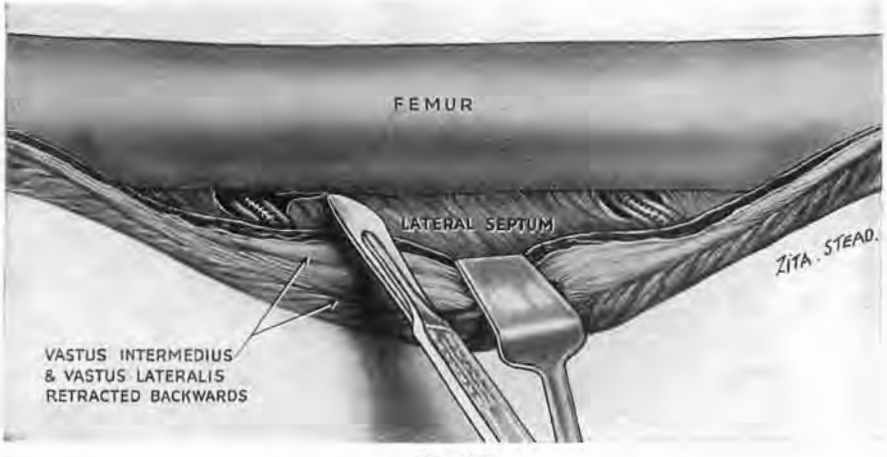


Fig. 125

Stripping the shaft of lateral septum

(The sleeve is open and the femur stripped of quadriceps.) Sit, looking level with the bone. Press back the vastus lateralis and outer moiety of intermedius. Find the perforating bundles coming through the septal archways. The pressure on the muscle draws the vessels back sufficiently to let a *knife* divide the septum from the linea.

upwards : at first against the vasti origins ; and presently—behind the septum—against the shorter head of biceps.

The *lateral intermuscular septum*, irregular in grain and giving passage to the perforating vessels, requires special treatment. Sit looking level with the wound and *see* the vessels coming through their roomy archways. Retraction of the vasti will draw these vessels back sufficiently to let you *cut* the septum close to bone and leave them safe (Fig. 125). (A surgeon, Maurice Pearson, in South Africa—*British Medical Journal*, 1930, **1**, 910—has paid this femoral approach the compliment of making it a ' one-man job.' He has devised retractors (Fig. 126), weighted at the ends, which lever up the shaft and press the muscles back.)

Drainage.—Counter-openings, too, are made with perfect safety by cutting down upon a forceps passed between the outer part of vastus intermedius and the bone. The outer face of lateral septum shuts the forceps off from the sciatic nerve (Fig. 127) and guides it back to skin behind the field of operation. For with the limb recumbent the

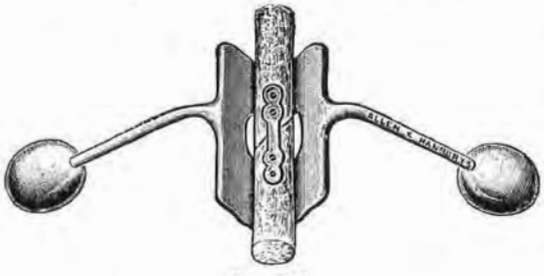


Fig. 126

Maurice Pearson's retractors

These are self-retaining ; they lift the shaft, press back the muscles, and take the place of an assistant.

(The block for this figure has been kindly lent by Messrs Allen & Hanburys.)

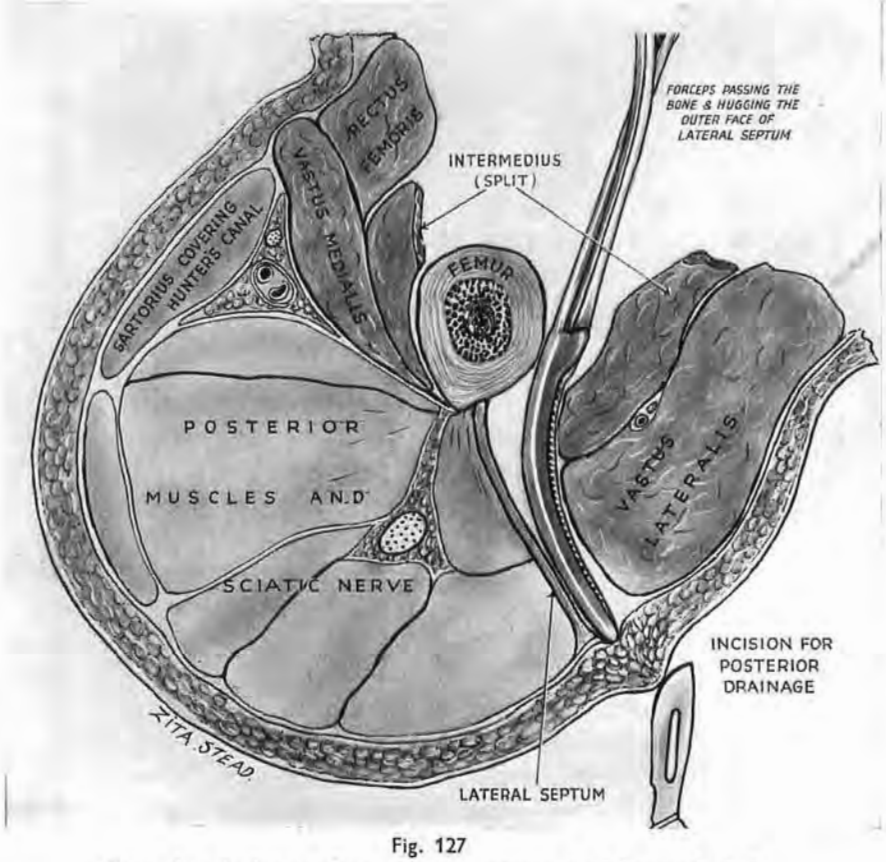


Fig. 127

Posterior drainage after anterior exposure of femoral shaft

When you have ripped the seam and split vastus intermedius, slide a forceps past the outer side of shaft, and make it hug the outer face of septum till the skin is bulged behind. Note how the septum buffers the sciatic nerve.

septum is approximately vertical—a statement true of every portion that we use in making *this* exposure. The reason seems to be as follows. Close to the knee for a few fingerbreadths the septum keeps a frontal plane and faces fore and aft; that is because the mass of quadriceps in front of it is almost equal to the biceps mass behind. But farther up the thigh the quadriceps preponderates so quickly as to turn the septum back into a plane that faces right and left. I stress the point to meet suggestions that exposure of the femur from in front is incompatible with proper drainage.

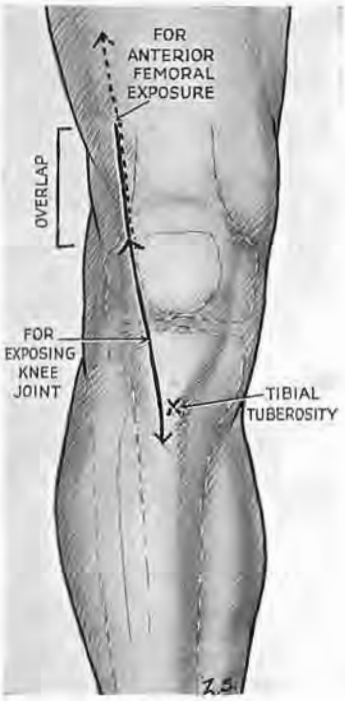


Fig. 128, Part 1

Incision including knee joint with anterior femoral exposure

The black line shows the incision for separate exposure of the joint. The knife avoids the tibial tuberosity.

Extension of Anterior Femoral Exposure to the Knee Joint.—The distal part of this approach is easily continued with the wide benign exposure devised by Timbrell Fisher for the knee joint.[1] He brings his own incision down along the inner edge of the patella. Let us, instead, continue ours along the *outer* edge (keeping, like Fisher, clear of tibial tubercle so that the scar will not be knelt on). This outer cut lies parallel to the main cutaneous nerves and is remote from the medial, transversely placed saphenous branch whose injury gives trouble after menisectomy. Bring the cut a fingerbreadth below the level of the tubercle (Fig. 128). Reflect the skin medially and expose the *inner* edge of patella; expose also the inner edge of quadriceps tendon to the height of four fingerbreadths. Then split the fibrous covering of the patella along the middle line; reflect the cover inwards just beyond the margin of the bone; cut along that inner edge into the joint. Continue this cut upwards (avoiding inner vastus) through the *tendon* of quadriceps sufficiently to let us dislocate the patella (strung between ligament and tendon) so that its articular face rests on the outer side of outer femoral condyle. Flex the knee to a right angle and make the joint yawn. I have used Fisher's fine, original exposure to pick

[1] *The Lancet*, 1923, **1**, 945.

shot-gun pellets from the back of a condylar recess, and also—with the trivial change described above—for excising knees through straight incisions (p. 7).

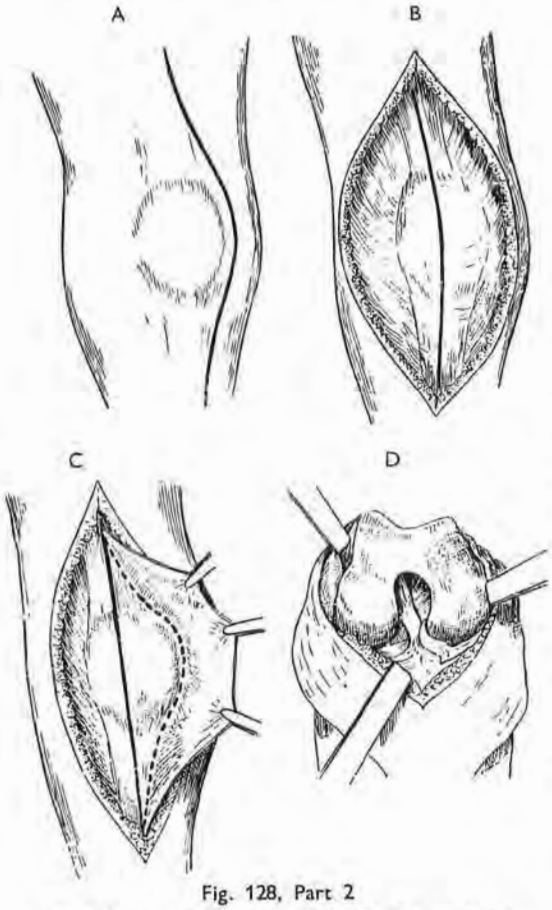


Fig. 128, Part 2

These four drawings, copied by kind permission of Mr A. G. Timbrell Fisher and of *The Lancet*, show that author's original wide exposure of the knee joint through a medial skin incision, A. The procedures figured in B, C and D—reflection inwards of the prepatellar fascia (B), medial arthrotomy (C), and lateral luxation of patella, with flexion of the joint (D)—can all be performed through the *lateral* incision continuing anterior femoral exposure (Fig. 128, Part 1).

Repair will (if we wish) seal the cavity with three staggered rows of suture. Drainage can be got in the face-down position—the only way (without resection of a condyle) of using gravity to empty pools in either blind posterior pouch. But drainage damns the knee joint to adhesions; and where the joint and not the life is threatened, as happens often in the early case of knee infection, I have secured quick healing and good function by injecting 10-15 c.cm. of mercurochrome (1 per cent. in water) after thorough aspiration of pus, repeating the procedure three or four times with two-day intervals. Mercurochrome, I found, was harmless to the joint, and was bacteriostatic in that dosage. (This was before the advent of more recent drugs about whose action on and in synoviæ I have no personal experience.)

THE UPPER PART OF THE ANTERIOR FEMORAL APPROACH

Let us consider certain details of a region shared by this exposure of the femur and by Smith-Petersen's exposure of the hip.

The fascial webs.—After we part the muscles and move towards the femoral neck, two, three, or four superimposed and separate layers of fascia, remarkable in strength and shape, cross the path of the knife. These layers occupy the space between the origins of the rectus femoris and tensor fasciæ muscles, uniting the *deep* aspects of their sheaths (Fig. 129). Each—like the web between two 'Victory' fingers—is furnished with a clear-cut margin, concave distally. *One* of the webs (but which, it is impossible to prophesy) has on its deeper face and near its edge an artery the size of radial—the ascending branch of the lateral circumflex; so it is well before we cut the webs to clamp their margins till we find the vessel.

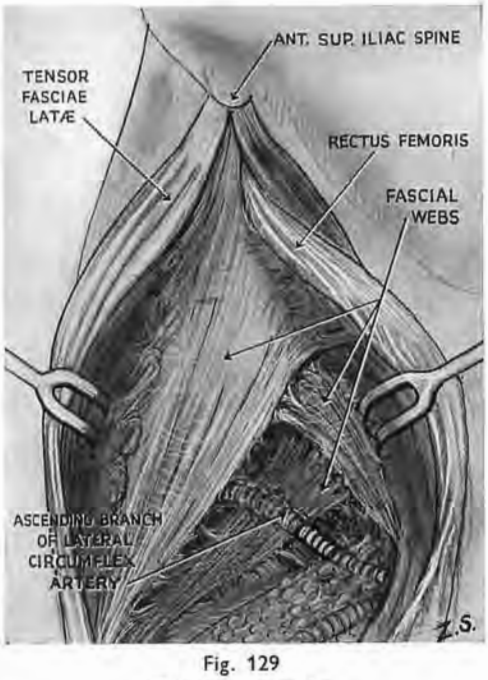


Fig. 129

The fascial webs

These cover the front of hip joint and join the deep aspects of the sheaths of rectus femoris and tensor muscles. Note the relation of web and artery.

These webs deserve a study which I found no time to give them. A glimpse of a figure in Paturet's *Traité d'Anatomie Humaine* (1951), Vol. II, p. 599, a fascinating book, which I owe to the gift of Sir Gordon Gordon-Taylor, led me to suspect a link between my so-called webs and Paturet's 'recurrent' (or third) head of rectus femoris. I have no sure warrant for that surmise, nor (in a very limited search) have I had the fortune to find a convincing third head. I leave Fig. 130 as a guide for more thorough explorations.

The double bonnet.—These web-like structures screen the joint in front. When they are cut a finger-tip pressed firmly on the

capsule can just squeeze in above its upper face and force a path between the capsule and a hood which covers it—a double hood or bonnet formed by gluteus medius and minimus, whose deeper part (the minimus) is moulded down in streamline on the joint. So, to expose the deep articular machinery, we raise the bonnet (Fig. 131).

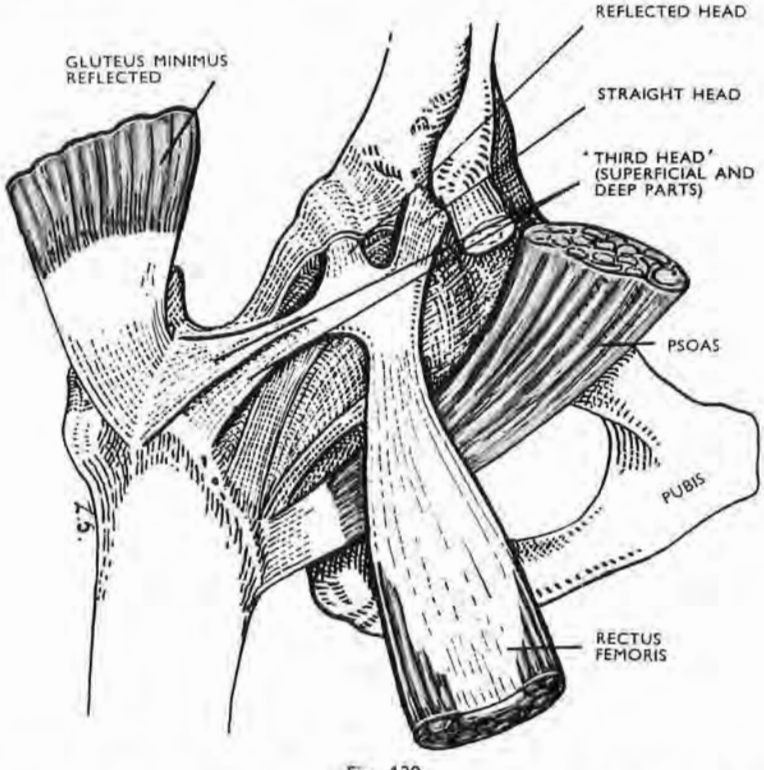


Fig. 130

The 'third head' of rectus femoris (after Paturet). Its deep part joins the iliofemoral ligament and the trochanteric line; its superficial part joins the tendon of gluteus minimus on the front of great trochanter. (The tendon of sartorius is not labelled.)

ANTERIOR APPROACH TO THE FEMUR COMBINED WITH SMITH-PETERSEN'S EXPOSURE OF THE HIP JOINT

These two are complementary procedures, a fact of special value in a fracture dislocation (Fig. 131).[1] And so in passing from

[1] Referred to in a paper on that subject (*British Journal of Surgery*, 1934, **22**, 205) written with Bayumi. Mahmud Bayumi died in 1940, only a short while after the Royal College of Surgeons of England had conferred his Fellowship without examination—a good friend, a loyal follower of Sir Robert Jones, and pioneer in Egypt of common sense in orthopædic methods.

the femur to the hip continue the incision to the level of at least the highest point of the iliac crest—four fingerbreadths behind the anterior superior spine. Then you can raise the twofold gluteal bonnet and turn it back sufficiently to bring the deeply situated hip joint to the *surface*. For that you must, if you are working in the opposite direction (from joint to femur), be sure to rip the seam between the rectus femoris and vastus lateralis at least a wide span

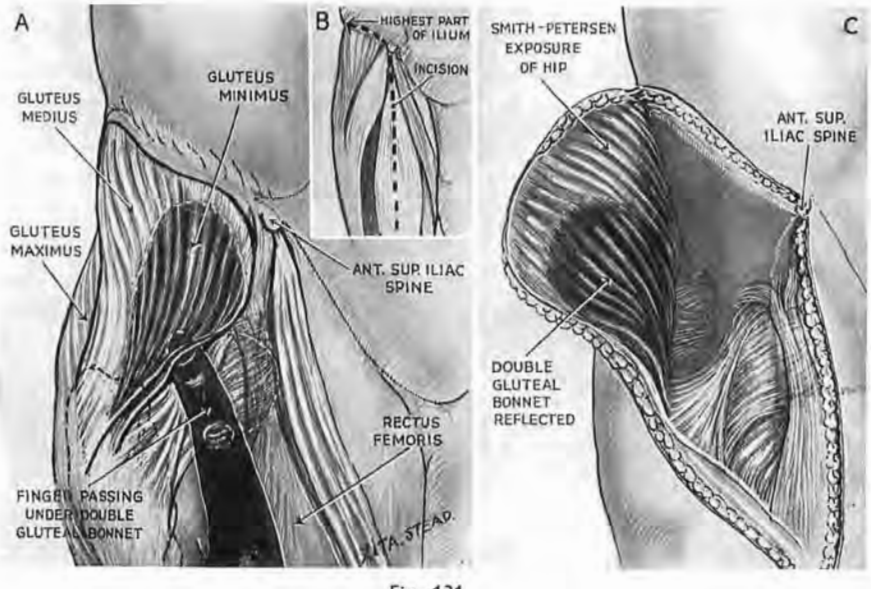


Fig. 131

The double gluteal bonnet and the combined approach to hip and femur

A. Gluteus medius fits over minimus to cover the top of hip joint. B. The incision. Note that it must reach (1) the highest point of iliac crest ; (2) at least a span, distal to the anterior superior spine. This lets you hinge back the muscles sufficiently to bring both joint and femur to the *surface*. C. Shows how the anterior approach to femoral shaft merges with the Smith-Petersen exposure of hip.

distal to the ' spine.' A skimping of the wound, in either case, will leave this deep joint cribbed about by muscle.

I have preferred to *cut* away the glutei from crest and outer face of ilium, instead of peeling off the periosteum : the knife leaves two things that are useful—a carpet on the outer face of ilium ; a fringe along its crest. The fringe will serve for reconstructive suturing ; the carpet lets us catch with ordinary forceps divided vessels in its pile of cut gluteal fibres. But if instead we peel the muscles off, we set ourselves the task of stopping bleeding from a *bone*.

Repair.—Sutures at the crest of ilium bring the great mass of muscle back in place, and pressure keeps it there. Healing is sound in young or old; for fleshy fibres cut from bone (unlike a tendinous detachment) unite again both fast and well.

EXPOSURES OF THE POPLITEAL FACE OF FEMUR

This face can be approached and dealt with from the inner or the outer side; or from the back. Each mode of access has its use. That from the *inner* side is not so easily continued up the shaft: the field is crossed by major vessels which must be mobilised and looped away (p. 215).

The *outer* access on the other hand can be at once prolonged far up the thigh—with due respect for perforating vessels. A medial or lateral sinus requiring excision will frequently decide our choice of route.

Fresh injury, again, may need the third or *mesial* approach, but use of it in face of fibrous matting courts danger to the nerves and vessels. Then, too, a hypertrophic scar may form behind the knee—a chance event, outweighed by ease of access and facilities obtained in tracing nerves and vessels up or down the limb; the place in that respect is like a no-man's land through which attack may go in two directions. (Description of this midline route comes later—with the calf, p. 251.)

THE INNER (MEDIAL) APPROACH

A plan intending to exploit the rear of any situation solely from the flank might seem a hopeless paradox. But in our surgical assault we hold this clear advantage over generals—the *place* can turn obligingly and let us in.

Try it yourself—or on a skeleton—while one (or other) lies upon the back with limbs extended. Rest the outer edge, say, of the *right* foot on the left shin, letting the right knee sag. This turns the popliteal face towards the left—round, nearly, through a right angle. Then, with a sandbag, raise the other buttock (or decorously tilt instead the pelvis of your skeleton): the popliteal surface turns still farther round and looks not only left but up, towards the ceiling.

The vessels and the bone.—In all exposures of the popliteal face we must negotiate the popliteal *vessels*. That is made easy by a thumbwide gap which parts the vessels from the bone and owes existence to the fact that while, above, the trunks lie close against the shaft, below, the condyles (bridged, of course, by capsule) fend both artery and vein away from femur—much as a backward flexion of the fist will fend a ruler, lying lengthwise, off the dorsum of the carpus (Fig. 132).

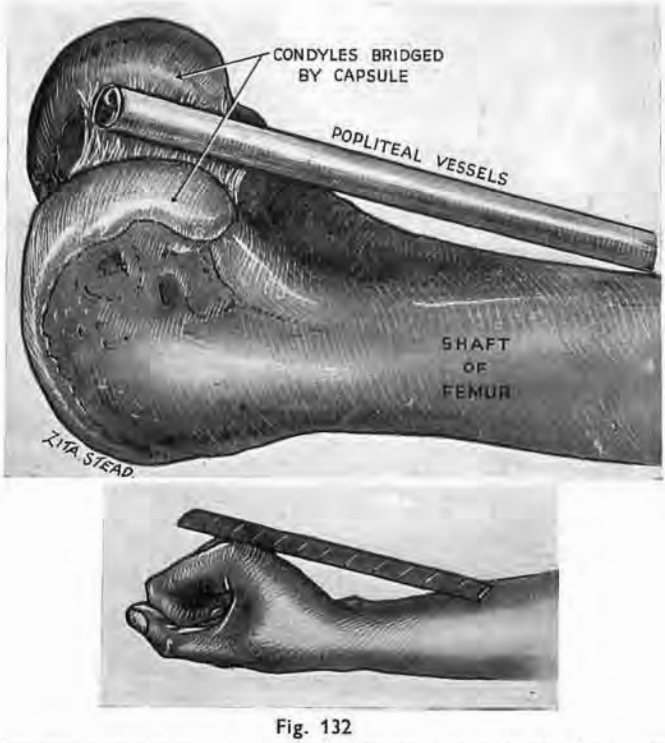


Fig. 132

Showing how the bridge of capsule between the condyles fends the vessels off the popliteal face, leaving a useful thumbwide interval.

The *guiding tendon of the adductor magnus* is overlaid by muscle; sartorius and gracilis cover its medial side. But, when the knee is bent and fascia divided, these bellies slip right back and show the tendon; only a loose, thin membrane just behind this whitish cord remains to part us from the popliteal space.

THE OPERATION

Position.—A sandbag underneath the buttock of the sound side tilts the recumbent patient. Place the foot of the affected

limb so that its outer edge rests on the other shin as near the knee as possible [1] (Fig. 133).

Incision.—Cut *lengthwise* for an ample span, crossing adductor tubercle. The knife follows the bend of the limb and only severs

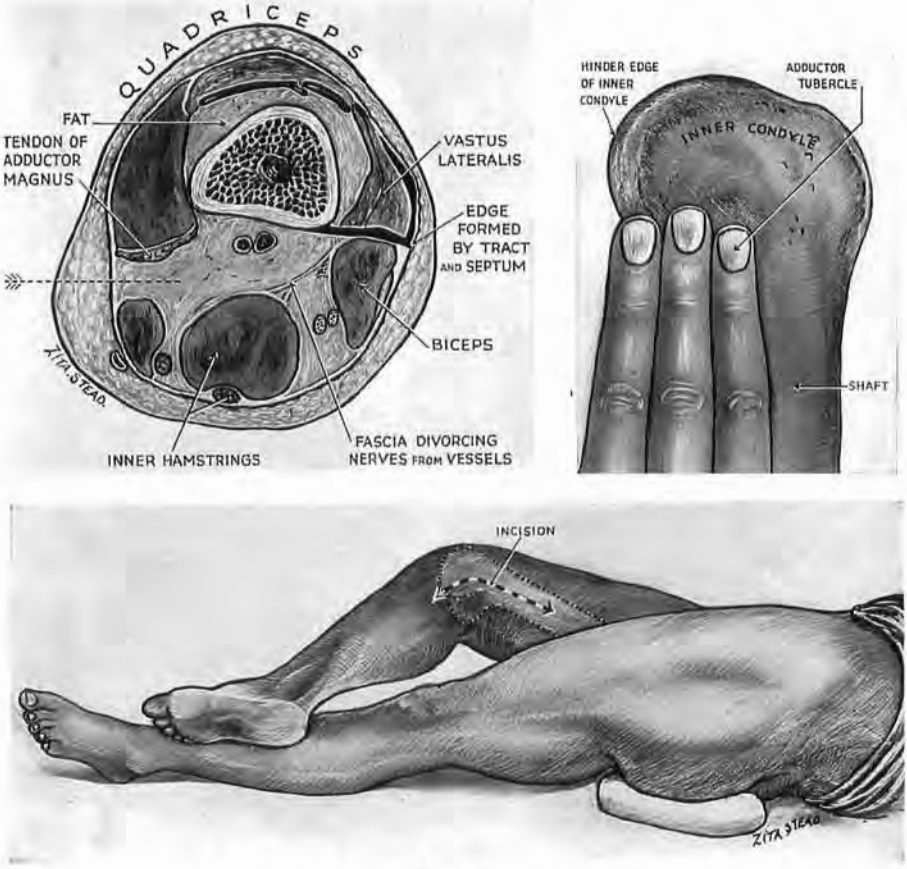


Fig. 133

Position and incision for inner popliteal approach

The knee is shown raised in order to demonstrate the incision clearly ; in practice it rests on the table. Note above a three-finger method of locating adductor tubercle. When the 'free' edge of the hinder finger is at the hinder edge of inner condyle the pulp of the anterior finger covers the tubercle. Note, too, the way in, as shown by the arrow in the cross-section. (This has been adapted from Eycleshymer and Shoemaker, Section 88, p. 146.)

skin and surface fat. Three fingerbreadths of this incision are distal to the tubercle, the rest and major part is proximal (Fig. 133). Be careful here : a medial condyle has often been mistaken for adductor tubercle ; incisions then lie too far back. Locate the

[1] If the knee of the affected side does not flex easily, work from the *opposite* side of the table.

hindmost margin of the condyle; the tubercle is found three fingerbreadths in front (Fig. 133).

Dissect the hinder edge of skin back for about an inch; expose sartorius above the level of the adductor tubercle; divide the fascia in front of it; then (with Mayo scissors 'on the flat') detach the deep surface of the muscle, avoiding thus a risk of injuring synovial membrane that lies between the condyle and sartorius.

The free sartorius falls back and leaves exposed the guiding tendon of adductor magnus in front of which the large saphenous nerve leaves the canal of Hunter. The nerve is sometimes carried off upon the deeper aspect of sartorius; or else lies loosely, strung across the wound. With it is found the superficial branch of the descending genicular artery—the old anastomotic. The *deep* branch of this vessel runs along adductor tendon surrounded by some fibres of the inner vastus. Nor do we see the great saphenous vein (which lies upon the surface of the sartorius), if we have rightly placed our skin incision.

Immediately behind the adductor tendon pick up and open the loose thin fascia—the last impediment before you reach the fossa. Slide a finger in, keeping its back against the tendon, till you touch the centre of the popliteal face (Fig. 134). The *vessels* lie, we know, a thumbwidth from the bone, so bend the finger-tip to find them. Widen the entry to the space and let the finger mobilise the vessels —up to the opening in the adductor magnus, down to the condyles of the femur. As we retract them gently back, some twigs they send to bone string out across the wound and thus are easily controlled and cut. The popliteal face of the femur then lies bare (Fig. 134). (The major *nerves* do not appear in this exposure; they run remote from bone and from the surgeon (p. 221 and footnote to p. 241).)

THE MEDIAL ROUTE EXTENDED TO FEMOROPOPLITEAL TRUNKS AND TO THE SHAFT.—Prolong the upper part of the incision *towards* the mid-point between anterior superior spine and pubic symphysis—in the direction of the femoral artery (Fig. 135). Find the anterolateral edge of the sartorius; liberate and move the belly inwards off the membrane roofing Hunter's femoral canal. Then split the roof and find the vessels. When the knee is bent the femoropopliteal trunks will come to hand with gentle separation and be loose enough to loop aside. The *outward* twigs which moor the bundle here are few and widely spread; one set of these, much larger and more constant than the rest, lies about seven fingerbreadths above the adductor tubercle. A little blunt dissection

made along the leash and on the outer aspect of the parent bundle will let us raise the major vessels like a bucket-handle and clear an access to the shaft.[1]

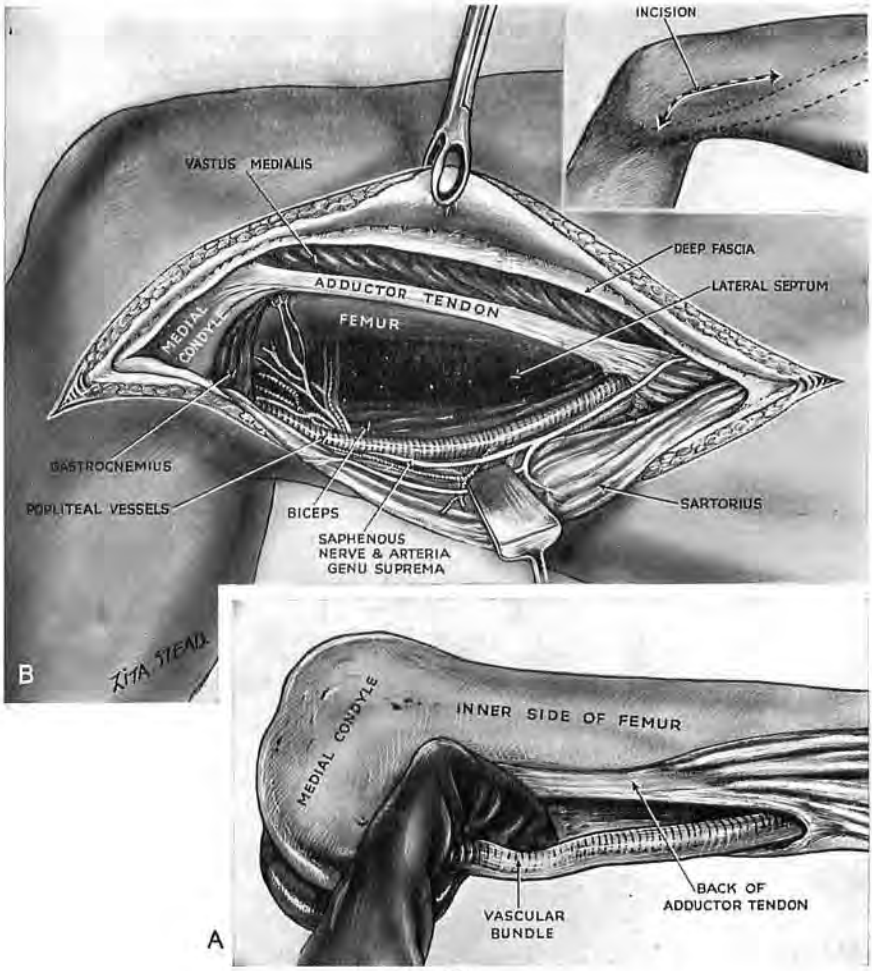


Fig. 134

Exposure of the popliteal face from the inner side

A. Open the flimsy fascia just *behind* adductor magnus tendon ; slide a finger into the fossa keeping its back against the tendon ; touch the *centre* of the popliteal space. Hook the finger to locate the vessels. Widen the opening and mobilise the vessels. B. The popliteal face exposed.

[1] *Mutual relations of femoropopliteal vein and artery.*—Sartorius will help us to remember them : down the *thigh* sartorius and vein have *opposite* relations to the artery. So, where sartorius is lateral, near Poupart's ligament, the vein is medial ; in Hunter's canal sartorius lies in front, the vein behind ; beside the popliteal face of femur sartorius is medial, the vein is lateral. Still farther down, within the bottle-neck produced between the condyles and the heads of gastrocnemius, the vein—as if perforce—lies close behind the artery. But in the *leg* it holds once more a medial position—just as it does near Poupart's ligament. (See legend to Fig. 157).

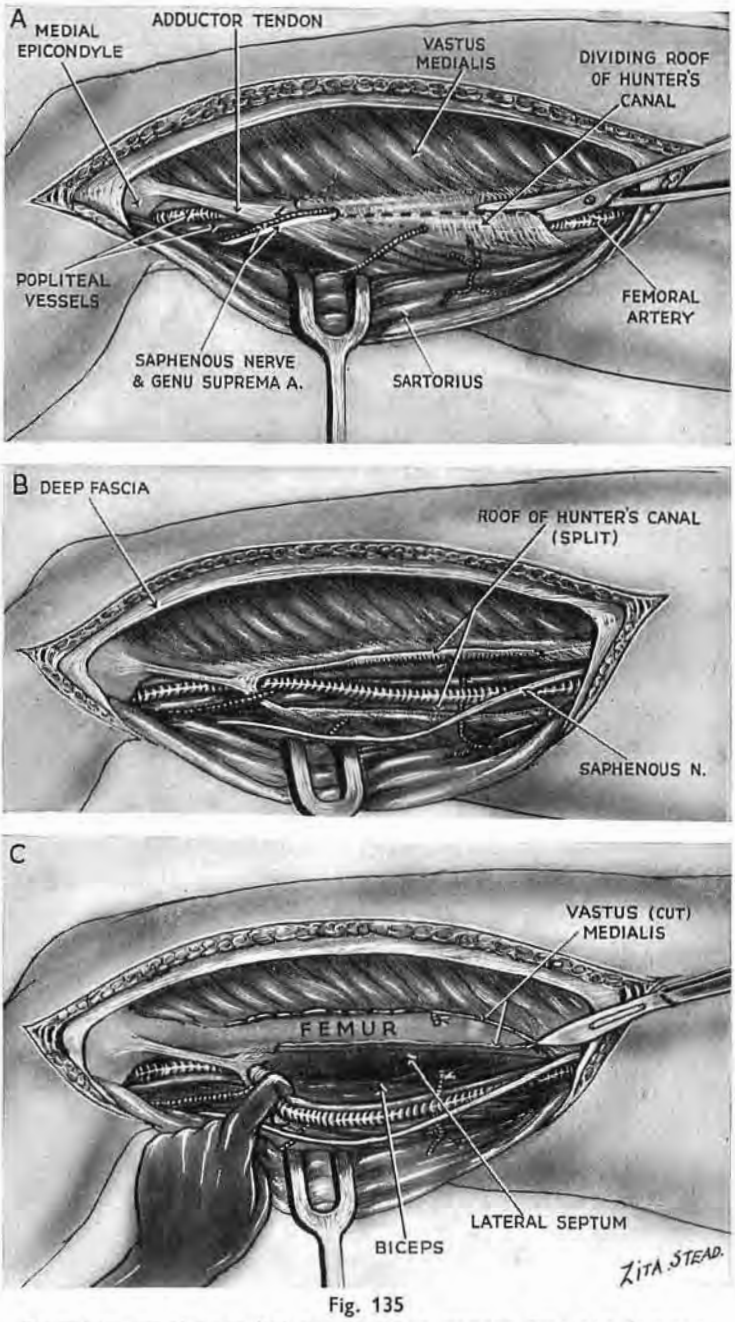


Fig. 135

Extension of the medial approach to expose first the femoro-popliteal trunks in continuity, then the shaft

A. Displace sartorius from the roof of Hunter's canal which is then split. B. Bend the knee and mobilise the femoropopliteal trunks. In doing this the leash of very large vessels which binds the trunks to vastus medialis seven fingerbreadths above adductor tubercle can be cut, or liberated with Mayo scissors. (In the figure it is cut.) C. Loop the main trunks aside—like a bucket-handle—and clear a path to femoral shaft.

Then, working at the *back* of the vastus medialis, detach the muscle from its slender hold on bone; for there, as if to help us, the fibres spring from linea aspera and cover, but have no attachment to, the inner side of femur. So, by a mere extension of the route of Fiolle and Delmas, we expose a span or more of shaft in continuity with popliteal surface.

THE OUTER (LATERAL) APPROACH

Exposure of the popliteal surface from the outer side is simple. We take advantage of a loop-hole leading straight into the fossa, and widen it to reach the bone.

ANATOMY

The loop-hole.—Close to the outer condyle the short head of biceps lies 'free' behind the septum, and there a touch—once fascia is opened—will separate the belly and reveal (between the biceps, the septum and the condyle) a loop-hole opening in the popliteal fossa—a crevice we shall presently enlarge (Fig. 136). But we must find it first. And what a mess if we should fail! For cuts that blunder into quadriceps through tract or septum will sometimes cause a singular confusion, incredible till actually seen.

The iliotibial edge.—Provided that the knee can be even slightly flexed, mistakes, for once, are almost inexcusable. We can enlist the certain guidance of a hard and constant edge which marks the union (at an angle) of lateral septum with the hinder margin of the iliotibial tract (Fig. 136, A and B). The *edge* will therefore lead us in behind the septum to the loop-hole.

We have a choice of ways for finding it. The wise use both.

THE TWO-FINGER METHOD.—With the knee partly flexed run your middle and index fingers (side by side and touching) *lengthways* down the outer surface of the thigh—your left fingers for the left thigh, your right for the right. When the tip of your middle finger touches the back of the fibular head the pulp of index rests on skin that shifts across the stable hinder edge of iliotibial tract (Fig. 136, C). Behind this edge (which merges, inwards, with the septum) is a loose, soft mass of biceps—so different with anæsthesia from the cord we feel behind a wakeful knee.[1]

[1] The biceps 'tendon' just above the joint is *not* the cord-like structure which often seems so obvious to eye or touch. It is instead a *lamina* that coats a wider belly and goes slack with it. "*Les deux portions de ce muscle s'attachent à l'extrémité supérieure du péroné par un tendon considérable qui monte en s'élargissant derrière ces deux portions réunies*" Little escaped the Baron Boyer.

THE TEST OF RELATIVE MOBILITY.—Grasping the soft and mobile biceps belly close above the condyle we find it moves across the stable edge (Fig. 136, D). This simple test will guide our knife and bring us opposite the loop-hole.

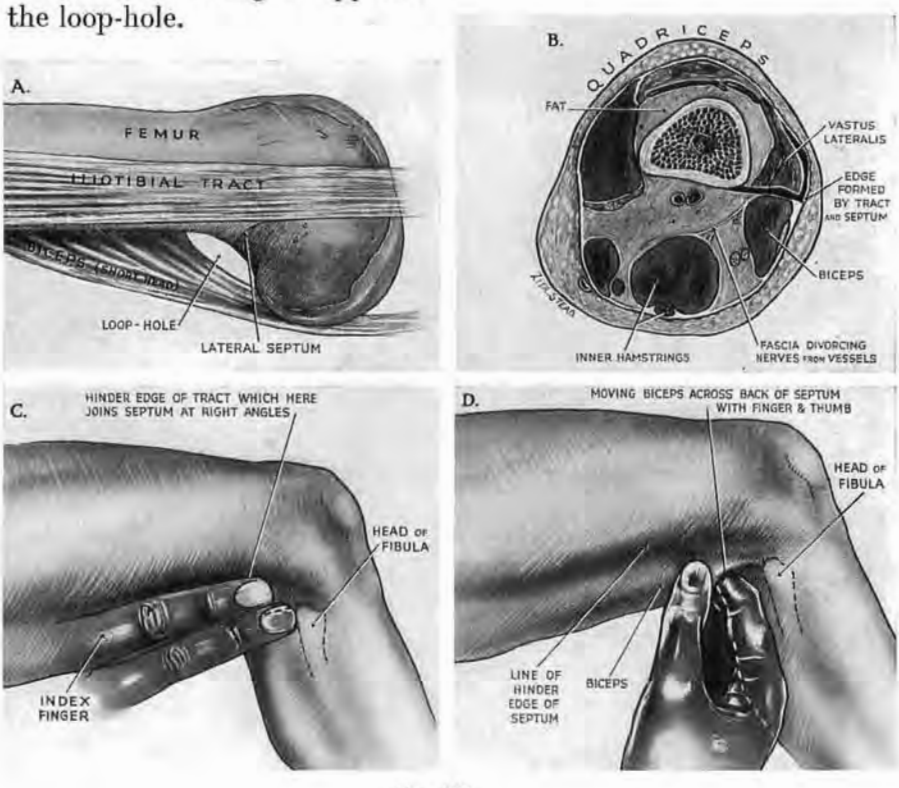


Fig. 136

The outer popliteal approach

A. The loop-hole. B. Cross-section showing how the guiding edge which lies in front of the loop-hole is formed by the junction of iliotibial tract with lateral septum. At this low level (but not higher up) tract and septum form a right angle. C. *Two-finger method of finding the edge.* Use right middle and index fingers for the right side, left for the left. Slide them lengthwise down the thigh till the tip of middle finger strikes the back of fibular head. The pulp of index feels the edge. D. *The test of relative mobility.* Find the edge by moving biceps across the back of septum. (This test is useful when the knee cannot be flexed.)

The biceps, passing to the fibula, crosses the outer head of the gastrocnemius, and, on the outer side of lateral condyle, lies for a little space against the synovial membrane of the knee—a fact to keep in mind.

THE OPERATION

Position.—Place the patient on the sound side with the sound limb straight. Lay the knee of the affected side just before its fellow knee so that the heel will rest on the ' sound ' shin and tilt the popliteal face to a convenient angle (Fig. 137).

Fig. 137

Lateral popliteal exposure

Position and incision. The *position* serves, too, for exposing fibula (p. 292 below).

Incision.—A longitudinal cut a span in length—through skin and fat but *not* through deeper fascia—exactly maps the hinder, guiding edge of the iliotibial tract, down to the head of the fibula (Fig. 137). Make *doubly* certain of this guiding edge before you seek the loop-hole. Then, close above the condyle, pinch up fascia just behind the edge; divide it lengthwise with the edge as guide. A finger-breadth above the condyle a touch with Mayo scissors will detach the ' free ' part of the biceps belly from the septum and reveal the loop-hole. (Avoid the use of pointed scissors which might prick synovia round the condyle.)

Enlarge the loop-hole with the finger. Work gently up along behind the septum, and free the slight attachment of the biceps. As you do this you meet with two or three resistant strands—twigs which the perforating vessels give to biceps before they pass (through septal arches) to the quadriceps (p. 205). Divide and tie these twigs. Avoid the cramp of working

down a pit by separating the biceps upwards to the *limit* of your skin incision. Then through the gap slide in a finger close above the condyle, keeping its back against the hinder surface of the septum. Touch with the nail the centre of the bony plane, and hook the finger gently to catch and mobilise the rope-like parcel of the vessels; divide a few unpaired and variable offsets that moor it loosely to the femur. Retraction then displays the popliteal face in full (Fig. 138).

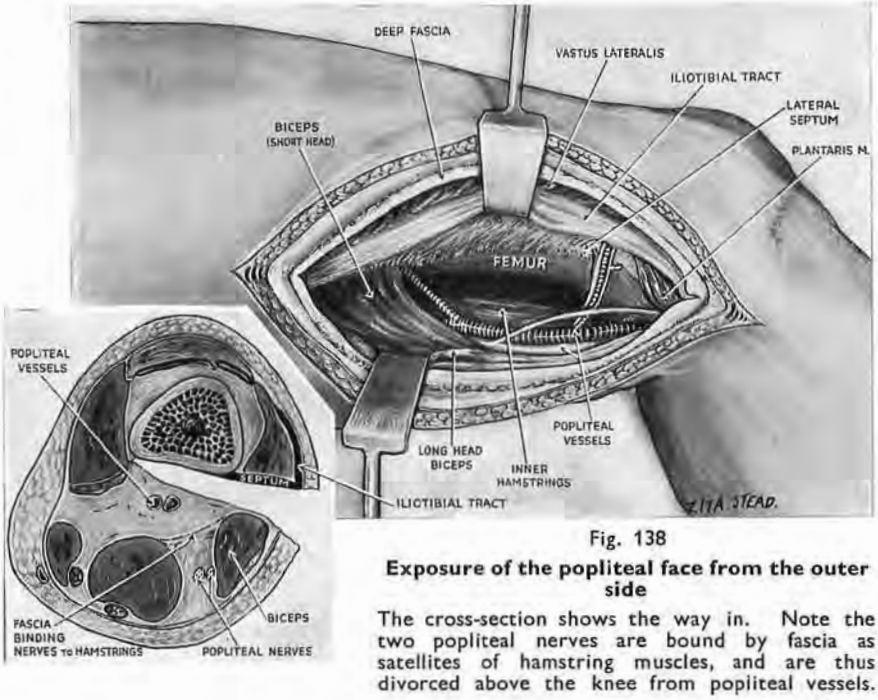


Fig. 138

Exposure of the popliteal face from the outer side

The cross-section shows the way in. Note the two popliteal nerves are bound by fascia as satellites of hamstring muscles, and are thus divorced above the knee from popliteal vessels.

The major nerves—like persons with too many aliases [1]—keep in the background: reaching the fossa from behind, they lie, as one might guess, behind the vessels (which reach it from in front). The nerves, in fact, are satellites of the hamstring bellies and have (above the knee) a mere, and easily divorced, *proximity* to vessels. That is why, when the popliteal artery and vein are hooked up by a finger, the nerves are unperceived and left behind: until they reach the leg, a sheet of intervening fascia postpones the linkage which creates a neurovascular bundle (Fig. 138, inset).

[1] For comment on these aliases see footnote, p. 244.

THE LATERAL POPLITEAL ROUTE EXTENDED TO THE OUTER FACE OF SHAFT.—Ten inches more of femur can be seen by this extension. No main trunks cross the field ; we deal instead with transverse branches of the perforating vessels (Fig. 139).

Let us continue the incision of the skin (Fig. 137) a handbreadth

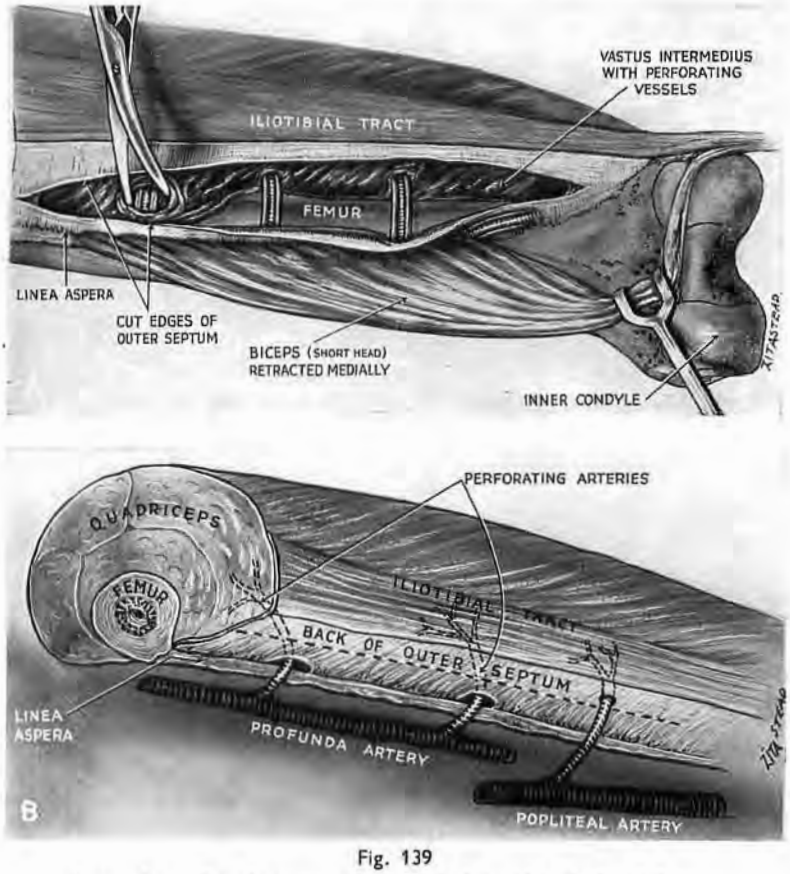


Fig. 139

Lateral popliteal exposure extended to the shaft of femur

A. Split the outer septum lengthwise from behind. Trace the ladder-like lay-out of vessels through the vasti ; then work between the ' rungs ' and bare the bone.
B. Shows the anatomy in diagram.

up beyond the length of shaft we wish to bare ; and, in the same direction, pursue the stripping of the biceps from septum and (as well) from the linea. This will expose the naked back of the septum.

The vascular bundles.—The terminals of perforating vessels from profunda cross the field to reach the outer vastus group in series with some lower twigs that spring from the popliteal trunks. But none—except this lower singleton or pair—are obvious : *it*

runs a little way in view before it perforates the back of septum, contrasting thus with branches of the profunda that disappear, as soon as they have crossed the linea, through septal *arches* ranged along the shaft.

If then we split the septum lengthwise from behind, we come directly on the *back* of the quadriceps (on the vastus intermedius below, and half-way up the shaft, on the vastus lateralis, Fig. 119, D). Beginning at the linea we trace the bundles through the rather open texture of the vasti. A very little care will keep the vessels safe while a rugine strips off the flimsy hold of muscle from the outer side of shaft.[1] This leaves the bone conveniently accessible between and underneath the bundles, which now lie spaced like ladder rungs across its naked flank (Fig. 139). And, if we wish, we can divide a rung or two.

A METHOD OF EXPOSING THE FEMOROPOPLITEAL TRUNKS WIDELY FROM BEHIND

For a maximal exposure the *incision* begins in the leg behind the tendon of semitendinosus and passes up along the medial hamstrings to reach the midline *above* the popliteal fossa and continues there as high as the gluteal fold. The level of this corresponds roughly with the apex of Scarpa's femoral triangle four fingerbreadths below the midinguinal point. Open the deep fascia parallel to the several parts of the skin incision but not immediately deep to them. Above and close to the femoral condyles, slide the palmar face of the fingers inwards across the backs of the two inner hamstrings—semitendinosus and membranosus. Curve the fingers so that their tips go *deep* to the superficial pair of *medial* muscles—gracilis and sartorius (Fig. 140, A). Begin below at the tendon of adductor magnus and part the medial edge of magnus from the lower end of sartorius, and also from the deep face of gracilis. Draw the magnus belly out towards the femoral shaft and with it bring the longus : their full retraction opens a plane of cleavage that lets us reach and enter into Hunter's canal from behind (Fig. 140, B).

[1] The clearance of the *inner* face of femur from the back is troublesome ; it is most difficult in the approach to peel off tough insertions of adductors without progressive injury to major veins. For, with the patient prone, the perforating vessels are jammed between adductors and the femur. In contrast it is simple, as we have seen, to push these vessels backwards—clear of bone—when working from the front (p. 205).

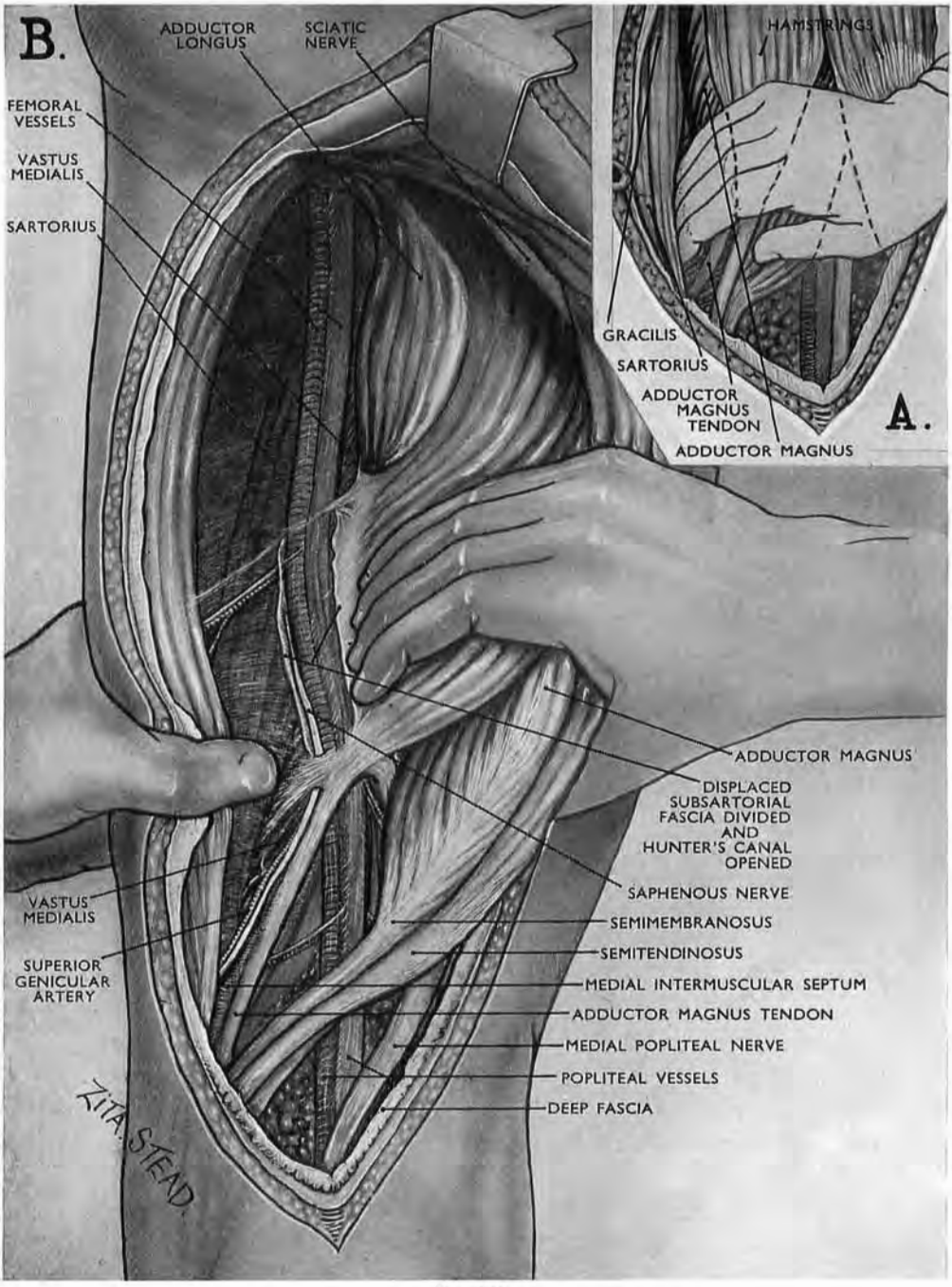


Fig. 140

Exposure of right femoropopliteal trunks from behind

Inset A shows how the palmar face of the fingers slides inwards across the back of medial hamstrings. The tips of the fingers dig deep to gracilis and then to sartorius ; they thus curve round the separable inner edge of adductor magnus. This they draw outwards together with adductor longus, and thus (as in Fig. 141, B) bring the subsartorial fascia round *behind* the femoral trunks. The trunks are disclosed when the fascia is opened.

Inset B shows the *en masse* retraction of adductors, which—like café journals slung by the edge on a rod—are turned towards the femur (see p. 237).

The length of the exposure is illustrated.

Access through a displaced fascia.—The line for entering 'Hunter' follows the direction of the medial edge of the belly of adductor magnus. Incision up this line opens the canal, not as one might expect through its thin posterior fascial wall, but through the much thicker subsartorial fascia. The reason for this is that though the subsartorial fascia, while undisturbed, spreads

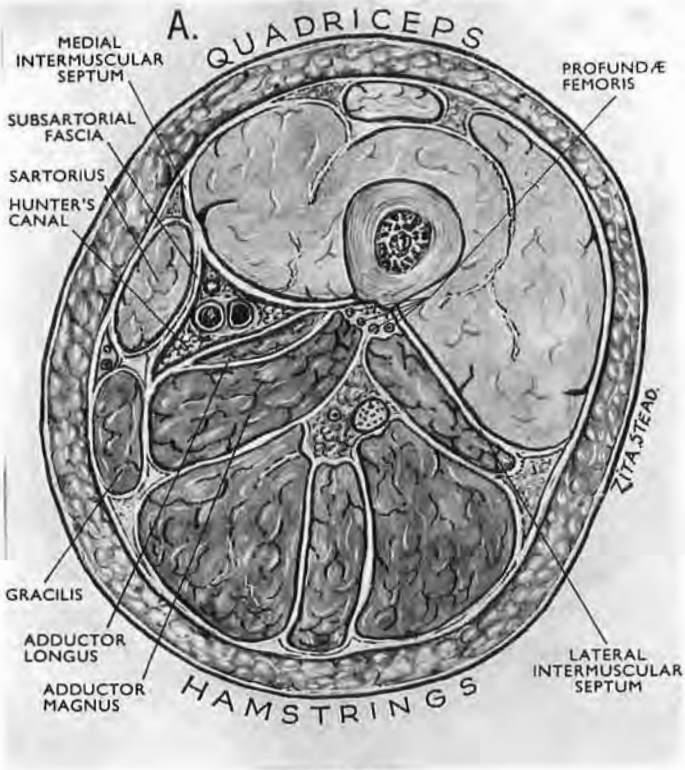


Fig. 141, A.
The subsartorial fascia undisturbed.

in a sagittal plane (Fig. 141, A) through the lower two-thirds of thigh, the strong retraction we have put on the adductor mass has drawn the fascia away from sartorius and has then dragged it round *behind* the femoral trunks (Fig. 141, B). Emergence through this fascia of the supreme genicular artery, the saphenous nerve or its accessory (Fig. 142), and sometimes, too, of a communication with a posterior obturator branch, guides us straight into Hunter's canal.

During the strong retraction of adductors the subsartorial

fascia becomes concealed in a gutter bounded and overlapped by adductor muscle and vastus medialis—a concealment that is of no consequence once the clue of emerging nerve or artery has led us to the main femoral trunks above the opening in adductor magnus :

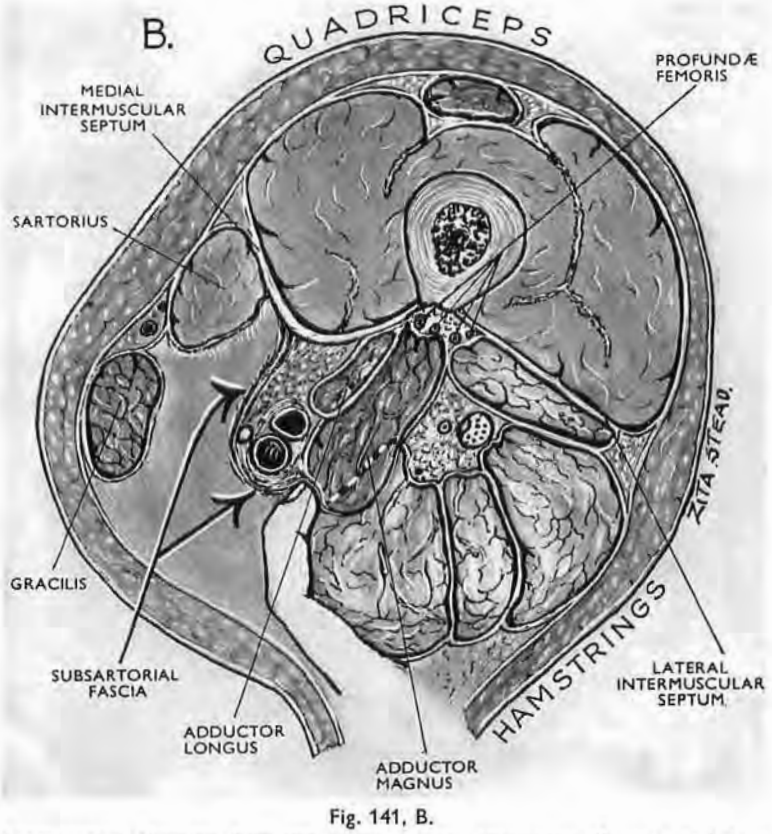


Fig. 141, B.

Cross-section showing how the strong lateral retraction of great and long adductors distorts Hunter's canal—displacing the subsartorial fascia from the deep face of sartorious and dragging it round *behind* the superficial femoral trunks so that we reach them by opening it (see Fig. 140, B).

after that we merely slit through the subsartorial fascia and follow them.

Thus, finally, these trunks themselves become our guide in extending their own exposure upwards—which finger separation achieves. The higher we go the deeper we get, but 9 in. of superficial femoral vein and artery are easily available, plus 4 in. of popliteal above the knee-joint line, and some 3 in. below. And happily the *backs* of femoral artery and vein are relatively free from offsets.

The saphenous nerve.—Our early medial thrust of fingers by displacing sartorius and gracilis will have already moved the nerve—which passes between these two muscles—away from the medial side of the superficial femoral artery so that we can easily catch the nerve by bending a finger up into this neurovascular angle. (The nerve, as we trace it *from below*, lies first in front of the magnus tendon and then approaching the artery touches its medial side for a few fingerbreadths before turning to pass up the anterior wall of the vessel.)

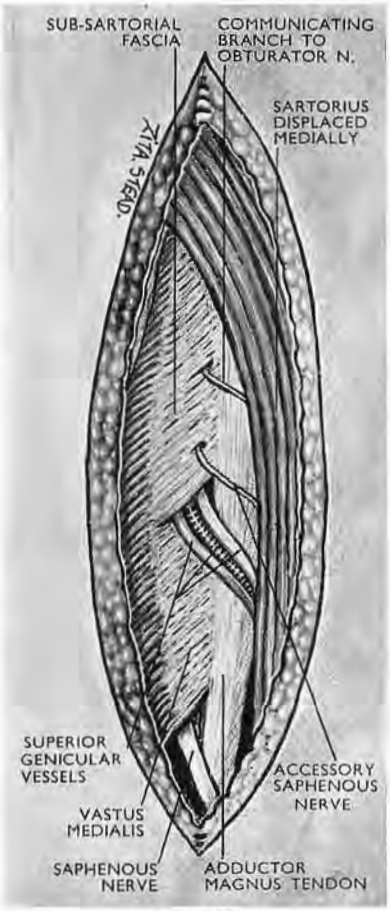


Fig. 142

This figure shows nerves and vessels, some or all of which may pierce the distal part of the subsartorial fascia. These include superior genicular veins and artery, the saphenous nerve and its accessory, a twig communicating with the posterior branch of the obturator nerve.
The subsartorial fascia in this figure is *undisturbed* (compare Fig. 141, A and B).

EXPOSURE OF DEEP FEMORAL VESSELS

Global wars multiply lesions otherwise rare. Yet, excepting in the scale of personal distress, the toll that reaches 'base' from deep femoral trunks is slight: Homer, and others after him, record the quick deadliness of relevant wounds. Wars then, especially, or some new need, may give sporadic currency to pages that stem from a ten-year-old request by Sir James Paterson Ross in a most kindly review.

I shall deal with problems that arose, and then summarise the actual procedure.

BARRIERS OF MUSCLE, BONE, AND MAIN FEMORAL TRUNK

Much of the 12 in. length of profunda vein and artery lies " where the cluster of muscles in a man's thigh is thickest." That is one of three facts which dominate the problem of complete exposure. The second is that the profundæ, in their distal 5 in. reach, are fastened near or actually stripe the medial lip of linea

Fig. 143

Recumbent femurs are like stranded boats : the spread or *flare* of the sides obstructs a frontal access to the keel (or linea aspera) and so to the profunda vessels that stripe its length. (The broken line shows the horizontal plane.)

aspera ; and linea, in the limbs of recumbent patients, is like a keel from which the sides of femoral shaft bulge or slope up towards the surgeon, exactly as the sides of boats are said to *flare* (Fig. 143). The shaft then will overhang and mask the keel-like linea, together with the satellite and distal 5 in. of profundæ.

Thus for *complete* exposure of the deep femorals, which course in the front and back of thigh, a posture is required that will relax muscles and will also turn the femur in such a way that *one* position of the limb lets us open the thigh in front and on its hinder face (p. 233).

The third fact—dominating proximal approach—is also exigent. Profunda artery frequently springs either from the back or from the outer side of the common femoral trunk—most often at some level between the two transverse planes that graze the upper and lower borders of the pubic symphysis. From the outer origin the vessel winds down in a loose half-spiral curve to lie behind the superficial femoral artery, parted from it by two veins, the femoral and its own deep companion. This anteroposterior arrangement of four large vessels (femoral artery, femoral vein, profunda femoris vein, profunda artery—in that order from before back, but often, too, with a slant from within out) calls for *oblique* approach to the deeper pair—a fact brought home to me by a 'slip of the knife,' not perhaps the sort that Kipling honoured as 'predestined,' but one which undeservedly was fortunate.

During a hasty cadaver demonstration of the femoral-shaft exposure (described on p. 197) I made an incision aimed, as I thought, at the lateral angle of patella. This, however, with the leg and foot, was covered by a cloth, and when deep fascia was divided I found I had reached the *wrong* side of rectus femoris—the medial instead of the lateral.[1]

I then discovered that the whole limb, owing to a fractured femoral neck, lay in the fullest possible eversion. My mistake was, of course, due—like so many at all stages of operative procedure—to losing touch with bony points. Happening, however, to move the rectus femoris outwards during a distasteful review of the field, I saw that I had obtained access to the upper 7 in. of the deep femoral vessels—an access which, because it was oblique, was excellent (Fig. 144).

The cloak of nerve branches.—Viewed, however, from the lateral side near Poupart's ligament a cloak of nerves, formed by the sudden terminal branching of the femoral trunk, screens the outer face of the great vessels, deep and superficial. But the cloak is easily displaced, for some of its constituents supply or are linked with the two mobile bellies of the front of thigh—sartorius and rectus. So when we draw these muscles outwards most of the cloak of nerves tends to move out with them and thus uncover the outer and, for us, strategic face of the main vessels in Scarpa's triangle.

[1] "Do you know," said d'Artagnan, "why master pastrycooks never work with their own hands?"
"I wish you'd tell me," said Porthos.
"Well, the fact is they fear to scorch a tart or curdle cream in front of apprentice pupils: it might raise a laugh, and you mustn't laugh at master-cooks."

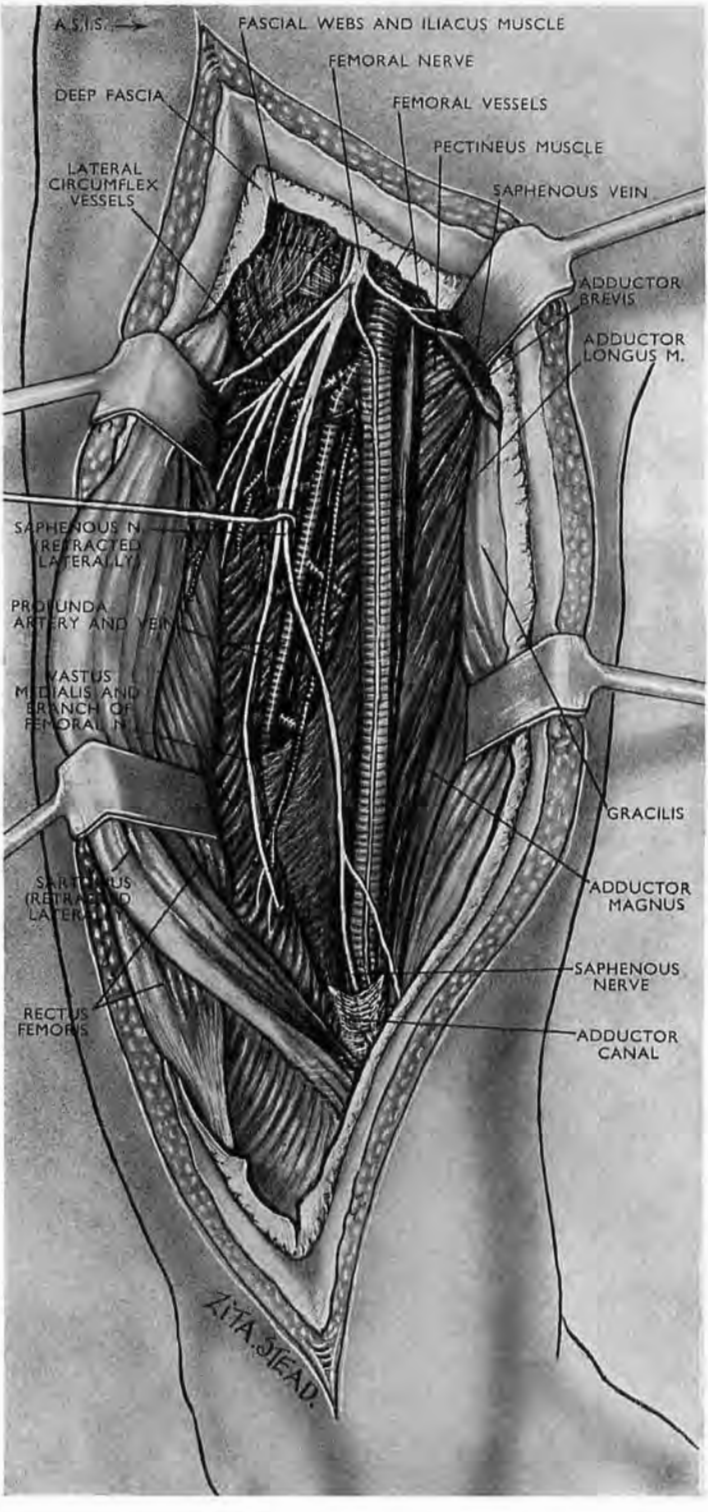
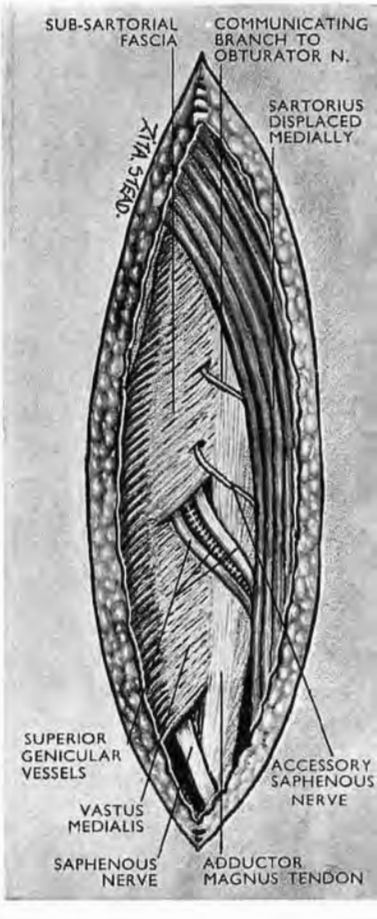


Fig. 144

The oblique lateral view of femora arteries

Because rectus femoris and sartorius ar supplied by the femoral nerve, outwar retraction of these two muscles draw that nerve trunk away from the adjoin ing arteries and will thus educe th pattern of the femoral nerve which i peculiar to the patient—a pattern ver prone to vary.

Only a scrap of the sheet of subsartoria fascia has been preserved. The inse shows *one* arrangement of the structure that may pierce the distal part of th fascia. (It is this subsartorial sheet tha is drawn round *behind* the vessels b retracting adductor magnus (p. 225 Fig. 141, A and B) in a posterior femoro popliteal approach.)



A check to this movement comes from one or sometimes two fine threads which slope inwards from the nerve cloak and cross or may embrace the femoral vessels. When these threads have been cut the major part of the cloak is free to move out with the two muscles: sartorius carries off the intermediate cutaneous branches and its own nerve supply; rectus femoris also carries off its own supply and that of vastus lateralis. The branches to the other vasti muscles (intermedius and medialis) *already* lie lateral to the great vessels, while the saphenous nerve (and its accessory) make a lateral approach before actually reaching the front wall of the superficial femoral artery.

All these nerves, therefore, either (1) lie lateral to the vessels or (2) move away from the vessels when we retract the two mobile muscles, or (3) are, like saphenous, easily dissected off and drawn aside by separate retraction.

The accessory saphenous nerve.—This finds no place in standard British textbooks. It was first described by Cruveilhier (1791-1873), and is firmly established in French teaching: Poirier, Hovelacque, and Paturet treat of it in almost identical detail. The nerve would seem to share an origin from the intermediate and medial cutaneous nerves of British anatomy. An offset of the accessory saphenous may enter Hunter's canal to lie as a satellite nerve on the front of the femoral artery. This satellite may pierce the anteromedial wall of the canal at any level and reach medial skin above the knee; it may also end at any level by fusing with the saphenous nerve.[1]

OTHER CONSIDERATIONS

After a course of about a handbreadth in 'Scarpa' the profundæ leave the superficial femorals and pass behind adductor longus, lying between its belly and that of adductor brevis. Some 2 in. lower down the short adductor ends. Near this level, for some three fingerbreadths, the vessels lie and are bound in

[1] French anatomists describe the *femoral nerve* as dividing into four terminal parts: two deep parts—our own saphenous nerve and the trunk to quadriceps; two superficial parts—the internal and external musculocutaneous nerves of the thigh, both of which supply sartorius and skin. The external of these two superficial nerves gives origin to the *accessory* saphenous. The satellite nerve to the femoral artery is sometimes equated in French illustrations—though not in the text—with the *whole* accessory saphenous (Hovelacque (1917), *Anatomie des nerfs*, Plate LXXX; Paturet (1951), *Traité d'Anatomie*, vol. ii, Fig. 718): it is, however, only one of the nerve's two branches; the other branch is the satellite of the long saphenous *vein* and corresponds to part of our medial cutaneous nerve of the thigh.

satellite relation to nacreous bands of a medial aponeurosis that is part of vastus medialis. There, as they pass down the limb, the vessels veer slightly out to meet the inward slope of femoral shaft. This veering occurs about 9 in. above the upper face of the medial femoral condyle; it is important and I shall return to it. Below this spot all three adductor attachments join to form a tough sheath that binds the last 5 in. of profundæ to or close to the back of linea aspera.

The three parts of profundæ.—For purposes, then, of surgical approach the average 12 in. length of profundæ may be divided into three parts: (1) a *proximal part* about 5 in. long, moored chiefly by its own offsets and lying first near the groove between psoas and pectineus, then in front of pectineus, then behind adductor longus, where it is briefly sandwiched by longus in front and brevis behind; (2) a 2 in. *intermediate part* held at the '9 in. spot,' as though pasted on to the nacreous aponeurosis of medial vastus by a thin imperfectly translucent fascia; (3) a 5 in. *distal* or *asperal part* surrounded and affixed to linea by dense insertions of adductor muscle.

Of this foot-long vein and artery about seven upper inches are accessible by an anterior approach passing medial to rectus femoris, while the lower 8 in. can be reached from behind. Thus it will be seen that roughly 3 in. (the fifth, sixth, and seventh, counting from above down) are found by using either route.

Discovery of the distal 5 in. of the deep vein and artery is simplified if we first find the intermediate portion of the vessels and use it as a guide to their asperal continuation.

'The 9 in. spot.'—The intermediate portion of profundæ lies at a spot about 9 in. (a *full* span) above the upper surface of the medial femoral condyle, and I keep the term '9 in. spot' for convenience. T. P. Garry, however, has devised a manual way of marking it, more accurate by far than linear measurement. I shall describe his method with the technique of operation.

THE OPERATION

Postures.—A *supine position*, with the limb fully everted, serves for access to the proximal 7 in. of profundæ and at the same time to the whole length of the common and superficial femoral vessels, plus some 4 in. of popliteal trunks (p. 215). The *prone position* allows us to reach the distal 8 in. of profundæ together with (should need arise) the whole 7 in. of popliteal

trunks, plus nine distal inches of superficial femorals, amounting thus to a length of some 16 in. of femoropopliteal vessels (p. 226).[1]

THE SPECIAL POSTURE FOR COMPLETE EXPOSURE OF PROFUNDÆ. —This posture is required for simultaneous access to the proximal and distal parts of the deep femorals; as, for example, when a communicating aneurysm is thought to lie at the intermediate part of these 12 in. trunks, or where there is doubt as to whether superficial or deep femorals, or both, are involved. For though this doubt is most likely to arise in relation to proximal lesions, the four femoral vessels, superficial and deep, remain relatively close together for some distance below Scarpa's triangle where they neighbour the '9 in. spot.' Unless, then, we are completely confident of reaching a sufficient length of profundæ, either in front or from behind, the special posture for full access is indicated.

The patient lies on the *sound* side with the 'sound' scapula flat on the table. Bend the 'sound' hip and 'sound' knee each to a right angle and make the lateral face of the sound limb touch the table. (This position of the sound limb gives exactly the right amount of rotation to the trunk.)

Then (*a*) *in a thin, long-limbed patient*, flex the knee and hip of the 'operation' side each through 20 degrees, making the *medial face of the knee* lie flat on the table. No change of posture is required in the tall and thin when passing from the proximal to the distal approach.

(*b*) *In a stout or short-limbed patient*, put the *sound* limb as at first described; but—in order to avoid the cramping of your access to 'Scarpa' which might here result from flexion at the groin—keep the 'operation' limb with knee and thigh extended and its foot in pure plantar flexion till you have completed the proximal exposure. *Then* flex the hip and knee of the operation side through 20 degrees, as in the thin and long-limbed, and lay the inner face of the knee on the table. (This slight move, if made gently, calls for no change of towels.)

INCISIONS

The anterior incision runs for a full span from a point two fingerbreadths medial to the anterior superior iliac spine towards the medial angle of the patella. Divide deep fascia and with it raise and displace inward the superficial inguinal glands when,

[1] It is, however, well, after exposing eight distal inches of the 12 in. profundæ, to check the natural urge to go still higher and reach the upper four: depth and gluteus maximus are hindrances, while the hip joint parts us from the two top inches.

as so often, they mass in front of the femoral trunks. Mobilise the medial edge of sartorius first, keeping a fingerbreadth medial to the muscle so as to avoid intermediate cutaneous nerves linked with the sheath. Then mobilise the medial edge of rectus femoris, taking care not to injure the very large lateral circumflex vessels that cross immediately deep to the muscle some three fingerbreadths below 'Poupart.'

The nerve cloak.—Look for any fine nerve threads sloping down medially across the main vessels. Divide the threads and retract sartorius and rectus laterally, thus removing the major part of the cloak of femoral-nerve branches from the outer face of the vascular trunks (pp. 229 and 231).

Find the more deeply running nerves (to vastus medialis and vastus intermedius) which lie just lateral to the superficial femoral vessels. Look for and detach the saphenous nerve or nerves that approach the artery from without before they come to lie along its anterior wall; retract these deeper nerves laterally to expose the outer face of the superficial and deep femoral trunks. These tend to lose their sagittal arrangement in the lower part of Scarpa's triangle where the profundæ shift out towards the inward slope of the femur, so that of the four great vessels the profunda artery instead of lying farthest back is now most lateral.

The deep femoral vessels below 'Scarpa' leave the superficial trunks and pass behind the long adductor where they can be followed for about three fingerbreadths after mobilising the upper edge of that muscle.

Some seven proximal inches of profundæ are now accessible.

The posterior incision at the level of the popliteal space should run behind the inner hamstrings and *then* pass up the midline of thigh. (The course of these long incisions must often vary on account of wound or scar resection, and provided they do not cut vertically through a flexor crease their actual line loses much importance in virtue of the access we can get by skin reflection.)

After dividing deep fascia, clear the field sufficiently to reach the back of adductor magnus: part the medial and lateral hamstrings, controlling several large isolable vessels that feed these muscles and intervene; mobilise the sciatic nerve and displace it medially, working on its 'safe' *outer* side, from which (as Grant points out) only one collateral branch springs—that to the short head of biceps.

Define the asperal edge of adductor magnus; it lies beside and medial to this short head which reaches up as far as the

gluteal fold. Two fingerbreadths below the fold define the spot that I have loosely termed '9 in.,' where profundæ are satellite to vastus medialis and veer obliquely out to stripe or closely link with linea aspera. This spot is marked as perfectly as vascular anatomy allows by means devised by Mr T. P. Garry, to which we can presently resort (Fig. 145).

Garry's marking.—The spot lies near the back of the inner side of femur at the intersection of two planes: (1) a sagittal plane in the midline of thigh, and (2) a transverse plane a hand-breadth distal to the ridge that bounds the lower edge of great trochanter. The surgeon works from back to front along this intersection. (The *ridge* is plainly felt, through skin or towels, by moving the hand *up* the outer face of the femur. It lies three fingerbreadths below the top of great trochanter.)

The asperal edge of magnus.—While defining this edge and parting it from the short head of biceps we may note that the relaxed fleshy fibres of magnus bulge slightly in across linea and curve out again to reach their asperal insertion. In this way they overlap short, *longitudinal* segments of tendon that link them with bone. When the fleshy fibres are carefully detached and drawn outwards a translucent membrane appears, and if this is divided some three fingerbreadths above the opening in adductor magnus, the profundæ vessels in general appear, sandwiched between the membrane and the tough asperal aponeurosis of adductor longus. In some subjects no vessels are seen—a condition that may be unilateral, and this and other handicaps have led me to suggest the plan that follows :—

A. *We have explored 'Scarpa'* sufficiently far to find, isolate, and put a guiding loop round the segment of profundæ that is satellite to the nacreous vastus bands. Then we can work *down* from it by detaching the asperal edge of magnus.

B. *We have not explored 'Scarpa.'*—We shall then begin detachment of the asperal edge of magnus some three finger-breadths above the magnus opening and look for profundæ where they lie on or close to linea, sandwiched between translucent membrane and the tough aponeurosis of longus. Then (1) we find the vessels and follow them; or (2) we fail to find them, in which event we must expose the satellite segment from *behind*, and make it guide us downwards to the distal reach of profundæ. We therefore note the point where Garry's planes intersect, and there we separate the coarse fibres of magnus, which at this level is from one to two fingerbreadths thick. We come then *as a rule*

on a thin areolar layer in which a leash of small vessels passes transversely outwards, arranged sometimes like a fan. These

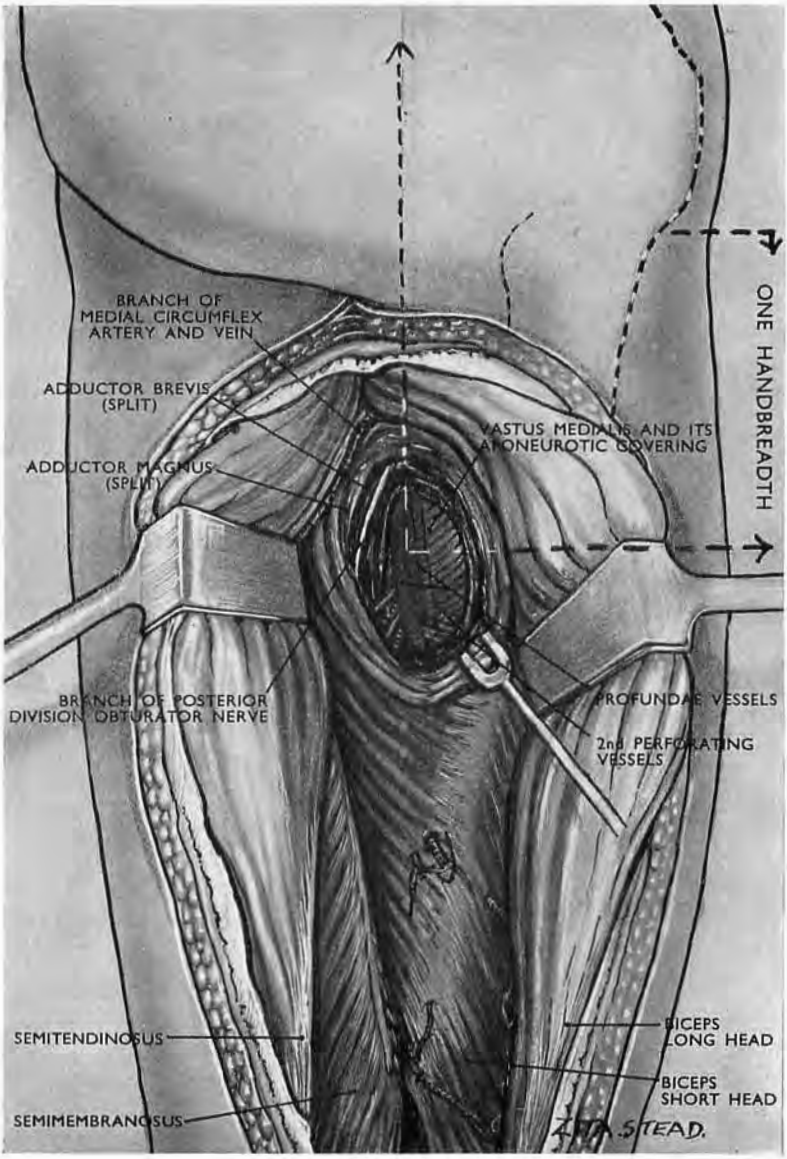


Fig. 145

Garry's marking (see text) for finding the upper (satellite) reach of profunda vessels. The blue profunda vein is fastened to the nacreous aponeurosis of vastus medialis by a thin fascia through which both structures show faintly.

structures mark the plane of cleavage that parts adductor brevis from the front face of magnus. When, however, the brevis muscle

has an exceptionally low (or high) attachment to linea, this station on our path may be absent. Usually the vascular leash must be cut and tied and we must split the $\frac{1}{4}$ in. thickness of the brevis belly, whose fibres at this level have exactly the same slant as those of magnus but are less coarse.

As soon as we have split completely through adductor brevis we reach a surface barred with sloping nacreous bands, through which the femur can be felt. The lustre of these bands is reduced by a thin fascial covering which fastens bands and profundæ in satellite relation at the '9 in. spot'—much as the visceral branches of internal iliac are pasted to the side walls of pelvis (p. 170). A careful division of the fascia covering the bands will therefore liberate this portion of profundæ and let the vein show blue against the nacreous background. The bands together form the aponeurotic covering of vastus medialis as it clothes the femur; they have accordingly the slope of medial vastus fibres, contrasting sharply with adductor slope.[1]

It is a comfort to know that we can at any moment compress the distal portion of profunda vein and artery against bone; but the hinder field is rich in anastomoses of muscle branches that link the perforating vessels.

COMPLETE COMBINED EXPOSURE OF MAIN THIGH VESSELS

The synthesis needs no elaboration. The reader will perceive that the posture described on page 233 for full access, back and front, to profundæ femoris (from Scarpa's triangle down, p. 235), when joined with the method of reaching the femoropopliteal vessels from behind (p. 223), allows—with *one* position of the patient—complete exposure of the whole 12 in. length of profundæ together with the twenty-odd inches of femoropopliteal trunks.

The 'journals-on-a-rod' procedure.—For we can treat the two

[1] These nacreous bands arising from linea are an essential feature of the vastus medialis, their deep surface gives a needed extra hold to fleshy fibres that clothe—but do not spring from—the medial face of femoral shaft. Lower down the thigh the bands unite with adductor fibres and thus produce the medial intermuscular septum. (If the profundæ are drawn inwards at the '9 in. spot,' they reveal the beginning of this union in the shape of a slip of fibres from adductor longus coming down in *front* of the vessels and crossing the slope of the nacreous bands.)

Poirier gives the *medial intermuscular septum* a more robust constitution than it receives from most anatomists. He describes it (1) as formed essentially from the aponeurosis of origin of vastus medialis; (2) as taking part in forming the lateral wall of Hunter's canal; (3) as accompanying the tendon of adductor magnus to the medial (epi)condyle after joining with the aponeurotic insertions of adductor muscles.

Poirier's view appears just: the aponeurosis of the medial vastus sends a strong contribution to the investing fascia of the thigh.

adductor muscles, magnus and longus, like two journals that one sees in clubs and continental cafés, slung for convenience by an edge on the same rod or shaft. Through the posterior approach we reach them from behind. Then, if we curve a hand round the free edge of these linked adductor ' journals ' (Fig. 140), we can draw them both towards the shaft of femur and thereby gain posterior access to Hunter's canal (p. 225). Thus we can extend exposure from popliteal vessels to superficial femorals as far as ' Scarpa ' ; while, if we leave the back of magnus *flat* beside the femur, we can set free its fixed or asperal edge—working, of course, down the shaft into the stripping angle. When that is done gently and piecemeal, a little patience will reveal intact the 5 in. distal reach of the profunda vein and artery. For the rest, the exploitation of Garry's marking (Fig. 145) and of an *oblique* access to Scarpa's triangle (Fig. 144) completes both femoral exposures, the deep and superficial.

ACCESS TO PROFUNDÆ OFFSETS

Proximal portions of these offsets are seen when the main trunks are exposed. Remoter parts may require separate approach. (To simplify descriptions of direction I shall deal only with arteries, leaving the reader to supply companion but counterflowing veins.)

The medial circumflex artery.—This springs from the back of profunda some two or three fingerbreadths below ' Poupart ' and has a backward course of about a thumbwidth before leaving Scarpa's triangle, where it is often visible if we draw the femoral trunks *laterally* so as to uncover the deep groove between psoas and pectineus. This thumbwidth of artery enters the groove in a sagittal direction ; it cannot be traced beyond ' Scarpa ' without detaching or at least mobilising pectineus.

Leaving Scarpa's triangle the vessel lies beneath the femoral neck and there is stated to divide into (1) an *ascending* offset which goes behind the neck to meet the great trochanter, and (2) a so-called ' transverse ' portion which, in fact, *prolongs* the circumflex and feeds the hamstrings. (See Cunningham's clear diagram, Fig. 146.)

In my day Dublin students, ignoring the distinction between ' transverse branch ' and parent artery, employed six handy words to memorise the course of medial circumflex through intervals between three *pair* of muscles : " Parish-Priest Of-Bray

Queer-Man " stood helpfully for Psoas-Pectineus, Obturator-Brevis, Quadratus-Magnus—' Obturator ' being externus, ' Brevis ' and ' Magnus,' adductors. That six-word ' open sesame ' will guide us through these barriers. For first, in Scarpa's floor, lie ' Psoas-Pectineus ' ; and while psoas must remain inviolate, we can mobilise and if need be dislodge pectineus. Beginning therefore at the pubic tubercle, which marks the upper and medial end of the oblique cleavage line between pectineus and

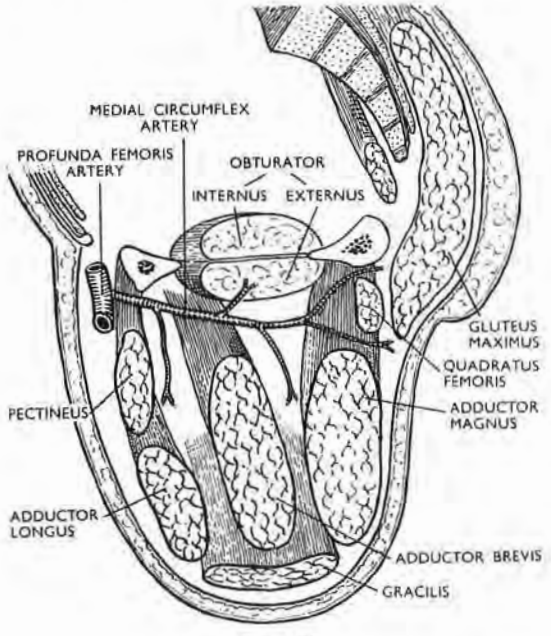


Fig. 146

The sagittal course of the medial circumflex artery (after Cunningham).

adductor longus, part the two muscles cleanly for about four fingerbreadths. Mobilise the belly of pectineus, working from within out on its deep surface. It is then often possible to reach the artery after it has passed the upper and outer edge of the muscle. If the access is cramped, detach pectineus from its linear and J-shaped origin on pubic ramus. The muscle lifted and gently drawn out, serves both as buffer and retractor for the femorals (see also p. 174). A thumb along the ramus should continually guard the femoral veins when we detach the muscle. In front of pectineus lie minor vessels, which we shall cut and then retract along with it—the deep and superficial external pudendals whose

veins discharge into the arch of great saphenous, which also lies in front of pectineus and slightly shares its outward shift.

Remoter lesions of medial circumflex—behind the 'Obturator-Brevis' barrier—require a division of adductor brevis, the sectionable lower member of the pair. Lesions deeper still, such as those affecting the hindmost part of medial circumflex itself or ascending branches that pass from it (with no mnemonic) between quadratus femoris and obturator, such lesions will lie *behind* the 'Quadratus-Magnus' plane and so be *subgluteal*. They are reached by hinging back the lid-like maximus (p. 180).

Incision for the medial circumflex vessels will as a rule prolong upwards the one already made to explore 'Scarpa'; it will thus cross in front of 'Poupart' and extend a handbreadth up the belly. Deepen this abdominal handbreadth to reach (and leave intact) external oblique aponeurosis. This permits reflection inwards of the skin and lets us clear the field sufficiently to loop spermatic cord or round ligament from pubic tubercle and either mobilise pectineus or detach its origin.

The lateral circumflex artery (Fig. 198), which often springs from femorals instead of from profunda, goes laterally out of 'Scarpa' sandwiched first between the sartorius and iliacus, then, farther out, between rectus femoris and vastus intermedius. The main need, therefore, with lesions close to 'Scarpa,' is to relax sartorius and rectus fully. If that is not achieved sufficiently for rectus by the posture used in the *complete* exposure of profundæ (p. 233), turn the patient on his back, straighten the knee, and prop the heel well off the table.

Lesions of lateral circumflex that lie some distance *out* from the profundæ will need the upper span of an incision used to reach the front of femur—the one beginning at the accurate bisection of the notch immediately beneath anterior superior iliac spine and aimed towards the outer angle of patella (p. 200). (The patient lies recumbent with the heel raised.) Tensor fasciæ is parted from sartorius, then rectus femoris from outer vastus. Most of the fan of lateral circumflex—the transverse and descending part—is then displayed. The third, ascending, portion of the fan lies covered by the distal free edge of a fascial web that shows, with others, just below the 'spine' on parting rectus femoris from tensor (p. 209).

The perforating arteries—1, 2, 3, 4 (but they may number two or six).—No single route will fully expose their circuitous courses (Fig. 139). Short lengths of 1, and often 2, are visible by the anterior access to profundæ (Fig. 144), while proximal extremes (and

nothing more) of 2 and 3 are seen from *behind* on separating great adductor heads—when that is feasible—and reaching parent trunks. But this route bares the whole of 4, except the outer terminals.

The outer terminals of 2, 3, 4.—During the exposure of the femur from in front we can see a proximal fingerbreadth of each terminal, where each lies framed within its arch of lateral septum against the keel of linea (Fig. 125). We get this view by looking level with the wound when we have split and liberated vastus intermedius and drawn *back* its outer half from bone. Beyond these single naked fingerbreadths the vessels vanish in the substance of the outer parts of vasti and form therein a set of 'ladder-rungs,' curved forward round the shaft of femur.

This ladder-rung *quartet* of terminals (if we include a common supplement from popliteal trunks) is reached by widening upwards the outer route to popliteal surface (p. 222). The hinder face of lateral intermuscular septum, already partly cleared from biceps, is further bared. If, then, the septum be bisected lengthwise, retraction of each severed edge displays the backs (though often fused) of outer portions of *two* vasti—below (as Poirier makes clear), the back of vastus *intermedius*; above, of lateralis (Fig. 119). McBurney cleavage of the slanting grain reveals the 'rungs' (Fig. 139).

REFLECTIONS ON RELATED POSTERIOR EXPOSURES IN THIGH AND LEG AND ON THE LEG IN GENERAL

An old approach of Guthrie's through the calf—a method which of late received new life and grace—gives origin to several exposures. In these we separate the heads of the gastrocnemius, proceeding proximally for the thigh, distally for the leg. Attack on either part where it adjoins the other will of necessity involve the fellow segment; for nerves and vessels hold so fast in each that if we limit our approach to leg or thigh we cannot mobilise the neurovascular 'bundle.' [1]

[1] '*Bundle.*'—We have already noted (p. 221) as a point of practical importance that popliteal nerves and vessels are divorced above the knee; they therefore fail (above the knee) to constitute a veritable neurovascular bundle. The fact is obvious when we approach these structures from the *side*: the finger hooks up vessels only, for fascia segregates the nerves and binds their trunks as satellites to hamstrings (see the cross-sections, Figs. 136 and 138). That, we saw, is why the nerves elude our search in medial or lateral approach. But if we enter from the back and reach as deep as popliteal vessels, we must in doing so destroy the crucial sheet of thin, divorcing fascia; and then—when that is gone—the mere proximity of nerve and vessels will let us hook them up collectively in what *appears* to be a bundle. (This note explains why 'bundle' has inverted commas here, and on pp. 251 and 253.)

The ' bundle ' dominates the popliteal space ; control of it is vital, whether we wish to deal with its constituents or draw it sideways from our path.

The gastrocnemial heads.—First we must separate these heads which are surprisingly disposed ; for though the widest part of

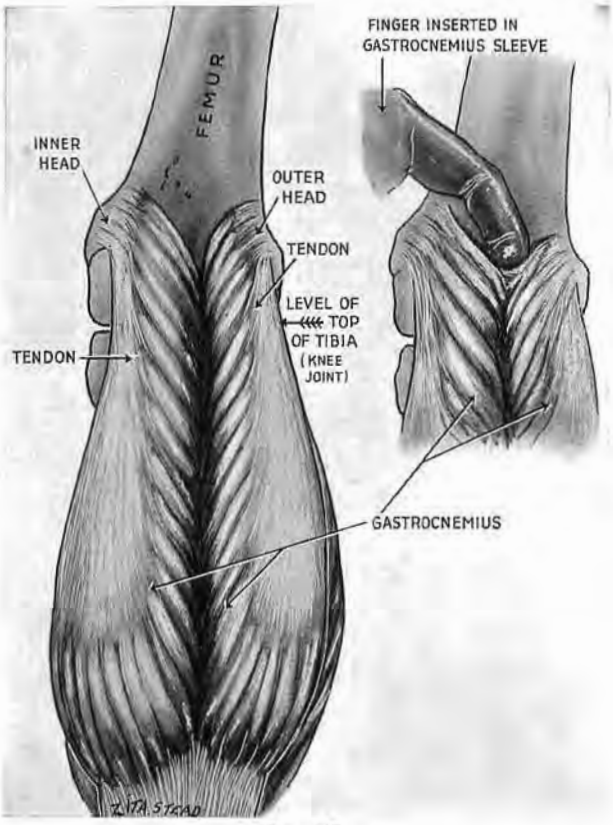


Fig. 147

Showing how the gastrocnemius V is formed *above* the level of the knee joint. A finger can define the V which marks the entrance to the half-sleeve covering the back of leg.

femur lies between their origins, they do not form, as that might lead one to expect, a long V pointing down the limb. Instead they meet before they leave the thigh and make a shallow midline V above the joint ; and there, if other guides default, a finger may be hooked between the heads (Fig. 147).

The mesial guides.—The early union of the heads gives value to guides that help in parting them below ; for swollen calves are soon deformed by posture, and midline structures shift. Two

guides—a vein and nerve—will almost always set us right: they mark the groove between the bellies of the gastrocnemius—the seam to rip, Fig. 148. The vein (the blue guide) is the short saphenous; it rests on fascia covering the groove. (A deep elastic layer of superficial fascia—the kind used recently in plastic work—invests

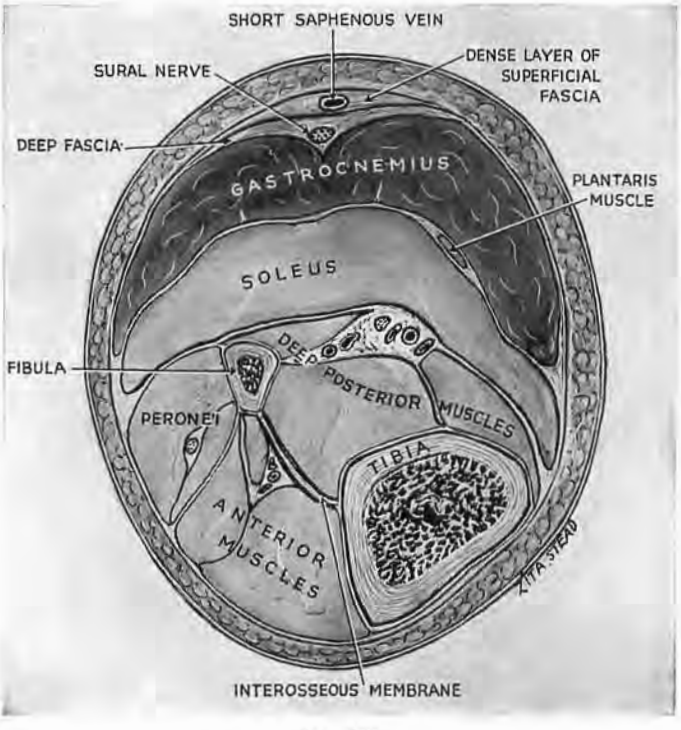


Fig. 148

Guides to the gastrocnemius seam

Note how the blue guide (short saphenous vein) is bridged by deep fibres of *superficial* fascia which bind it to the surface of deep fascia. (Sometimes the vein is deep to deep fascia.) The white guide (sural nerve) is regularly deep to deep fascia and *occupies* the groove between the gastrocnemial heads.

the upper reach of short saphenous vein. Preserving fluids rich in phenol sometimes make this layer simulate deep fascia; the vein then seems to occupy a level deeper than they say it should—a thing it *really* does quite frequently. My thanks are due to the Dominions officers who put me wise to this.)

Another guide (the white) lies in the groove itself, and thus within the envelope of fascia. It is the sural or calf nerve which springs from the trunk, now called the medial popliteal; more

distally, near tendo Achillis it gets a strong communicating branch from common peroneal (now called lateral popliteal).[1]

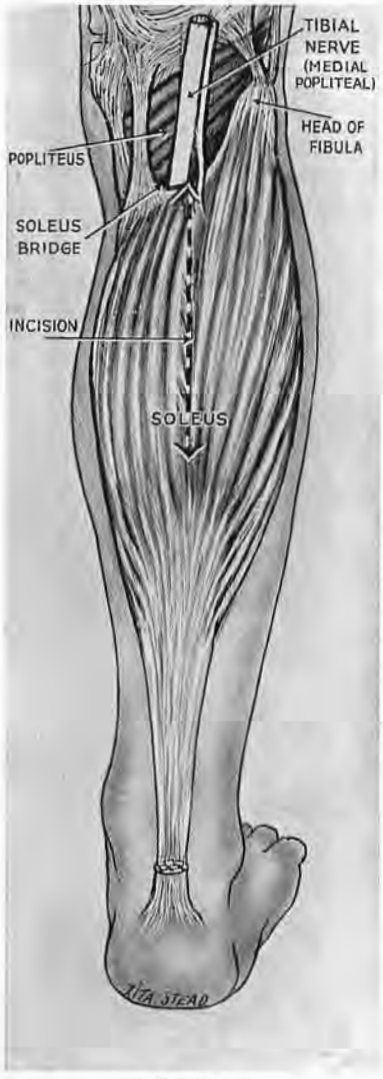


Fig. 149

The soleus bridge

The main vessels pass deep to it—between calf muscle and deep muscular group. Note where the large muscular nerve enters the edge of the bridge.

The half-sleeve and the striped seam.—The gastrocnemial heads unite to clothe the calf with a half-sleeve which we can lift with ease from underlying structure. The seam, we know, is doubly striped—in blue and white. Ripping the seam we find the popliteal bundle which goes from view beneath the slanting archway of a bridge formed between tibia and fibula by soleus belly (Fig. 149). The grain of soleus is chiefly longitudinal; so we can split the bridge and find the bundle deep to it. Nothing could be easier; the shade of Guthrie (with whom Larrey walked arm in arm through Cairo wards) might well rejoice. His method has survived the interlude when men, perhaps like Hunter's pupil, earned it the title "bloody," ranking the muscles "beefsteak number one"—and two and three.

The riddle of the bolster leg.—Indeed, this wide approach should have displaced by now the medial and cramped exposure in the calf, so indirect, so cherished by examiners,

[1] Rehearsal of these aliases is due to recent efforts aimed at making us *un*learn. We are to scrap, it seems, the painfully acquired (but excellent) "tibial" and "common peroneal" of the B.N.A.; so that, once more, internal (or medial) popliteal must change—invisibly—within a single segment of the limb and call itself posterior tibial, merely to suit the very questionable naming of an artery (see p. 246). "Tibial" plays no such tricks, and "peroneal" marks the striking early difference in course between its own deep branch and vessels *afterwards* related. Calling the other peroneal branch "the superficial," in place of musculocutaneous, prevents (I know) uncertainty regarding site—in arm, or leg—when looking through the journals.

Alice, again, in *this* peculiar nightmare, might compromise with popli-tibial, and popli-fibular.

so blind and therefore dangerous. For who knows what may lurk in swollen limbs from raid or accident? "A lucky-bag" was Ryall's word for the abdomen;[1] and, in respect of chance variety, the bloated calf becomes a kind of belly. The whole traumatic list of 'closed' conditions must be long for I have seen the following myself: a fissured fracture causing bleeding from the arch of anterior tibial vessels, which formed a clot that blocked the crural circulation (see p. 272); a bruised arterial trunk with distal vasoconstriction; aneurysm of the peroneal artery due to a broken shaft of fibula that wrenched away a *distant* branch; the bursting of some forty varices (with no arterial injury) caused by the pressure of a wheel; a gross œdema of each separate muscle (this in the upper limb) associated with constriction of main arteries to twine-like thinness. (The size and pulse of these diminished vessels were suddenly restored after a major slitting of fascial wrap and sheaths of muscle.)

A medley such as that in bolster limbs may wear a common mask of swelling and defective circulation, but any wholesale swaddling of these injuries in plaster—without the benefit of open exploration—will hold as grim an outlook as it would for sets of dubious 'acute' abdomens.

Tracing the bundle down the calf, we saw, was simple; to trace it midway up the back of thigh is simpler still. For hamstrings part behind the knee, and we prolong their separation. We shall exploit this facile cleavage in amputating through the thigh with aid of local block, reducing hæmorrhage as though we used a tourniquet; which we shall not (p. 255).

A GLIMPSE OF LEG

Leaving the no-man's land behind the knee let us revive a general acquaintance with the leg, not troubling greatly over detail.

The calf we have already seen; the two great muscles, gastrocnemius and soleus, sandwich plantaris. We saw the neurovascular bundle pass beneath the bridge of soleus; there it assists in marking off the bunched mass of the calf from the flat length of *deep* posterior muscles. Let us observe the vessels first.

The main vascular bundle and its distal fork.—Once more we

[1] Sir Charles Ryall (1869-1922), remembered for his work on the danger of implanting cancer cells during operative interference, and better still for the affection in which he was held by his colleagues.

are the dupes of terminology. "There is," we learn, "a main popliteal trunk that ends at the distal edge of popliteus; there it divides into posterior and anterior tibial arteries." "Posterior tibial," we are told, "goes on a small way down and then gives off the peroneal branch" —a mere collateral, one might assume. We get no picture of the facts as seen by surgical approach.

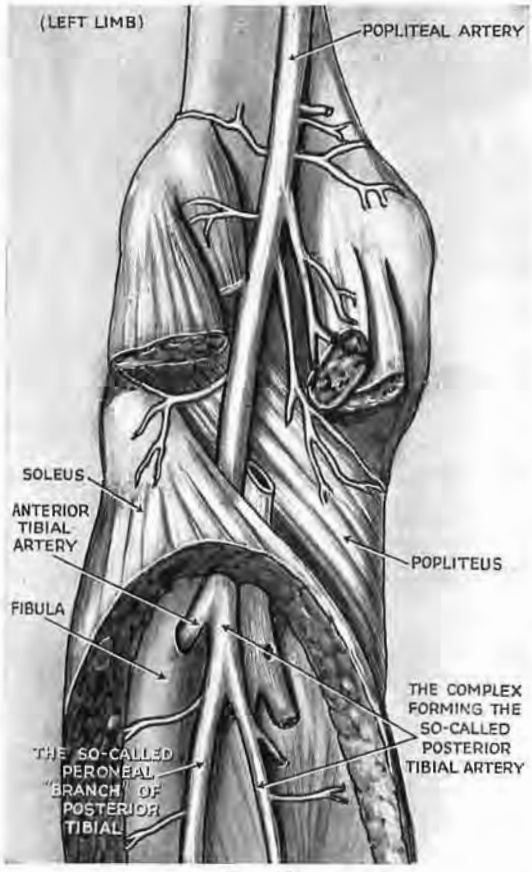


Fig. 150

The popliteal artery as currently depicted

(This is the only left-*limb* figure I have used. The drawing is after the relevant portion of Fig. 761, p. 794, Gray's *Anatomy*, 27th Edition, 1938; the indications have been modified.) A picture typical of many books, which rightly contradicts their texts: it shows conditions seen alike by artist and by surgeon—a main stem going down *beyond* its forward branch to end below by forking. (The texts end popliteal artery at anterior tibial and lump the rest of stem plus half the fork as 'posterior tibial,' having as 'branch' a vessel often larger than itself—the peroneal.) But artists, too, are fallible. The picture we have copied makes, like many others, anterior tibial come from the *side* of popliteal; in my experience (and Boyer's), it springs from the front—a point of surgical importance (pp. 272 and 273).

Looking afresh with those whose drawings contradict our texts (Fig. 150) we, too, shall see a stem—which is a 'main' —descending through the popliteal fossa, passing the popliteus muscle and going on some finger-breadths to end by forking sharply *like a catapult* —with larger emphasis at times on one or other side. That forked arrangement must be frequent: apart from absence of posterior tibial vessels in a single leg there has been no exception in the last thirty cadavers I have seen. That, too, is what a master of anatomy, the Baron Boyer, saw and described in 1815 (Fig. 151).

"And what," you will ask, "has become of the *anterior* tibial artery?" Well, it is just a branch from the front of a main

stem—a stem which Boyer calls the popliteal down to its tibioperoneal fork.[1]

We shall show presently how we can draw the proximal part of this anterior tibial branch right back into the calf and see exactly how it juts and curves (pp. 272 and 276).

But we are thinking too arterially ; the *veins* are large and thin-walled, sometimes varicose, outnumbering the branches of the

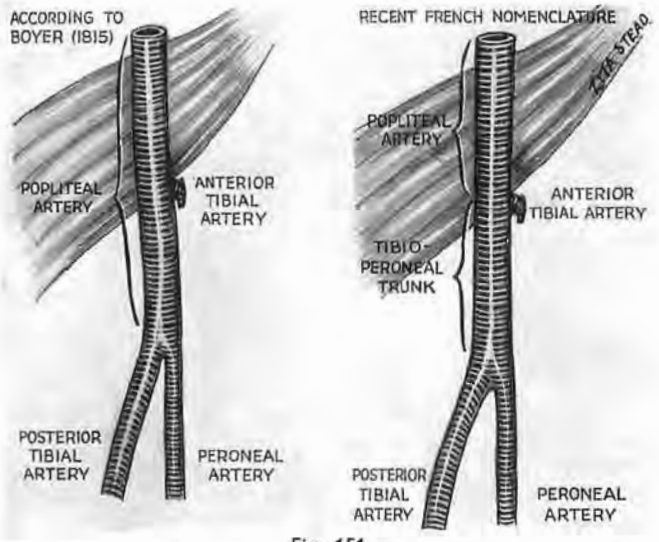


Fig. 151
Nomenclature which fits the distal forking of a main stem. (Note the term *tibioperoneal trunk*).

arteries by two to one. So veins bedevil intervention and complicate our much too simple picture of a place where vessels fork and arch—in triplicate.

The *distal portion of the bundle*, about the level where gastrocnemius and soleus join with tendo Achillis,[2] edges inwards from between the deep and superficial muscle layers, and is covered there by skin and fascia only (Fig. 152). Thence we can trace it up the leg, detaching as we go the slender mooring of soleus to the tibia, which may reach down within a handbreadth of the medial malleolus (p. 264 and p. 268).

[1] Since Boyer's day his countrymen, less simply though with clarity, make the popliteal end (as we do) at the anterior tibial branch, and then impose the name of *tibioperoneal trunk* on the last fingerbreadths of stem above the fork. We can, with those accounts, believe our eyes ; for each describes (as we do not) a major stem that goes *beyond* a forward branch and ends below by forking (Fig. 151).

[2] *Tendo Achillis*, changed in B.N.A. to *tendo calcaneus*.—This kind of make-believe at growing up is charmingly discouraged in pages cardinal to scientific outlook. "*La gentillesse des fables*," wrote Descartes, "*réveille l'esprit*" : their pleasant touch, he found, could stir the mind. (*Discours de la Méthode*, Part I.)

Leaving aside for later study the lateral peronei and the popliteus, turn for a moment to the tibial shaft.

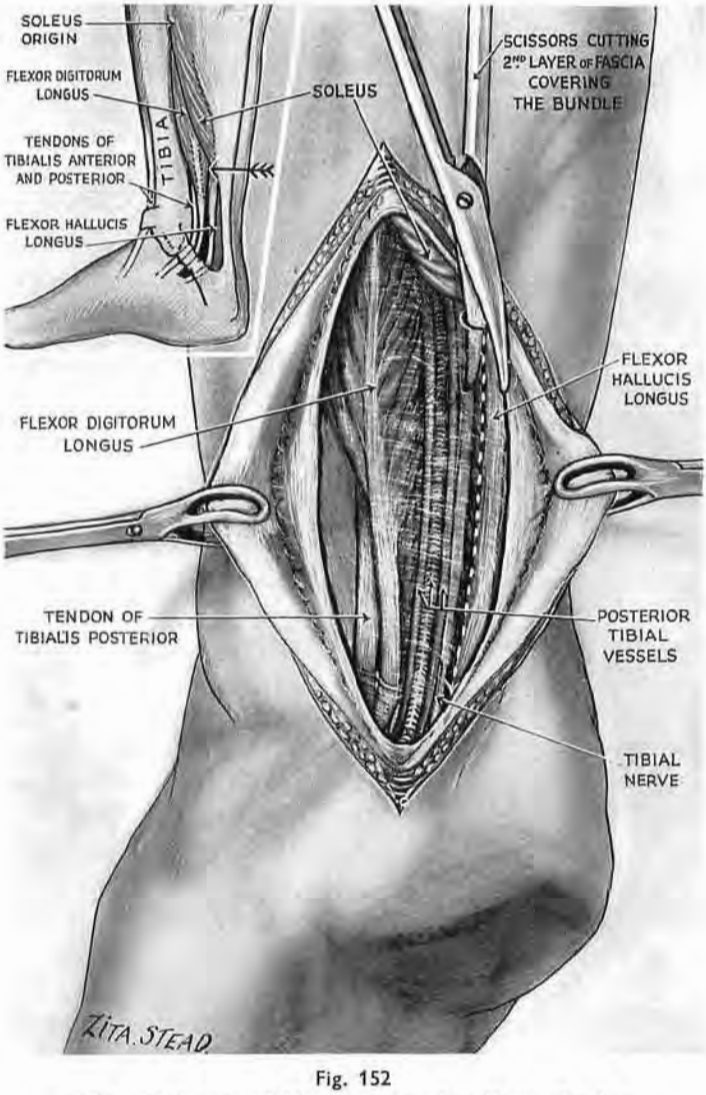


Fig. 152

The distal part of the posterior bundle in the leg

It is covered here by skin and by *two* layers of deep fascia. The inset shows how tibial fibres of soleus cross and interrupt the plane of cleavage between calf and deep muscles—the plane in which the bundle lies. The deeper fascial layer and these soleus fibres serve to moor tendo Achillis more firmly on the *tibial* side (pp. 268 and 269). The arrow of the inset points to where the bundle leaves the shelter of the calf.

Anterior and deep posterior leg muscles (Figs. 153 and 154).—The subcutaneous surface of the tibial shaft separates a belly of

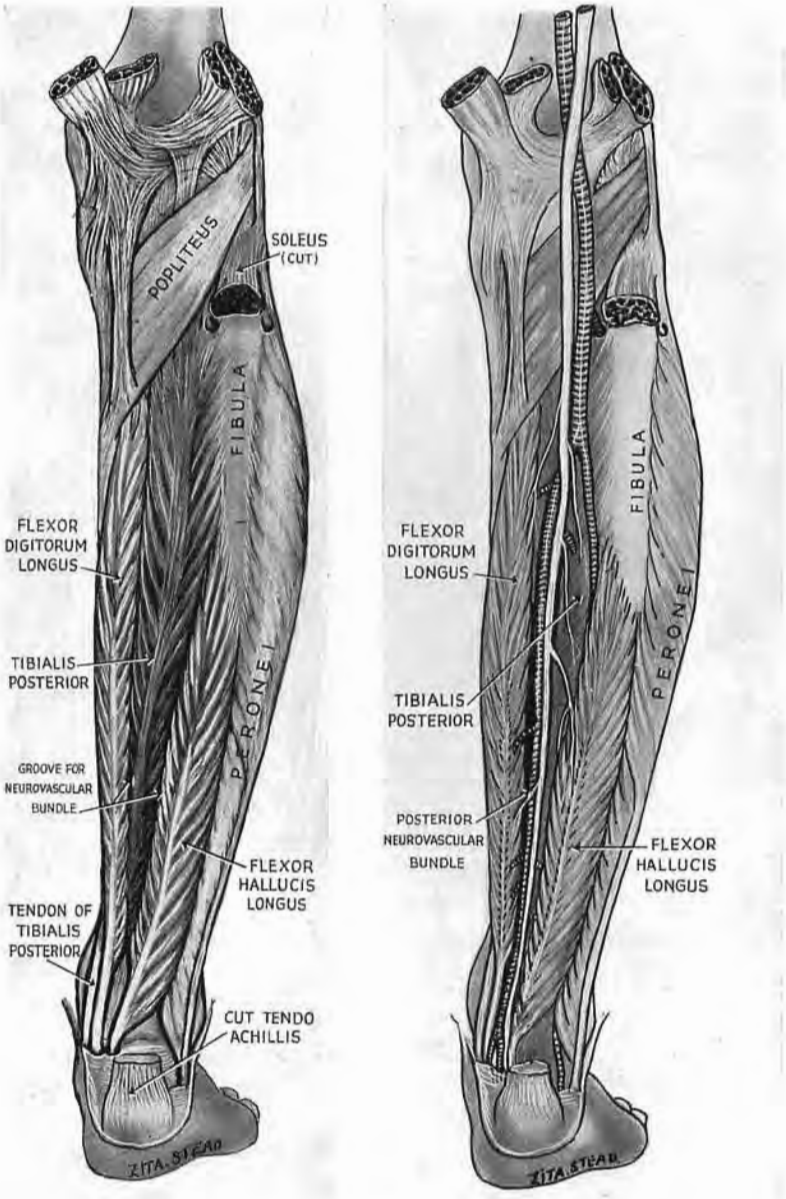


Fig. 153

The deep posterior leg muscles

Note how they form a groove for the posterior neurovascular bundle.

the deep posterior group behind from a belly in front; of these the anterior only is called tibialis; the belly behind is the long flexor of the toes.

The tibialis posterior springs from both bones of the leg; it is the deepest belly in the posterior compartment. Its *tendon*, however, comes to the surface by passing inwards, deep to the tendon of the long flexor—a relation of crossed fingers. In the distal third,

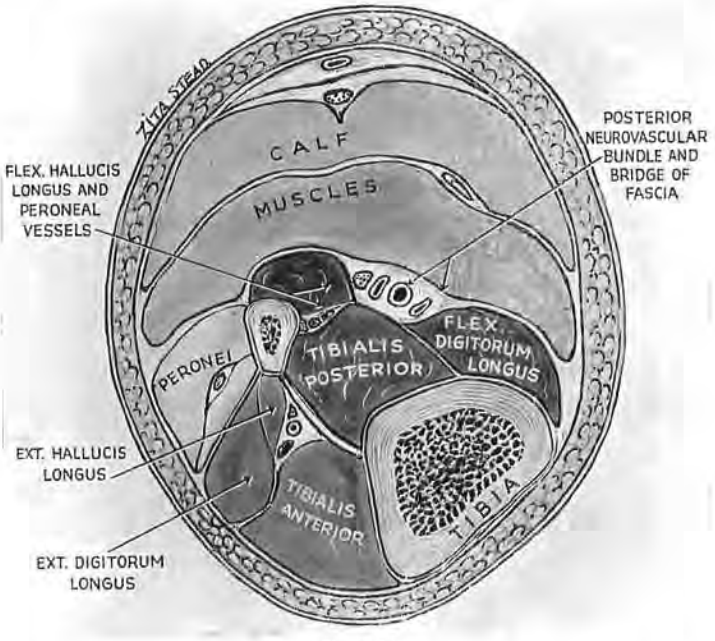


Fig. 154

The relations of deep posterior leg muscles with the anterior group

Note here, too, the groove for the posterior neurovascular bundle. A bridge of fascia makes the bundle a satellite of the deep group. Note how the subcutaneous face of tibial shaft separates the *belly* of tibialis anterior from the *belly* of flexor digitorum longus. (The inset to Fig. 152 shows how the face of tibial malleolus separates *tendons* of tibialis anterior and posterior.) Extensor hallucis longus is the only *deep* muscle of the anterior compartment.

therefore, the superficial face of tibia does actually separate two structures known as tibial—the tendons, *not* the bellies, of tibialis anterior and posterior (Fig. 152, inset).

The other muscle of the deep posterior group, flexor hallucis longus, springs (like extensor hallucis in front) from the middle two-fourths of the fibula—the 'middle half,' if you reduce the fraction. The bellies of this flexor and the flexor of the toes encroach sufficiently upon the hinder face of tibialis posterior to

form a gutter for the neurovascular bundle—a gutter bridged by thin, translucent fascia which grows thick distally where it escapes the shelter of the calf (Figs. 154 and 152).

Turning now to the *anterior compartment* we find two main superficial muscles, and later we shall look between them for the neurovascular bundle (p. 276). These muscles are (1) the tibialis anterior (whose belly *and* whose tendon flank the subcutaneous face of tibia), and (2) extensor digitorum longus (coming mainly from the fibula). The off-shoot muscle, peroneus tertius—a badge (not always present) which marks us from the apes—springs with extensor longus. The one deep muscle of the anterior compartment, extensor hallucis, arises from the ' middle half ' of fibula. Going obliquely (as it must to reach the inner toe), its belly overlaps the neurovascular bundle and sets a trap (p. 278).

This general and bare account (by furnishing a sort of common back-cloth) will stage in turn exposures in the limb and let us focus on the detail.

THE MIDLINE POPLITEAL APPROACH

For this we need add little to the general reflections on p. 241. Here, too, as in exposure from the outer or inner side, we have to mobilise and then displace the intervening ' bundle.' But working this time from the back there is (in contrast with a side approach) no " open sesame " ; the place itself will not revolve and let us in. So we must take it squarely, by direct assault (cf. p. 212).

Incision.—Find first the level of the joint—a fingerbreadth above the head of fibula (Fig. 155). Incise in what you *think* the middle line—a guess which (owing to swelling and decubitus) is often wrong. Cut through skin and fat a handbreadth distal to the joint. Bring the knife sideways just below the crease behind the knee; then upwards for a span, as shown in the inset.

The seam.—Look for the short saphenous vein (the blue guide to the middle line). It lies, remember, deep to fat, along the groove between the heads of gastrocnemius, most often on the surface of deep fascia (but sometimes underneath). If it does not appear at once, reflect a little skin at either edge. The final proof of mesiality, the sural nerve, is constantly subfascial: it occupies the groove (Fig. 156). Open deep fascia behind the calf to look for it, and not

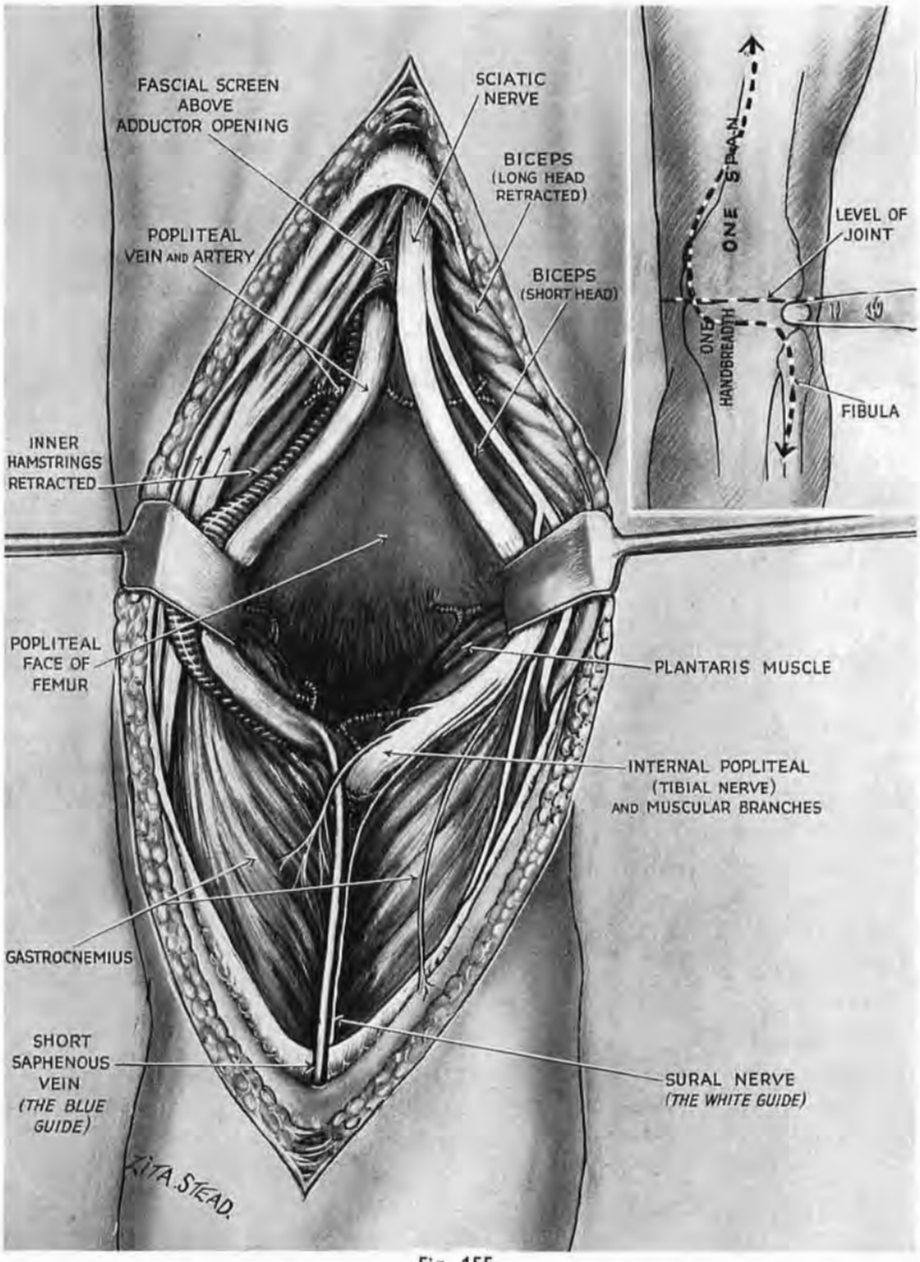


Fig. 155

Midline popliteal approach. (The figure gives a cramped and strained impression. It has been used designedly to show that freedom of the bundle and consequent exposure of the bone will only be secured when we have ripped the gastrocnemius seam.)

The long incision lets us mobilise the nerve and vessels : we either draw them bodily aside or part them (as above), moving the vessels towards the point of their fixation in adductor opening.

behind the knee joint, for there a greater trunk (medial popliteal nerve, or tibial of B.N.A.) lies close beneath investing fascia, and may be ripped in face of extra tension—like cortex under dura. When we have split the seam in gastrocnemius this popliteal trunk becomes a guide to separate the inner from the outer hamstrings;

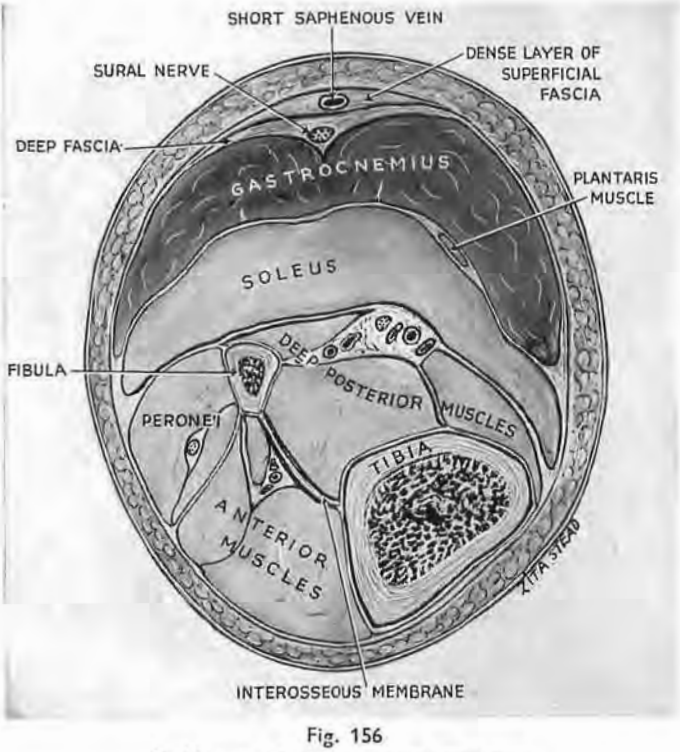


Fig. 156

Guides to the gastrocnemius seam

Note how the blue guide (short saphenous vein) is bridged by deep fibres of *superficial* fascia which bind it to the surface of deep fascia. (Sometimes the vein is deep to deep fascia.) The white guide (sural nerve) is regularly deep to deep fascia and *occupies* the groove between the gastrocnemial heads.

a finger helped a little with the knife dissolves their slight cohesion.

The 'bundle.'—Retraction of these sundered bellies in the calf and thigh reveals, beneath the inner popliteal (tibial) nerve, the close-knit popliteal vein and artery—the last impediment before we reach the bone. Then—if the finger finds it easy to displace—the 'bundle' goes *en masse* to either side; but, if it loosens grudgingly, we humour its constituents and pass between, moving the nerve towards its outer popliteal fellow,

the vessels inwards—to the side where they are fixed in the adductor opening. The popliteal plane at once becomes accessible (Fig. 155, noting the *legend*).

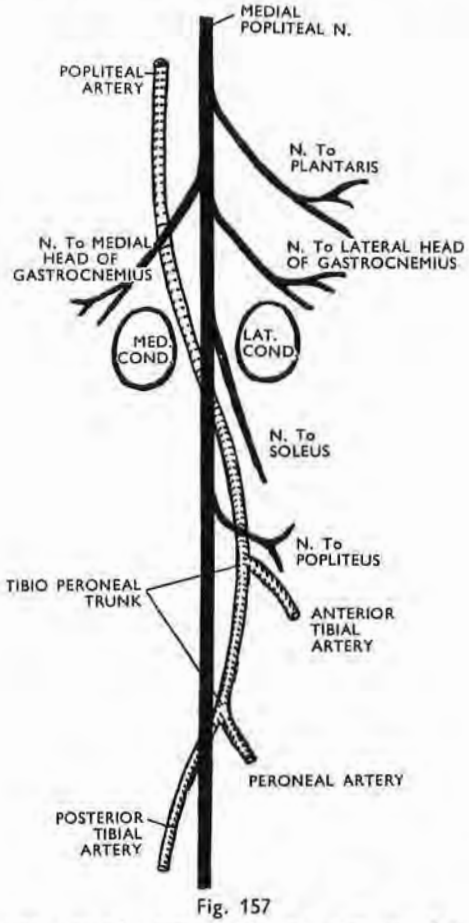


Fig. 157

The 'safe' inner side of the medial popliteal nerve (after Grant)

The popliteal artery curves away briefly towards fibula—as if drawn there by major branches. The *vein* (not shown here) parts nerve from artery throughout the fossa.

Bending the knee will loosen everything behind the joint and let the bone approach the surface. But relaxation sets peculiar traps, and semitendinosus may drift limply to the middle of the wound and there be claimed as great sciatic.[1]

[1] I saw this seemingly absurd mistake made twice, by reasonable men—a sign perhaps of decent equilibrium ; for those who let us know they are infallible in any field are either lunatics, "economists of truth," or in the even larger class one thinks of as 'unfortunate,' which lacks both virtue and the chance to fall.

EXTENSION OF THE MIDLINE ROUTE.—The distal part of this exposure lets us move the nerve and vessels far enough aside to cut through popliteus and expose the hinder, 'popliteal' face of tibia *without* dividing the soleus bridge (cf. p. 261 and footnote).

The next few pages show that we can use the mesial approach (combined with simple lateral posture) in the most frequent amputation of the thigh—that through the distal half.

A POSTURE FOR THIGH AMPUTATION WITH NO TOURNIQUET USING PROCAINE [1]

Custom has reconciled us to the supine posture for those who need this amputation. With that disposal limbs are slung from raised supports; or else a nurse must bear their weight. In either case we work at levels awkward for injecting nerves if

Fig. 158

The flexed limb pivots on the heel, which rests on the table. The nurse holds the leg and rotates it to present the front and sides of the patient's thigh to the surgeon without lifting the limb.

spinal block is inadvisable.[2] These troubles vanish when we place the patient on his healthy side; then, if the damaged limb will flex, the nurse need never lift the foot, but only grasp the leg and keep the heel—as *pivot*—on the table (Fig. 158). She thus presents

[1] *The Lancet*, 1940, **1**, 736.

[2] Procaine nerve-block, used alone or in company with gas-oxygen or minimal amounts of ether, was strikingly employed by Lotfy Abdelsamie, F.R.C.S., in my surgical unit at Kasr el Aini Hospital, Cairo, during work that much reduced mortality from crush. Abdelsamie's valuable paper should have new currency in time of war. (*The Lancet*, 1936, **1**, 187.)

each aspect of the patient's thigh: the sides in turn are brought to face the surgeon; while to expose the back she lets the knee fall gently down across its fellow (Fig. 159). So, after infiltrating areas of flap or cuff, and *all* the operative field—most thoroughly—with procaine ($\frac{1}{2}$ per cent.), we can in comfort see and block the great sciatic trunk. While that is growing numb we shall ligate main vessels and thus avoid the use of tourniquets.

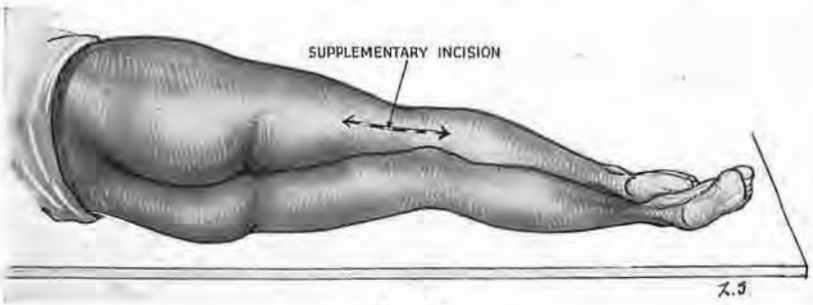


Fig. 159

The knee falling across its sound fellow gives access to the back of thigh. A long midline incision exposes the sciatic nerve for high injection and the main vessels for ligature.

The supplementary incision.—For this twin purpose make a *mesial* cut—first outlined by a weal—through popliteal skin one handbreadth distal to the joint and going upward to a spot three fingerbreadths above the site proposed for bone division (Fig. 159). We find the mesial guides (p. 242) and separate the boundaries of the popliteal space; then we can trace the tibial or inner popliteal nerve up to sciatic trunk, which we inject with 15 c.cm. of a 2 per cent. solution of procaine—first in the sheath, then in the total thickness of the trunk.

Ligation from behind of femoral vein and artery.—The blocking of the nerve affords an interval in which to tie the two main vessels. These run, of course, at deeper levels—near the bone. And though the artery and vein do not officially become the popliteal till they have passed the opening in adductor magnus, yet, as they near the opening, only a trifling web of tissue screens them from the posterior compartment. So, if we trace the vessels *from below* (where we can hook them blindly off the femur),[1] it is extremely simple to disrupt the web and tie them well above the level for dividing bone (Fig. 159). We then proceed according to our training or experience: incisions, joining with the mesial cut

[1] A stress on "from below" is justified: the *fevered* searches that one sees begin high up, where vein and artery are hard to find.

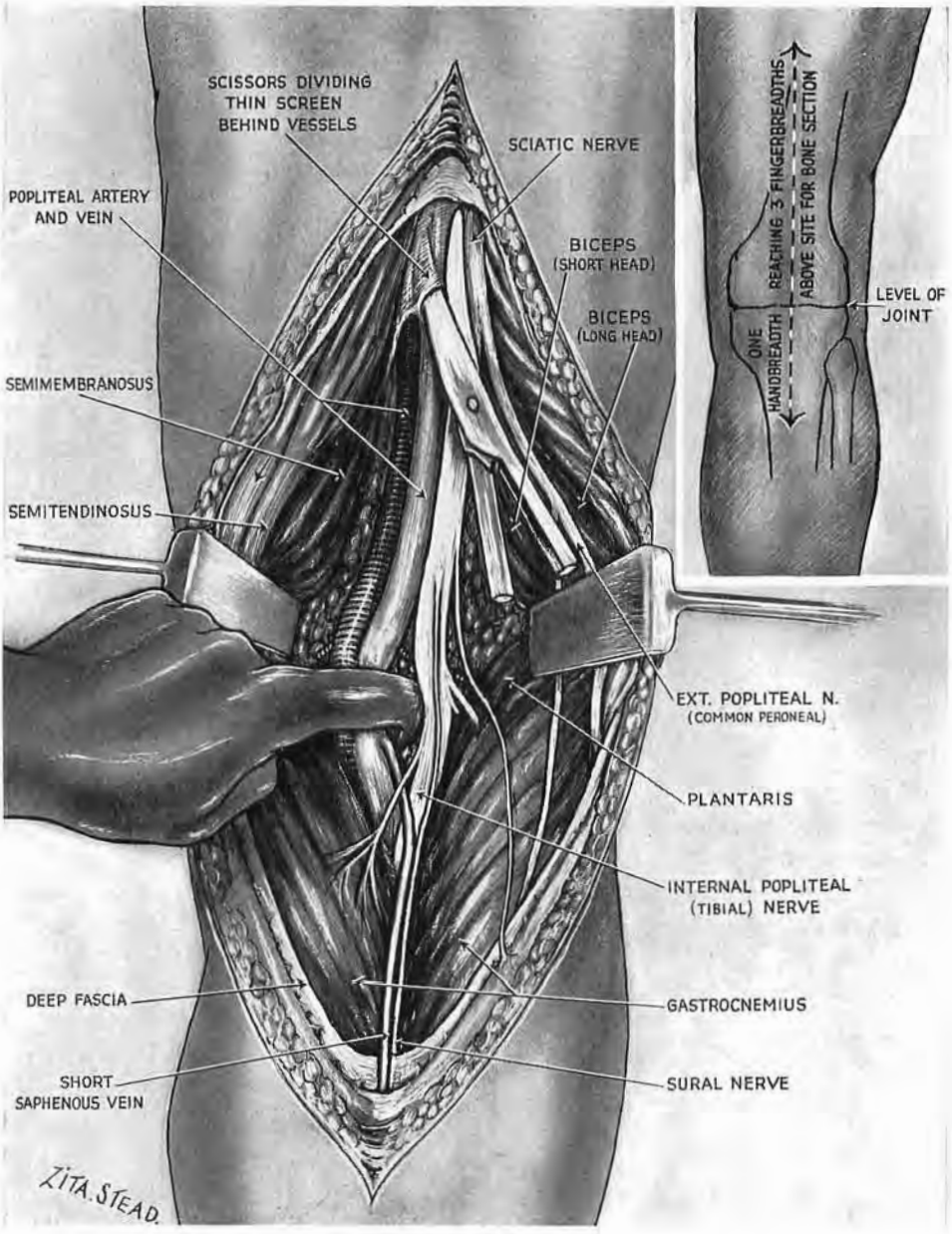


Fig. 160

The long midline incision and its use in thigh amputation under procaine

A finger introduced at the medial edge of the tibial (internal popliteal) nerve *behind the knee* hooks the main vessels up from the femur. Trace them proximally and tie them *above* adductor opening after dividing the thin fascia which screens them from behind. (The midline incision here is permissible since the knee joint will be removed.)

behind, run distally and forwards ; the flaps are made and muscles severed.

During these activities, however, the great sciatic trunk will rest in peace—until the time comes to remove the limb. With procaine infiltration not less than twenty minutes must elapse between injecting and dividing this capacious conduit of shock impulse. And that, indeed, is little time enough. Let us recall and profit by two clear and striking facts : our own distress when dentists shorten by a jot the dozen minutes *they* allow for nerves far smaller than the huge sciatic ; the sudden fading of the patient's pulse when stimuli get through a partial procaine block, unsupplemented by another anæsthetic.

The method used in the attempt to burke the later growth of axones will have prescribed already the length of nerve we first injected. I do not dare to say which method is the best, for no one knows ; but each will place the procaine to suit his own belief. It is at least important, once the limb is off, not to pull out the severed nerve and cut it short at levels unprotected by the procaine ; though I have seen this done.

We have to deal as well with the *saphenous nerve.* The guide to it—a whitish raphe on the medial side of thigh, found on displacing the sartorius—denotes the tendon of adductor magnus ; a nick with Mayo scissors made immediately in front of this will open the canal which holds the nerve. Then trace it up the thigh, inject it at the same level as sciatic, and divide it when the same long interval has lapsed.

I can confirm Abdelsamie's finding : " Amputation under *full* novocaine analgesia is a benign measure that does not shock the patient."

STUMP SEPSIS AFTER AMPUTATION FOR DISTAL INFECTION

I have seen many thigh amputations performed for this reason with careful technique after scrupulous preparation, but I have also seen, and had myself, too many septic results—perhaps because bacteria from distal foci were travelling up lymphatics during the operation, out of range of chemicals applied only to skin. In my experience sepsis came whether rubber drains were left a long or short time : if long left they seemed to determine infection ; but dangerous pooling of exudate ensued upon early removal. This pooling is prevented by placing ribbon gauze, heavily coated with

dilute bipp, as a slender pack under each layer at the time of suture—for example, between bone and fascia (or muscle), and between fascia and skin. The bipped ends of the ribbons protrude as drains, and the pack is so well lubricated that it can be removed painlessly after forty-eight hours. A dry wound is left which will at once be covered with a *thickly* bipped dressing. These drains do not carry in sepsis from without, as rubber may; and certainly, too, the bipp can check bacterial growth.[1]

A relevant example of its use in another field interested some of my co-workers in this country. The large cavity left by removing a mandibular osteoclastoma was packed with bipped ribbon after thorough treatment of the wall with the high-frequency current. The cavity (lined now with dead tissue) communicated not only with the surface of the neck but also with the mouth, and the patient ate and drank as usual from the day following operation. When we removed the pack for the first time at the end of a fortnight we found a lining of clean red granulations. The pack—except on its oral surface, where saliva had washed out some of the bipp—was unaltered and fresh like the cavity.

I have no experience of the original bipp, which might be toxic in this quantity, having never used any but the dilute variety, whose value I learnt from Stoney during World War I; nor have I met with any other preparation which could so triumph in the test just described.

[1] The ingredients of dilute bipp are :—

Bismuth carbonate . .	1 part	Hard paraffin	2 parts
Iodoform powder . . .	2 parts	Soft paraffin	12 parts

Its preparation requires careful attention to details, of which R. Atkinson Stoney, of Dublin, has sent me the following note :—

Put the iodoform and bismuth in a large mortar and mix well. Melt the hard and soft paraffin together on a water bath; stir well and cool slowly, stirring all the time. Take a little of the mixture of hard and soft paraffin and rub it up with the mixture of iodoform and bismuth till a smooth paste forms. Add the rest of the paraffin little by little to make a uniform ointment. The bipp should have the consistence of firm butter and should *not* be greasy. In very hot weather increase the quantity of hard paraffin and reduce the soft. (In wards the bipp is best kept in separate containers for individual patients.)

With this, I must confess, one does not quite recapture the lipstick qualities conferred on dilute bipp by pharmacists in France. But I have left the note—like that of p. 12 concerning compound fracture. For recent drugs are not the first, by many years, to start a habit of obtaining excellent results from wounds, however grossly soiled—which still, I see, claim victims.

EXPOSURE OF VESSELS AND NERVE IN THE BACK OF CALF

Incision.—Find first the level of the knee joint, a fingerbreadth

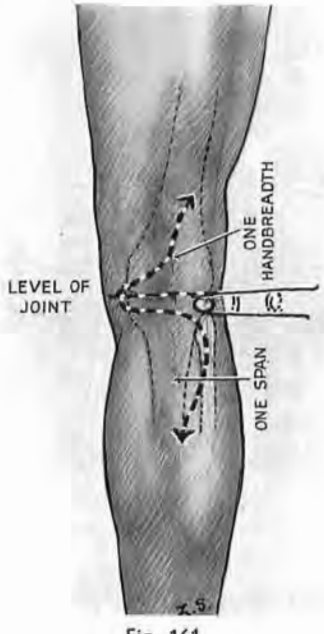


Fig. 161
Incision for midline calf exposure
Note the level of knee joint viewed from behind : it lies one fingerbreadth above fibula.

above the top of fibula. A *mesial* incision measured from this plane, runs for a handbreadth up the thigh, a span along the calf (Fig. 161). The rest we know : the half-sleeve of the gastrocnemius, striped on its seam in blue and white, and surgically ripped to show the soleus bridge ; the lengthwise splitting of the bridge ; the underlying venous and arterial ' catapult ' (pp. 246 and 247).

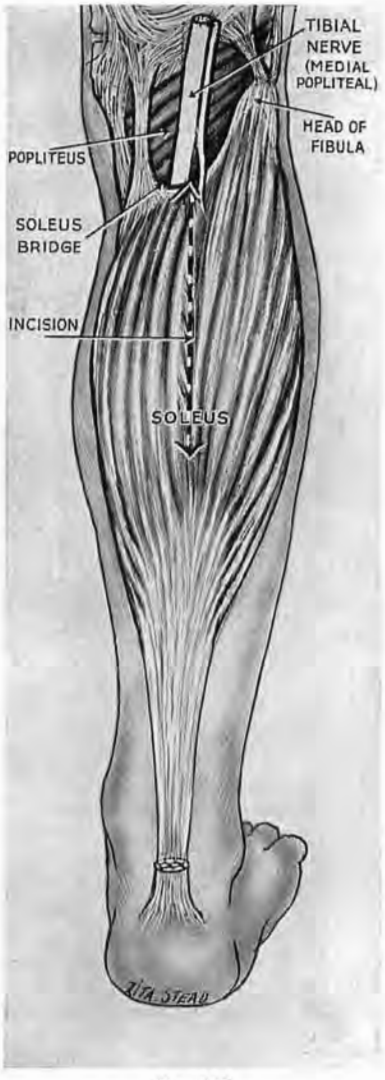


Fig. 162
The soleus bridge
The main vessels pass deep to it—between calf muscle and deep muscular group. Note where the large muscular nerve enters the edge of the bridge.

The bridge-mouth of soleus.—The tibial nerve which runs behind this catapult of vessels ' bisects ' their tibioperoneal fork, but first

supplies the bridge-mouth of soleus with a sturdy twig—most easily divided (Fig. 162). And so—before you split the bridge—define this entrance gently with a finger beside the disappearing vessels. (See that the foot is plantar flexed, and bend the knee to make the wound both lax and shallow.)

EXPOSURE OF THE 'POPLITEAL' FACE OF TIBIA.—This follows the exposure of the nerve and vessels whose bundles we can now displace to reach our first objective—the fan-shaped popliteus.[1]

A useful vertical extrinsic band.—The sheath that cloaks the popliteus is strengthened at its widest, medial, part by constant fibres which belong to semimembranosus (Fig. 163); these cross and stick upon the fan-like grain—a grain that yields when split a glimpse of concave bone through thick and grudging muscle. So for a better view, transect the popliteus. The knife should reach the tibia by cutting lengthwise down the band. A liberating cut is also made, respectively, along the upper and the lower margin of the popliteus. Both liberating cuts should finish *medial* to the middle line; they thus avoid the nerve to popliteus, which lies behind the muscle and ends by curving round its lower border. The upper cut should also miss the vessels (inferior medial genicular) which slope along the upper edge and are attached to it by the extrinsic band of fibres (Boyer). So, with its nerve intact, we mobilise the popliteus, raising it from bone towards the *fibula*. Then there is room to deal with our objective.

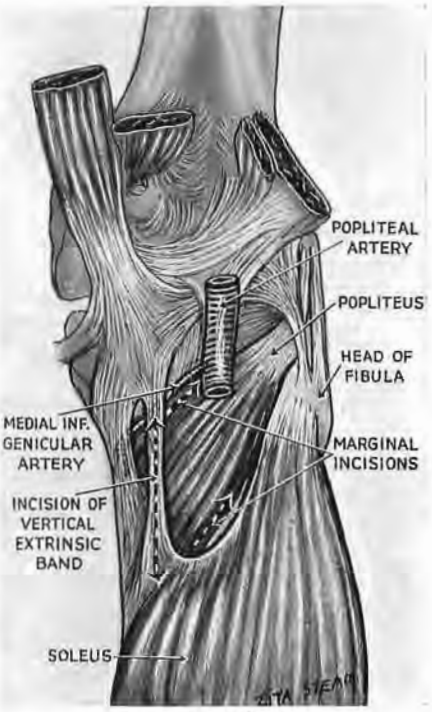


Fig. 163

The vertical extrinsic band

The knife transects the grain of popliteus by cutting lengthwise down the band. Liberating cuts are made along the margins of the muscle, sparing genicular vessels above. Retraction of the muscle towards fibula will expose the concave face of tibia. Repair by suturing *across* the band whose fibres stop the creep of sutures.

[1] The distal portion of the midline popliteal route (p. 251), which lets us mobilise the barrier of nerve and vessels, will also let us reach this hinder part of tibia—*without* dividing the soleus.

We make a sound repair by suturing the popliteus at right angles to the length of the extrinsic fibres ; for since they cross the fan they stop the sutures creeping through its grain.

EXPOSURE OF THE POSTERIOR NEUROVASCULAR BUNDLE IN THE LOWER PART OF THE CALF AND BELOW

Lesion of nerve and vessels half-way down the leg (or farther) is dealt with through a medial and *long* incision. The distal mark

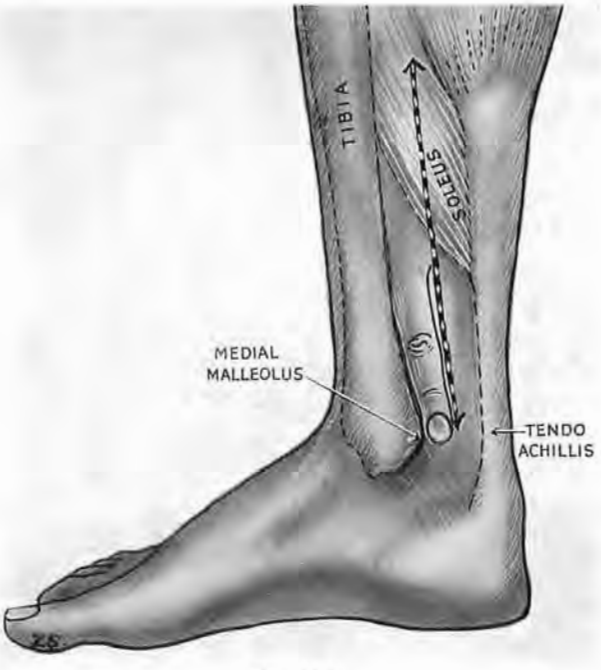


Fig. 164

Incision for the posterior neurovascular bundle of leg (distal half)

The finger with one edge pressed against the back of tibial malleolus marks with its other edge the distal end of the *artery*. Above, the knife avoids saphenous nerve and vein by cutting two fingerbreadths behind tibia. Note how fibres of soleus spring from tibia and cross the plane of cleavage that lies between calf muscles and the deep group.

for this should overlie the bundle. But where—exactly—is the mark ? Many books to-day agree in placing it " midway between the medial malleolus and the tendo calcaneus " :—a reasonable site, unfortunately countered on a previous page of one respected work, which makes the posterior tibial artery end " midway between the tip of the medial malleolus and the most prominent

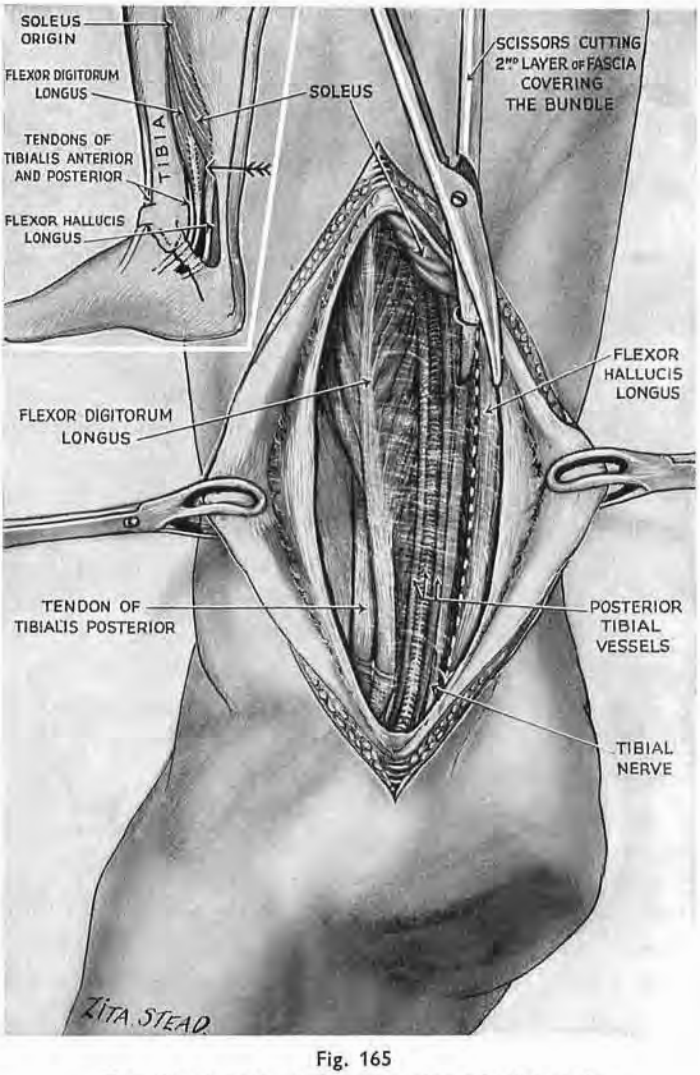


Fig. 165

The distal part of the posterior tibial bundle

Note the thick *second* layer of deep fascia covering the bundle. Above, it thins out to part deep muscles from calf. Divide it *beside* the bundle. To follow the bundle *up*, detach the tibial origin of soleus (inset). The arrow points to where the bundle leaves the shelter of the calf. If you must also reach the level of the ' catapult ' extend the exposure by the wide medial access (p. 265). (For plantar continuation see p. 300.)

part of the heel." This ancient piece of imprecision (by contrast with its clear-cut fellow) haunts, I find, the memory of surgeons, and echoes widely in alternatives: " the medial tubercle of the calcaneus "; " the centre of the convexity of the heel "—uncertain places, deep to thickened skin, that serve to misdirect incisions and guide them too far back.

Let us forget this careless talk. The vessels lie a fingerbreadth behind the medial malleolus. Try on yourself. Press one edge of a finger down along the *back* of malleolus; the other edge controls the tibial pulse. The finger therefore marks the *end* of an incision whose purpose is to amplify a plane of cleavage and thus is long enough to show the vessels without exactly following their course (Fig. 164).

Incision.—This will divide skin only. Measure a span extending from a fingerbreadth behind the medial malleolus to reach a point above, two fingerbreadths posterior to tibia—avoiding thus the long saphenous vein and the companion nerve which lies just deep to it (Hovelacque). Open the surface sleeve of fascia and then a *deeper* sheet which binds the bundle to the deeper group of muscles. This second fascial layer while it lies beside Achilles tendon is strong, opaque and tense, but passing under shelter of the calf it there becomes a thin translucent pellicle. Begin dividing it above, for down below the vessels may be slit as they approach the line of skin incision (Fig. 165). To trace it farther upwards use the plane of Fiolle and Delmas in front of the Achilles tendon—a solid strap that lets us lift the calf away from deeper muscles which hold the bundle in a satellite relation (pp. 250 and 251).

Nothing is perfect: the facile cleavage plane (which, in itself, might symbolise an influence of France on surgical technique) is crossed above by fibres of soleus. Detachment of these lower fleshy fibres allows, as I had previously described, a further view of nerve and vessels; but with such limited detachment a second means of access—through the middle line—was needed to expose the region of the ' catapult ' (pp. 241-247). Complete detachment of soleus from the tibia extends and simplifies exposure.

WIDE MEDIAL EXPOSURE BY THE COMPLETE DETACHMENT OF SOLEUS FROM TIBIA

Wounds of the calf must frequently claim use for midline access; but while the twofold character of gastrocnemius favours surgical approach, *veins* [1] in the belly of soleus may prove troublesome at operation.

Thus half a dozen large veins are likely to be cut in any central splitting of soleus belly; and, aside from special indications, this induces a return to medial approach—one, however, widely different from the old and often futile exercise of groping through a medial slit, compared with which the midline route, however bloody, gives what Binnie called a "soul-satisfying view."

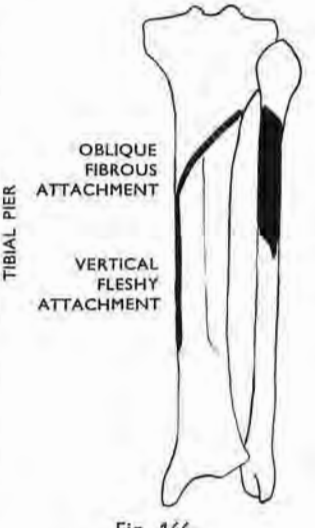


Fig. 166

The attachment of the piers of the soleal arch, tibial and peroneal

The tibial pier arises in two continuous segments—an upper oblique and fibrous, attached to the rough soleal line; a lower and vertical fleshy segment which does not mark the back of tibia.

The present method rests on the two piers of the arch by which soleus bridges the main neurovascular bundle. Each pier of the arch has a linear attachment, one to tibia, one to fibula. The longer tibial attachment has two *continuous* parts: the upper, oblique part rises from short stiff fibres that help to fashion the rough soleal line; the lower, longitudinal part of the attachment descends immediately behind the inner edge of tibia, but, being *fleshy* and not fibrous, fails to mark the back of the bone (Fig. 166).

If we detach both these continuous linear origins from tibia (Figs. 167 and 168), then, by virtue of the plane of cleavage that parts soleus from the deeper muscles, we can rotate soleus (and

[1] These veins are apt to thrombose early in a long decubitus and form potential launching sites for emboli. Later, if the blocked veins should become recanalised and thenceforth valveless, the pumping action of soleus will drive blood *down* towards their union with the triple set of veins—so often rediscovered and forgotten—that normally should drain the favourite site of varicose ulcer into the deep, posterior tibial veins. The soleus pump, disposing now of an excessive downflow, will force the valves belonging to this triple set of veins, making the venous blood reach skin instead of draining from it. So, with the stress of venous irrigation, and by seepage, the healthy but predestined site for ulcer becomes an ill-drained, ill-fed, pigmented swamp. (See F. B. Cockett and Elgan Jones, *Lancet*, 1953, **1**, 17.)

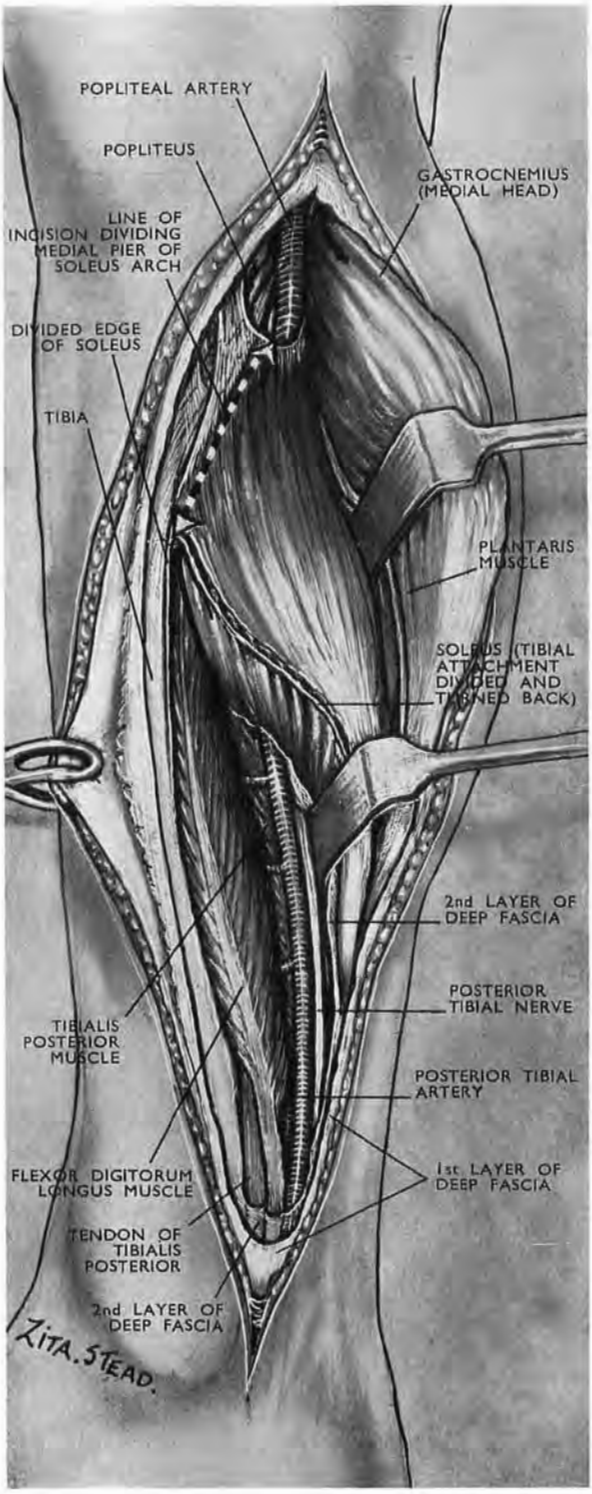


Fig. 167

The posterior tibial neurovascular bundle; a medial extension of its distal exposure

Stage I.—After separating the thin, longitudinal attachment of soleus from the medial edge of tibia, continue to detach the muscle from the soleal line. This *oblique* attachment forms the medial pier of the soleus arch in front of which the popliteal vessels and medial popliteal vessels and medial popliteal nerve change their names and pass down the leg.

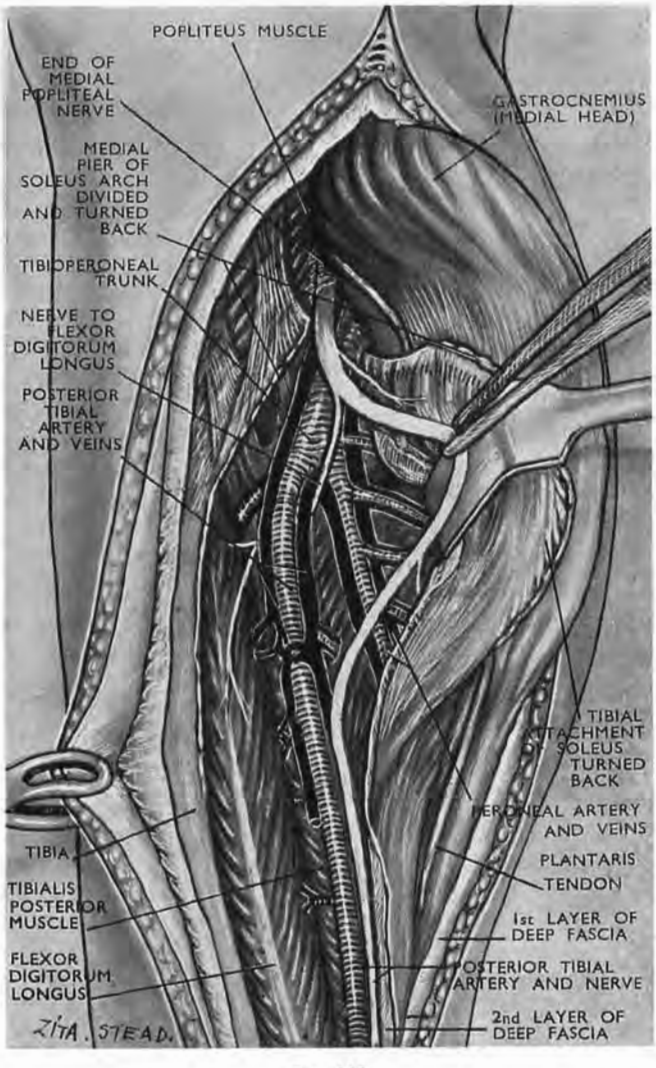


Fig. 168

The posterior tibial neurovascular bundle; a medial extension of its distal exposure

Stage II.—Now—with its tibial attachment cut—we can turn soleus back and out through two right angles. This will expose all the main neurovascular structures of the leg: the distal end of the medial popliteal nerve and its posterior tibial continuation, the tibioperoneal trunk (p. 247), the posterior tibial and peroneal vessels together with portions of all the deep muscles of the posterior compartment.

the whole calf) outwards through two right angles on the hinge formed by the short fibular pier.

The incision, made when the foot is plantar flexed and the knee bent, runs longitudinally. It starts from a handbreadth above the tip of the malleolus and ends three fingerbreadths below the line of the knee joint; its upper end should lie two fingerbreadths behind the inner edge of tibia; the rest, a fingerbreadth behind. The long saphenous vein and the saphenous nerve both run in surface fascia in front of the incision and are carried forward with the side-curtain.

Detachment of the tibial pier is almost bloodless. A finger will protect the neurovascular bundle where it is bridged by the soleus arch.

The access to the bundle is as complete as that got by the midline approach, but the ' catapult ' division of the tibioperoneal trunk (pp. 246 and 247), accompanied by veins, is now seen bunched in profile instead of full face. The posterior tibial nerve, continuing the medial popliteal, goes down immediately behind the trunk.

(Note that the distal portion of the tibial nerve has kept its relative position in the bundle: it still lies just behind and lateral to tibial vessels—exactly as it does when it ' bisects ' the catapult.)

Exposure of this hinder bundle is easily continued to the sole, if we should need to trace the plantar distribution of nerve and vessels (p. 300, and *legend* to Fig. 196, below).

EXPOSING THE BACK OF THE DISTAL END OF TIBIA

Mention of the tibia suggests the thought of an exposure from the inner side. But, if we try a simple test, we find we shall do better to employ a *fibular* approach. Kneel for a moment with the foot relaxed in plantar flexion. Then grasp and move the flaccid tendon of Achilles; it travels farther to the inner side—away from fibula—and so uncovers more of an objective which spreads across the middle line. One reason is that while its outer edge is ' free,' soleus fibres reaching down the shaft (it may be almost to a handbreadth from the medial malleolus) tie the Achilles tendon to the tibia. So, like a dog, it moves most easily towards its leash. Another—dominating—factor is that on the medial side Achilles tendon is more firmly fixed, than on the

lateral, against the *denser* portion of the sheet of fascia covering the deeper muscles of the leg (*legend* to Fig. 152, p. 248).

Displacement of Achillis is not the sole advantage of an outer access, for that will let us liberate as well the belly of the flexor hallucis—a muscle which arises from the fibula and spreads at once to hide the tibial surface. This belly (by the aid of a strategic interval) is readily displaced towards the *in*accessible and medial fixation of its tendon down the foot. Fig. 169 shows *one* occasion for this approach.

Position and incision.—A sand-bag laid beneath the instep of the 'face-down' patient bends his knee and keeps the foot in plantar flexion. The skin incision curves from a point a full thumbwidth below the fibular malleolus and goes a largish handbreadth up the leg, close to the outer edge of the Achilles tendon—a line that will avoid the sural nerve which otherwise is likely to be cut above and also distally (Fig. 170, A).

After incising fascia the knife once more will enter fat, crossed as a rule two fingerbreadths above os calcis by an artery, which must be severed; its parent stem, the peroneal, accompanied by veins that may be very large, lies here on bone and stripes the shaft of fibula just medial to the hinder edge.

A further opening of the fat will show a spot where we can reach the back of tibia, between hallucis and the fibula—an angular strategic interval (Fig. 171, A, inset).

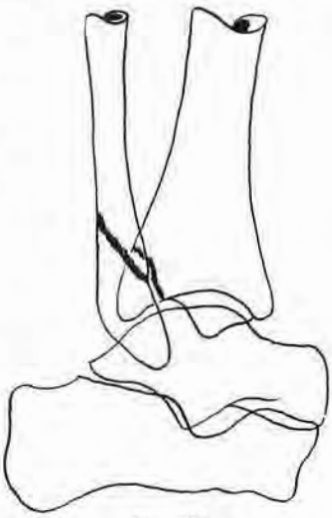


Fig. 169

The 'third malleolus' of Destot (from an X-ray tracing by M. Levine)

This is an inconstant local exaggeration of the normal excess in length of the *hinder* lip that bounds the distal face of tibia. Its function is to check such backward trends of the foot as threaten a downward step or landing from a jump.

When Destot's malleolus is prominent a relatively small force that stretches ligaments will break and thrust it backwards. (A car in one case stopping short, slid its passenger off seat to bump her sitting on her ankle.) More violent occasions make wider sweeps and shear through two or even three malleoli—Destot's plus the medial and lateral—each displaced backwards. The X-ray was taken after reduction of the displaced third malleolus which, like the broken fibula, was then fixed by a screw.

But first be sure you *have* identified hallucis. The common, disconcerting slip is to mistake for it the peroneus brevis whose belly has a way of bulging in towards the tibia. To test the matter embrace the doubtful muscle from behind with thumb and finger; and if in front of it you pinch the narrow fibula, your grasp includes

not hallucis but *both* the peronei. The hallucis lies farther medially and deeper (Fig. 170, c).

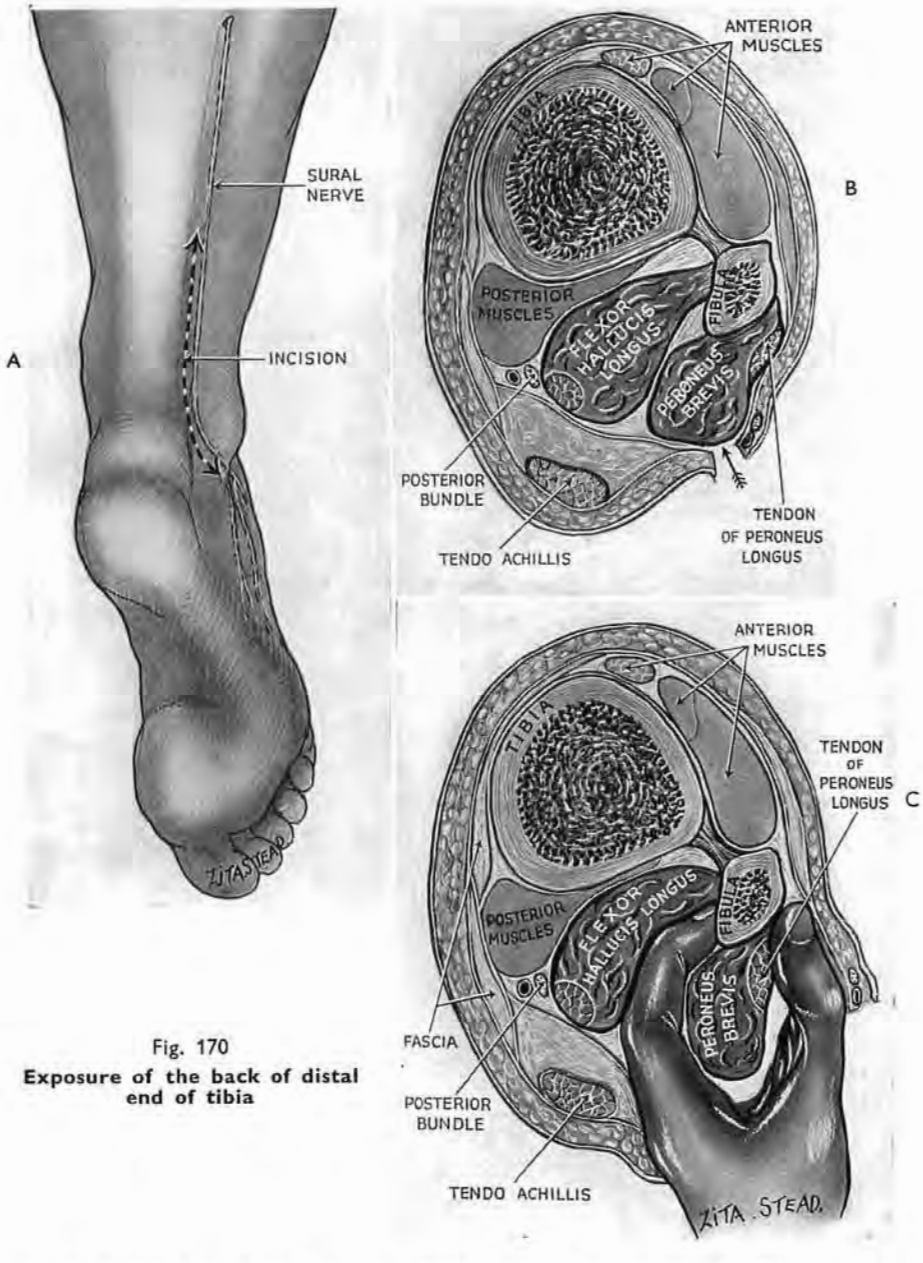


Fig. 170
Exposure of the back of distal end of tibia

A. The incision close and *lateral* to Achillis, avoiding sural nerve. B. The frequently deceptive bulging of peroneus brevis that simulates hallucis. C. Recognition of peroneus by closing on the narrow fibula in front with an embracing thumb and finger.

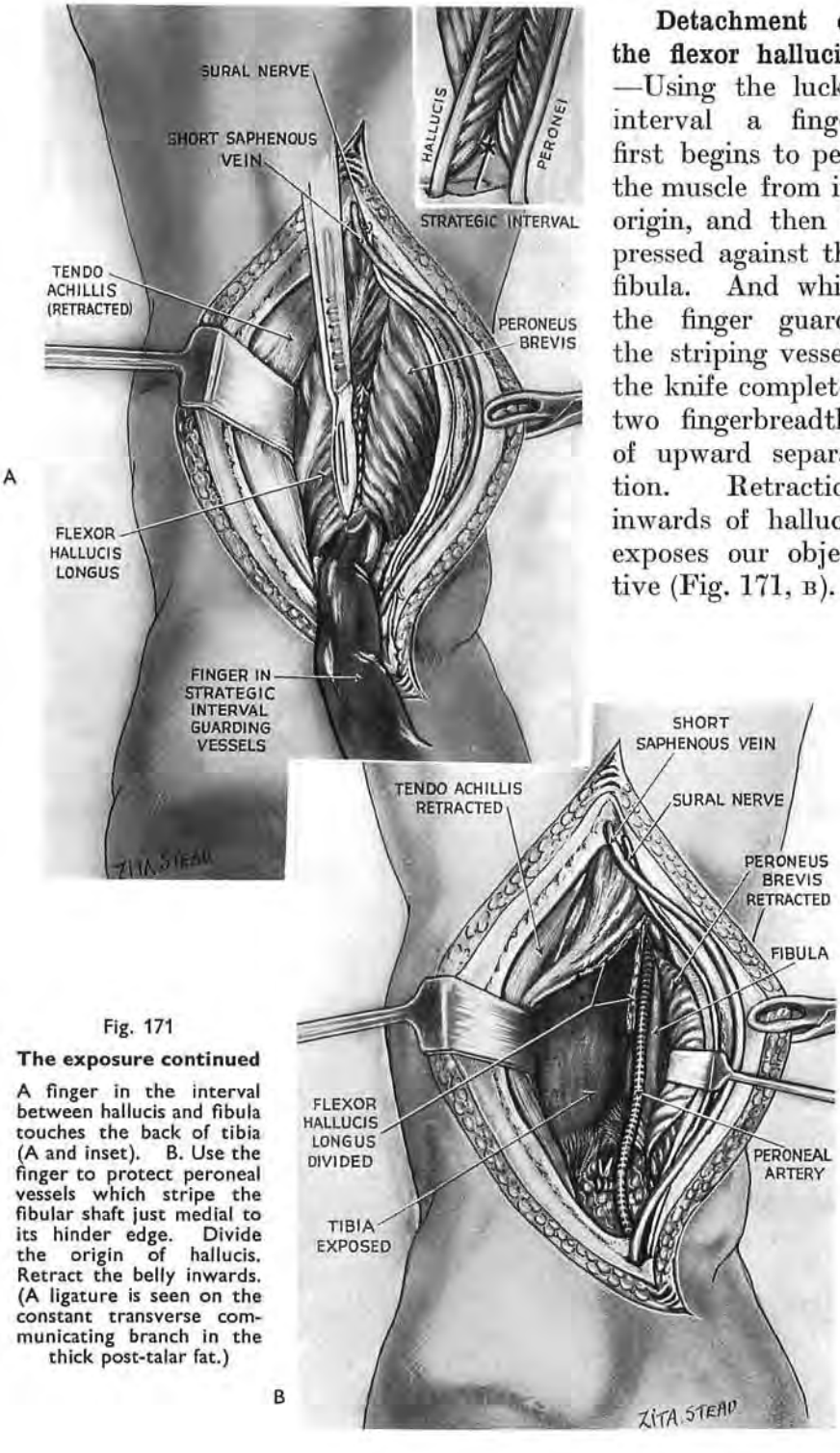


Fig. 171

The exposure continued

A finger in the interval between hallucis and fibula touches the back of tibia (A and inset). B. Use the finger to protect peroneal vessels which stripe the fibular shaft just medial to its hinder edge. Divide the origin of hallucis. Retract the belly inwards. (A ligature is seen on the constant transverse communicating branch in the thick post-talar fat.)

Detachment of the flexor hallucis. —Using the lucky interval a finger first begins to peel the muscle from its origin, and then is pressed against the fibula. And while the finger guards the striping vessels the knife completes two fingerbreadths of upward separation. Retraction inwards of hallucis exposes our objective (Fig. 171, B).

EXPOSURE OF THE ARCHED SEGMENT AND UPPER THIRD OF ANTERIOR TIBIAL VESSELS [1]

Our study of the *leg* began behind—the master site and starting place of crural trunks; the answer, thus, to Dupuytren's perplexity when faced with local bleeding: "But *which* is cut? Is it anterior or posterior tibial? The peroneal or the popliteal? One or else several at once?"

Transition from the back comes easily; the arching forward of anterior tibial vessels leads straight into the front compartment. Distal to the knee this deep, sequestered segment juts from the popliteal stem, and passing through or above the interosseous membrane turns down—like a tap.

Records of bleeding from the arch are rare enough to leave at least some surgeons unprepared to stop it by direct exposure. Yet this hæmorrhage is dangerous: the mass of blood (or clot) is placed exactly where it shuts both tap and main as well.

Fiolle and Delmas (1921, *Surgical Exposure of the Deep Seated Blood Vessels*, London, p. 21) describe how Pierre Duval (to reach an aneurysm of the arch) cut through and drew aside the upper third of fibula. For that he bared the bone, dividing peroneus longus, the outer head of gastrocnemius, and part of soleus—liberating first the common peroneal nerve and looping it aside.

The poor condition of my only patient with bleeding from the arching segment led me to try a quick alternative. I therefore used a tiny 'Mikulicz'—a tampon placed exactly where a finger-tip controlled the unseen vessel. But that might sometimes fail to stop the hæmorrhage, or might (like clot itself) impede the circulation.

Looking for other means I found a simple one.

THE OPERATION

With Dupuytren, no doubt, we wondered what was bleeding and have (I trust) begun to reconnoitre from the back. So—through a mesial incision of at least a span—we shall by now have ripped the sleeve of gastrocnemius and traced the popliteal vessels downwards to the bridge-mouth of soleus; and, if the mouth has overhung and masked the branching of the major trunks, we have already cleared a prospect by splitting lengthwise through the bridge.

But still there is no sight of our objective: the arch juts

[1] *The Lancet*, 1943, **1**, 141.

forward and away. Nor can we yet persuade it backwards into view, for it is fastened out of reach—in front. So, turning to the front, we *there* release the arch and draw it out behind.

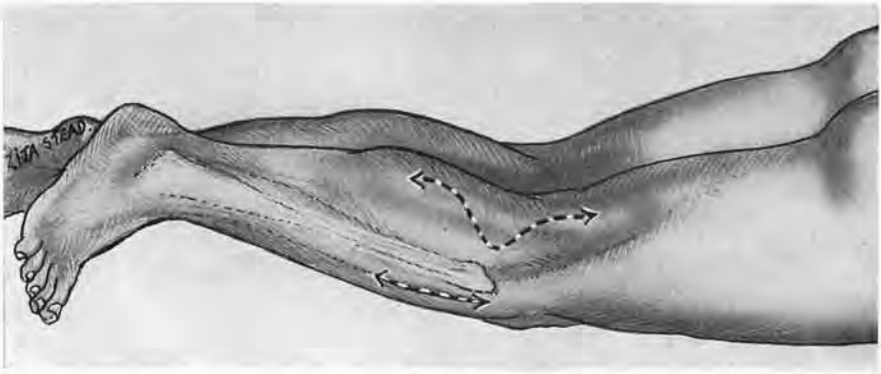


Fig. 172

Exposure of arched anterior tibial segment

With the patient face-down cant the foot across the sound ankle. You then have easy *simultaneous* access to front and back compartments of the leg.

Position.—Till now a sand-bag lifts the instep of the 'face-down' patient, bending his knee to slack the calf. Now (without altering the posture of his trunk) take the foot from the bag and lay its medial edge across his other ankle (Fig. 172). The trivial change gives access to the front compartment and leaves the hinder wound in sight and in control.

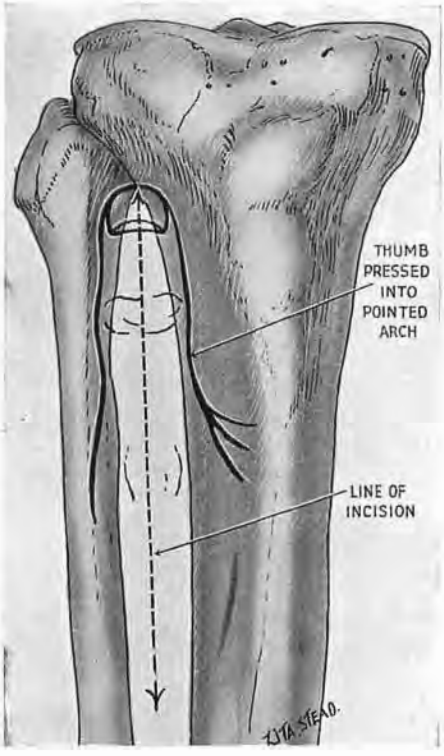


Fig. 173

Finding the intermuscular plane for opening the upper reach of the anterior compartment

The thumb, pressed up from below, fits lengthwise into the pointed arch between tibia and fibula. Open skin and fascia along a line bisecting the thumb from nail to wrist. The line marks where the curved plane of cleavage comes to the surface (see text); it does *not* mark the course of the anterior tibial bundle which here lies deep to the lateral muscle.

A rule of thumb for the anterior incision.—First we must separate the pair of muscles that cover the front of the vascular arch and its continuation down the leg. Between the two the

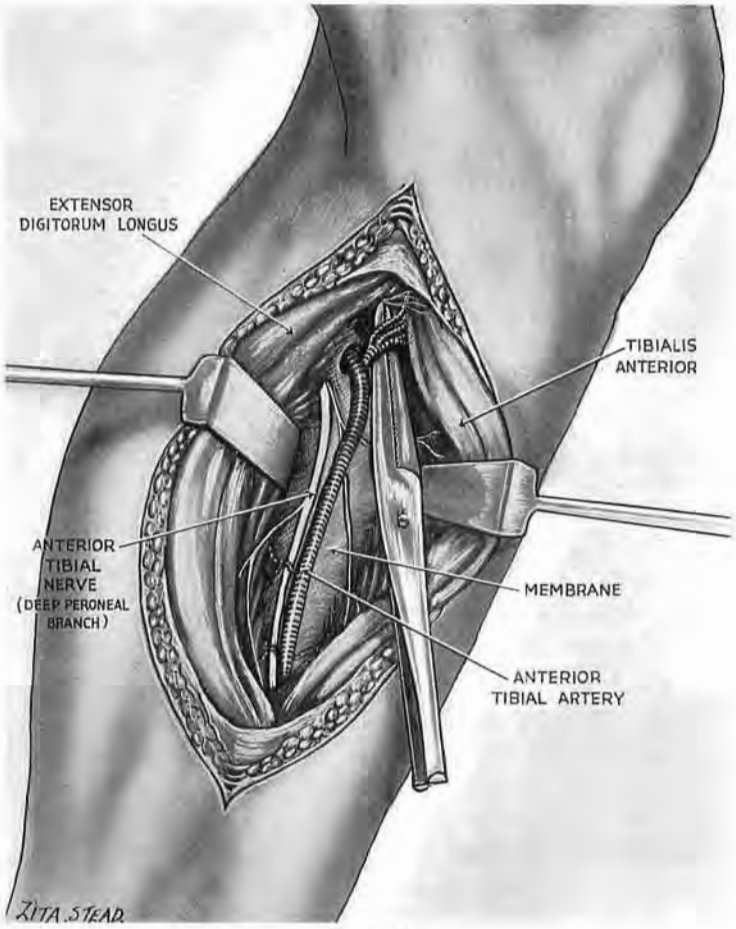


Fig. 174

Cutting the leash of anterior recurrent tibial vessels to free the arch

A pair of forceps slides up the interosseous membrane medial to the main neurovascular bundle and lifts the leash for section. A few small nerve twigs may run with it and can be spared: they do not moor the arch. If they are cut, tibialis anterior remains well supplied.

cleavage plane is *curved*: the belly of extensor longus digitorum bulges into that of tibialis. This curving plane comes to the fascial surface along a line which can be found with ease. Approaching from below press and fit the pulp of your thumb into the pointed, gothic archway formed above by tibia and fibula (Fig. 173). Divide the patient's skin as if you were bisecting the guiding

thumb from nail to wrist—a method of location more robust than ghostly pointers to the plane of cleavage (the academic groove or petty artery or whitish line) which soon fade out with trauma. Using this guide again, we open fascia along the same line, *not* tearing muscle. A finger separates the interlock of bellies and shows the bundle of anterior tibial vessels. These are deep to long

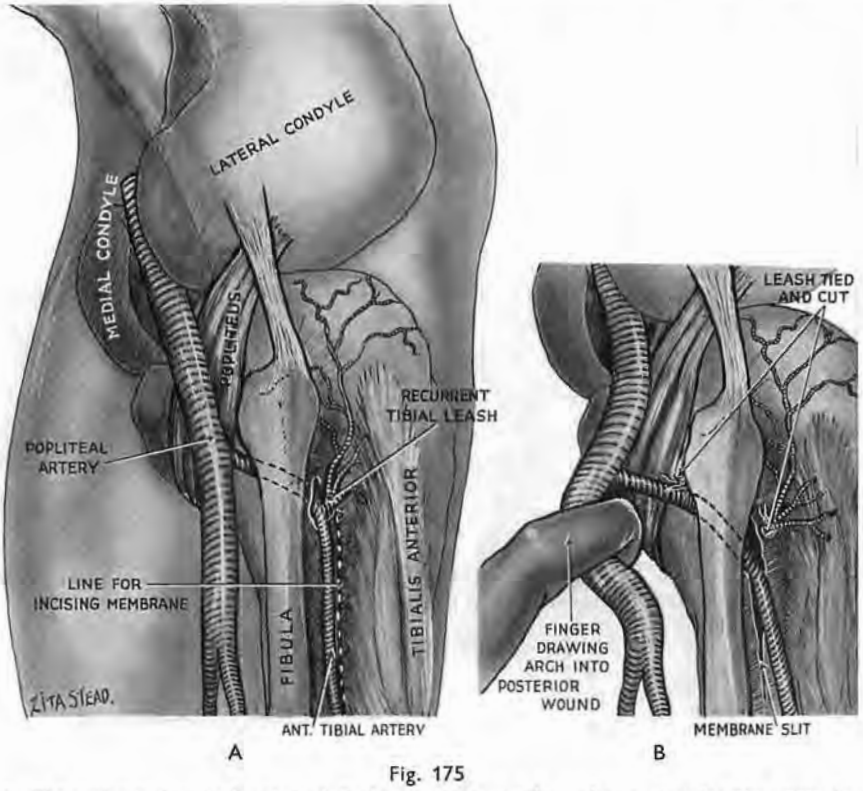


Fig. 175

A. The arch set free in front, and B, drawn back and brought to view in the posterior wound. A narrow opening through interosseous membrane has been widened medial to the vessels.

extensor and so lie lateral to our incision (see the *legend* to Fig. 173). When we have made them visible throughout the wound against the background of interosseous membrane we can proceed to mobilise their arch.

Impediments of leash, membrane, and muscle.—The arch is moored in front by its recurrent branch and venous tributaries—a wide-flung leash whose narrow end we cut (Figs. 174 and 175).[1]

[1] John Bell—brother to Charles, the physiologist—says of the anterior recurrent tibial: "It is a branch which comes off the fore part of the tibial artery instantly after it has pierced the interosseous membrane; it turns immediately upwards under the flesh of the tibialis anticus; it gives many muscular branches, some to the head of the tibialis,

Variable, small, peroneal recurrent vessels—the posterior which curls up in front of fibula, the anterior which *rises* in front of it—may also require section, or be torn through unnoticed.

Then, if the opening in the membrane is large enough already, we are at liberty to draw the arch back into the calf. But, if the hole itself is small—or narrowed by encroachment of the hinder tibialis—we must enlarge the passage, slitting the membrane downwards medial to the bundle (to avoid the nerve); and then, if need be, stretching with a finger a pathway through or over tibialis. That will remove the last impediment and let us bring the arch from front to back for safe and unrestricted access (Fig. 175).

EXPOSURE OF THE DISTAL TWO-THIRDS OF THE ANTERIOR TIBIAL NEUROVASCULAR BUNDLE

The long incision of Fiolle and Delmas so greatly simplifies the operation that those who read of it incline to over-confidence. Its virtue dwells in length: it reaches down to where the *tendons* have replaced a close-packed interlock of bellies; and using tendons we can cleanly split extensor digitorum from the tibialis. So all we have to do is choose correctly. And that is just where many fail: they take a near-by tendon for the tibialis and lose their way at once.

A little care avoids discomfiture. We know (pp. 248 and 250) that in the leg tibialis anterior borders its namesake shaft throughout: *that* is its certain countersign. The tendon lateral to tibialis (except immediately above the ankle—where hallucis comes forward to replace it) must, during anæsthetic relaxation, be a tendon of extensor digitorum longus; the interval between is the required interval.[1] But first let us divide the skin.

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others to the upper part of the extensor digitorum, and branches go round the head of the fibula to the origin of the long peronæus muscle. One branch goes directly upwards and spreads all over the front of the knee-joint mixing its branches in the common muscular net-work." (John and Charles Bell, 1816, *Anatomy and Physiology of the Human Body*, London, vol. ii, p. 28.)

[1] The text-books here are rather careless; or do they merely illustrate once more the striking difference in outlook of surgeon and anatomist? Their pictures show the tendon of extensor hallucis already flush with tendons of digitorum and tibialis, as high as midway up the leg. But, coming from the *depth* of the anterior compartment and springing from the 'middle half' of fibula, hallucis (when relaxed) *can* only reach the level of its superficial fellows a very little way above the ankle. The tendons, too, of longus digitorum are often drawn as though they formed a single strap within the leg—another point that might seem trivial were it not misleading. In fact, their segmentation as a rule goes about half-way up towards the knee; and, even where it fails to be complete, the *signs* of it (as Boyer wrote) are visible—"almost throughout the tendon's length." It would be only fair to mention that Baron Boyer practised as a surgeon and had the chance to guess what surgeons want.

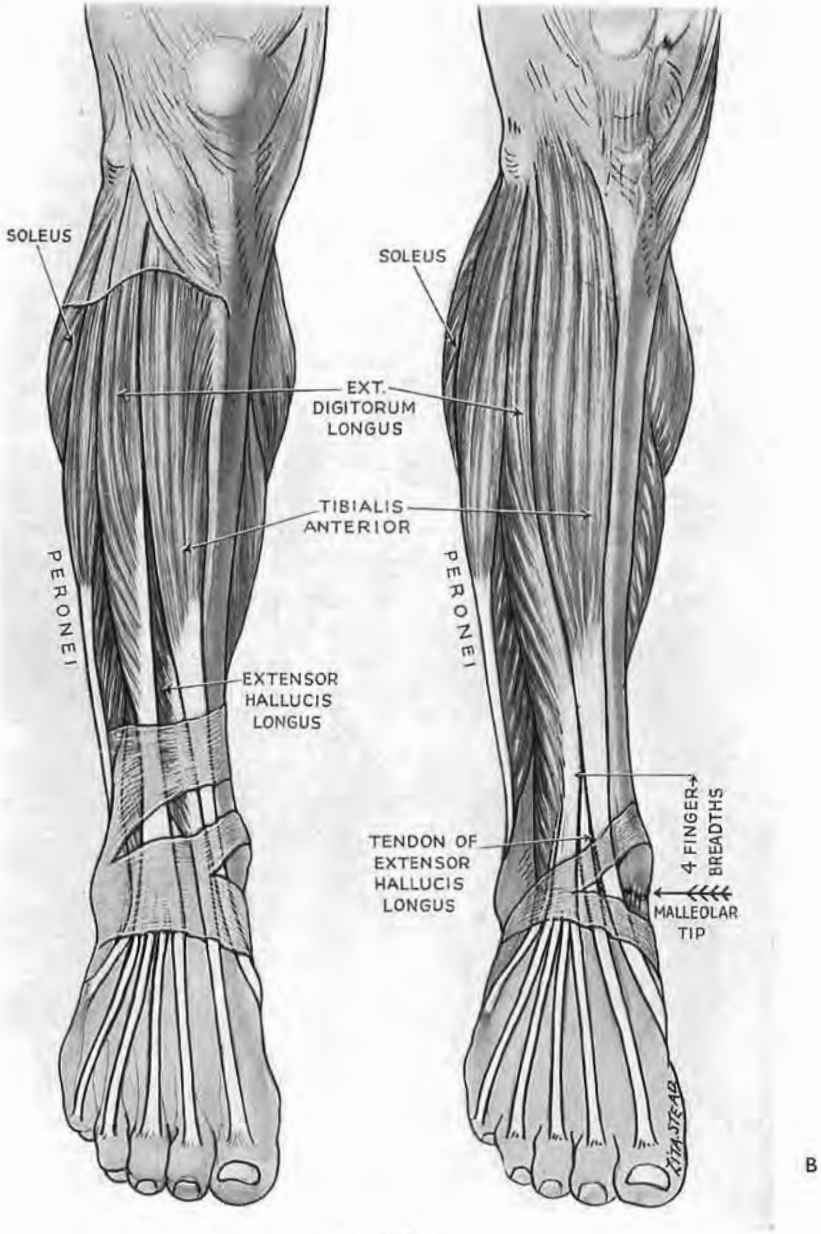

Fig. 176

The surfacing of extensor hallucis longus

A is the almost universal picture which affects to show an undisturbed relation, thus inducing surgeons to believe that hallucis reaches the surface midway up the leg and *there* begins to part tibialis anterior from extensor digitorum longus. Anatomists, perhaps, may cock a toe and say (like Galileo) : "But it does!"—unmindful that our patients, properly anæsthetised, do not cock toes. B. Hallucis, when relaxed, comes to the surface three fingerbreadths above the ankle joint. When fully active, tightness of the fascial sleeve combined with structural cohesion will merely let hallucis raise a ridge that carries up a covering of laxer muscles but does not sunder them.

Fig. 177

Incision for anterior tibial bundle (distal two-thirds)

'Rule' this a little-fingerbreadth to the fibular side of tibial crest. As it goes up the leg, incline the cut towards the bisected-thumb mark of Fig. 173, above. Below, a small medial reflection of skin finds the tibial crest; next to it is tibialis tendon.

Incision.—Press—in the distal half of the leg—your *little* finger against the outer (fibular) side of tibial crest (or shin). Then 'rule' a cut along the outer edge of where your finger lay—*not* opening through deep fascia. Cut for about a span (Fig. 177).

The bone and the tendon.—Now for the small precaution. Reflect a little skin at just one distal spot—enough to give a quite indubitable glimpse of tibia. Open the fascial sleeve in line with the incision. The tendon that is flattened close against the bone (and looking rather like it) is tibialis tendon; the interval we want lies at the tendon's outer edge, and *there* begins our separation.

The last pitfall.—But we can still contrive to go astray. Extensor hallucis, the only deep anterior muscle of the leg, slopes from the fibula to screen the neurovascular bundle. So, if we wander *lateral* to hallucis, we find, perhaps, another artery—or none at all.

You will avoid this terminal collapse by keeping touch with tibialis: work on its outer face, and find the bundle backed above by interosseous membrane, and distally by tibia (Fig. 178). The nerve (deep branch of peroneal, or anterior tibial), which starts upon the neck of fibula, curves gently in to lie in front of the companion vessels, and then, below, recedes a little out again towards the fibula.

That, at least, is what we learn. Nor can I give at first hand figures to dispute it; but Hovelacque in his *Anatomie des Nerfs*,

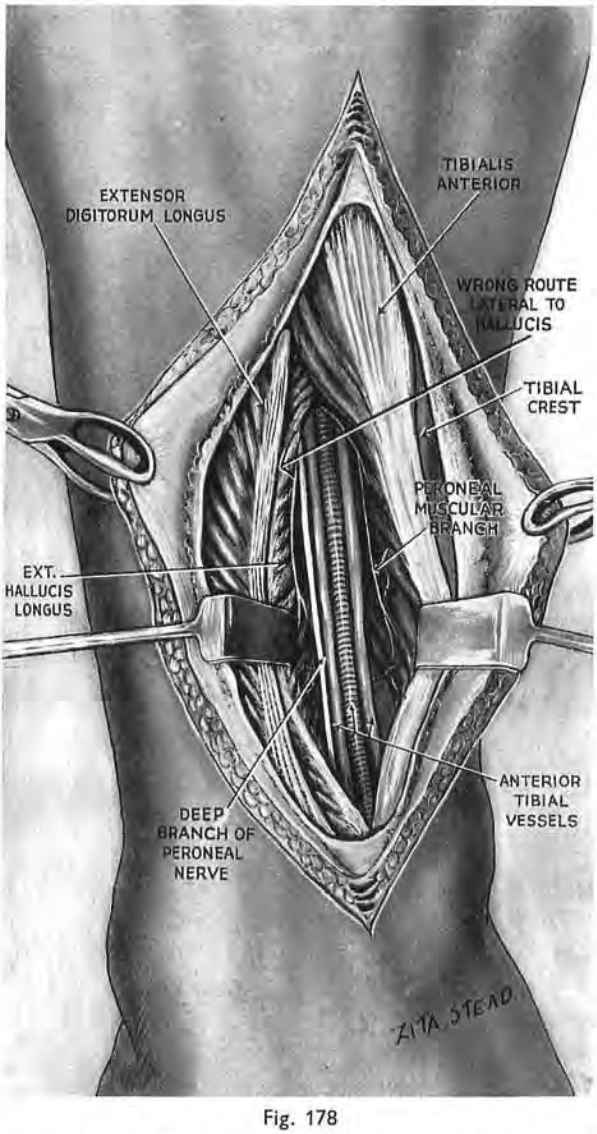

Fig. 178

Showing how the deeply placed extensor hallucis longus overlaps the bundle. The arrow shows the *wrong* route that may be taken—lateral to hallucis. (In this figure the nerve lies lateral to vessels.)

Paris, 1927, p. 609, describes the normal path of the anterior tibial as crossing to the *inner* side of its companion vessels, and shows this transit at the middle of the leg (Plate LXXXIX). He also

cites Marcellin-Duval who notes that in 450 legs the nerve had crossed the vessels in all but one per cent. For Boyer, too (in 1815), this transit was the common disposition.

One might from these divergences suspect a strange, cross-channel difference in gross anatomy; or even that (as Pascal said of truth) *meridians* decide the course of nerves—a thing I rather doubt.[1]

The distal reach of this approach to the anterior compartments of the leg merges directly with the late Willis Campbell's 'all-purpose' incision down the instep. I had omitted this extension from the previous edition, leaving a gap to which I returned with renewed distaste as a tongue will to a sore tooth.

This repugnance centred chiefly on my recollection of the gross ankles that go with mere removal of the talus, a rare necessity

Fig. 179

Knife for dividing moorings of talus from within the ankle joint. (It is a Kocher's dissector toughened and sharpened.)

required only after certain comminuted fractures or more rarely still by local bone disease.

Of late, however, a new description of an old use for talectomy had partly countered my dislike. In 1911 Lorthioir, to arthrodese a palsied foot, resected and decorticated the talus; then, after due removal of adjacent cartilage, he placed the bone back in its original position, as a *graft*.[2]

I owe a final liquidation of a 'talectomy complex' to the quick understanding and skill of a fourth-year student, my demonstrator, Mr M. Stranc, who in a brilliant academic career had not till then performed an operation of any kind whatever. For that reason I asked him to test the clarity of notes on talectomy which I had long shelved. I suggested, too, that he should try on the cadaver the efficacy of the knife made at my

[1] The more so since the artist in a recent 'Gray' refutes the text and shows the nerve as lying *tibial* to the artery within the lower segment of a leg. (Gray's *Anatomy*, 27th Edn., 1938. Compare Fig. 655, p. 649, with the statement in the first two lines on p. 1127.)

[2] W. S. Hunt and H. A. Thompson, *Journal of Bone and Joint Surgery*, 1954, 349. It was from an illustration in this paper that I first learnt of Hatt's spoons and their connection with talectomy. I imagine (for it is suggested but not described by these authors) that their use resembles that of the knife in Fig. 179, which, however, does not derive from them; Messrs Thackray of Leeds had it on order two years before the paper came into my hands.

request by Messrs Thackray to simplify the operation. This he did quite independently, demonstrating the knife (Fig. 179) and the foot (together with its talus resected and unblemished) before an audience that chanced to number professors of surgery from four universities.

The 'all-purpose' incision devised by Campbell begins a handbreadth above the malleoli and goes in superficial fat midway between them to the web that joins the two outer toes. It is only rarely that the lateral division of the musculocutaneous nerve can be spared (Fig. 180).

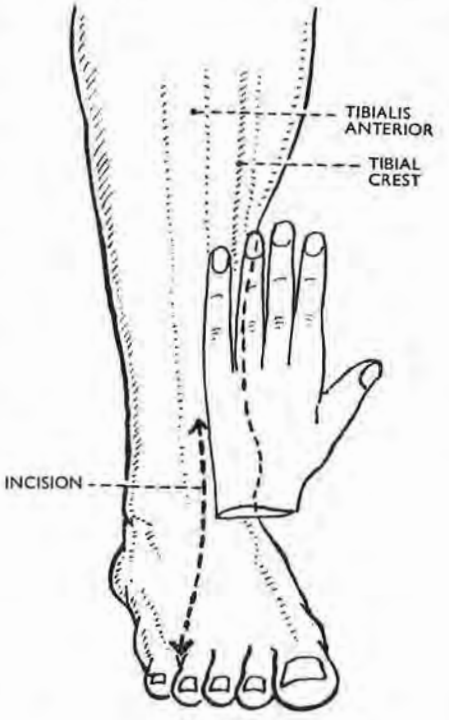

Fig. 180
This incision (which is Willis Campbell's) continues that on the front of the leg shown in Fig. 177

The sling-like extensor retinaculum. — This is our next objective. It may be shaped like a prostrate X or a prostrate Y.

1. *If like a* Y, detach the *double* stem of the Y from the upper face of the front of calcaneum and with it the included bony origin of extensor digitorum brevis.

2. *If like an* X—by reason of a surplus fastening to the fibular malleolus—divided this fastening too.

Once free of lateral attachments the whole sling of retinaculum can be turned over towards the medial side of the foot carrying off within its several compartments the long tendons of the instep (peroneus tertius and extensor digitorum longus, extensor hallucis longus, tibialis anterior) *with* their synovial sheaths. The anterior tibial neurovascular bundle remains to hug the deeper plane of bone and ligament.

Draw the retinaculum and tendons forcibly inwards, exposing the front of the ankle joint and the upper face of the mid-tarsal joint. Peroneus tertius provides a good buffer for this strong retraction. Then if talectomy is purposed, a transverse incision opens the front of the ankle joint after the anterior neurovascular bundle has been moved laterally.

The dorsal line of the mid-tarsal joint.—Viewed from above the line begins to cross the instep directly behind the navicular tubercle, a thumbwidth in front of the medial malleolus. (Both these points stand out with slight inversion of the foot and comfortably lodge the thumb between their two projections.) The line has two opposite curves: the rounded head of talus forms a medial and forward convexity; the recessive face of calcaneum, a lateral and forward concavity. The curves are crossed at their junction by the two parts of the bifurcate ligament which binds calcaneum to the cuboid and navicular bones. In addition there is the thin dorsal calcaneocuboid and talonavicular ligaments together with navicular fibres that come forward from the deltoid ligament. To open the mid-tarsal joint for the purpose of erasing cartilage follow the curves, cut these ligaments, and 'break' the foot downwards like the breech of a shotgun.

TALECTOMY FROM IN FRONT

Counting *all* the ligaments and bands that have been described as fixed to talus, ten (apart from the thin capsule of the ankle joint) must be cut to free the bone. Two are fascial derivatives not mentioned in British textbooks: one of these, the peroneo-talocalcanean, comes away (at least in part) when deeper-lying ligaments—posterior talofibular and posterior talocalcanean—are detached; the other, spreading from the flexor retinaculum, helps (with posterior talocalcanean) to bridge the talar groove for the long flexor tendon of the big toe. The occurrence of another ligament, the medial talocalcanean, seems to be inconstant, or is absorbed into the back of the deltoid expansion.

There are thus some nine (or ten) moorings that require section. All these, except two, can be severed from talus by working from *within* the synovial cavity of the ankle, using the knife shown in Fig. 179. This was modelled on the stout shape of a Kocher's dissector whose curve, I found, would fit the upper face of talus. The thick 'blade' is sharpened only at the end and at *adjacent* parts of either edge, the sharpened portions having thus the same extent as the end and edges of a small finger-nail. It thus forms a strong 6 in. tool, which—were it magnified by 8—could trim the margins of a lawn.

The rota of ligament division.—*From outside the ankle joint* cut the two ligaments already exposed: (1) the anterior talofibular ligament on the outer side of the neck of talus; (2) the dorsal

talonavicular ligament (unless the mid-tarsal joint has already been opened).

From inside the ankle joint, after twisting the plantar-flexed foot *out* to tense the medial ligament, keep the knife against the medial face of talus and cut the *deep* part of the deltoid ligament attached to it. Then twist the foot *in* and cut the stretched lateral talocalcanean ligament. (The lateral fibulocalcaneal ligament which overlaps it will probably be divided at the same time.)

Next divide the two layers of the interosseous talocalcanean ligament, beginning with the thick and often separate pivotal piece of the anterior layer; drive the sharp knife tip along the oblique course of the tarsal tunnel, from without, inwards and backwards. (The interosseous ligament should till now be left undivided so that talus and calcaneum will move together when we twist the foot to tighten medial and lateral ligaments for section.)

The *posterior*, remoter moorings are brought to the knife by catching the neck of the talus with bone forceps and drawing it forward.

The role of the 'trigonal' (lateral) tubercle.—Find first the prominent tubercle at the back of talus which sometimes remains separate as an os trigonum; it forms the *lateral* lip of the deep groove that lodges the tendon of flexor hallucis longus. Engage the groove with the knife tip, keeping the slightly concave surface of the blade against the bone. Turn the tip so that its sharp adjoining *edge* moves heelwards on the *lateral* wall of the groove to meet and cut the fibres that bridge the tendon posteriorly. As you turn the knife the blunt *back* of the tip thrusts the tendon aside. The liberated tendon, thus displaced, remains behind when forceps draw the talus forward.

Apart from the uncertain hope of its action after tarsal fixation, the long hallucis tendon is worth preserving, *if only as a buffer*. It lies between the blunt back of the knife's end and the posterior tibial neurovascular bundle, which it neighbours (as horse or harlot) in mnemonics as widely known as Grimm's fairy tales.

The lower end of the posterior tibial bundle—the only part of a main neurovascular structure that comes at all near the knife during this talectomy—lies about $\frac{1}{8}$ in. behind the medial talar tubercle of Stieda and is there separated from the bone by hallucis tendon[1] and the fibres that bridge it; and then, from the inner

[1] Division of hallucis tendon was the solitary flaw in Strane's first talectomy—a fortunate accident that taught us to avoid its repetition in the way described.

side of the same tubercle, by deep posterior fibres of the deltoid ligament (Figs. 183, D, and 184).

Still hugging the trigonal tubercle the knife proceeds first to free its hinder end, then its outer face from the long reach of the posterior talofibular ligament, which—at the end of the tubercle—lies behind and blends with the posterior talocalcanean so that *there* both structures are detached together.

Once the safety of the long hallucis tendon (and therefore of

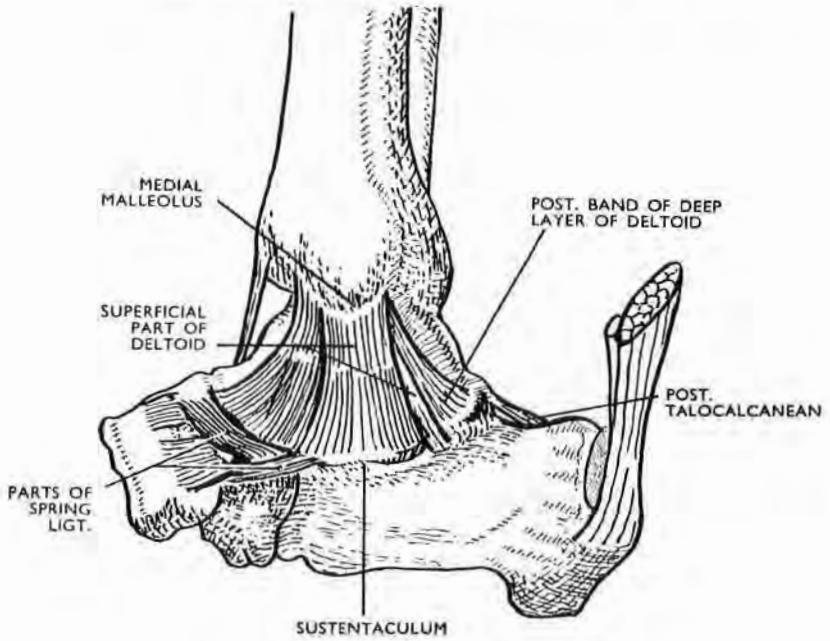

Fig. 181

Medial view of moorings of talus

A. The *superficial* fibres of the deltoid ligament cover all the deep (talar) fibres anteriorly. The deep fibres are seen posteriorly, and are fully exposed when the superficial fibres are reflected (Fig. 182).

posterior tibial bundle) is assured, any bands that still check the delivery of talus can be cut at the bone's surface. (One such check might be a widespread form of the peroneo-talocalcanean ligament, the *fascial* derivative of Rouvière and Canela and therefore lying heelward of the ordinary ligaments; so that, at least in part, it shares their separation.)

Perhaps the table on pages 286-287 may serve to chart a sequence for dividing talar moorings.

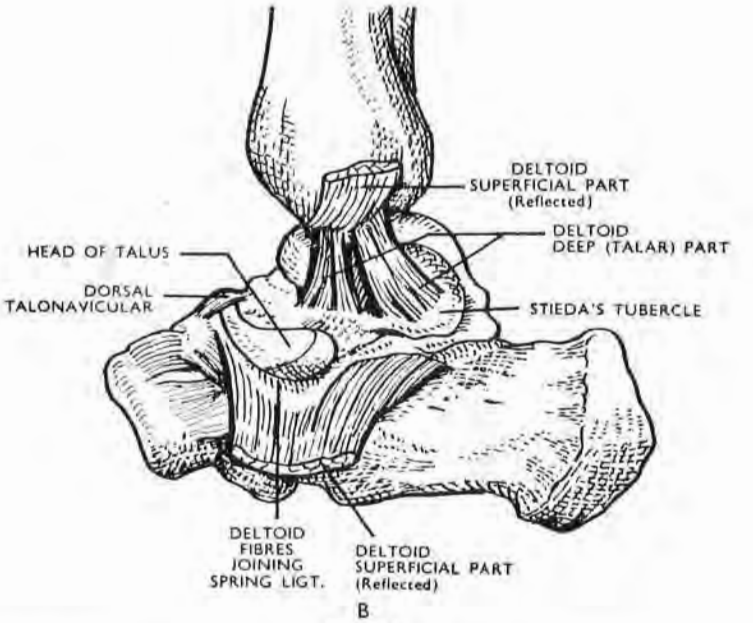

Fig. 182

Medial view of moorings of talus

B. The *deep* fibres of deltoid seen after reflection of superficial layer.

Note the strong posterior band sloping to Stieda's tubercle. Fibres of this band may escape early section and are then cut when talus is drawn forward in the last stage of liberating the talus. (The medial talocalcanean ligament was absent here.)

TALAR LIGAMENTS ARE DIVIDED FROM OUTSIDE AND FROM INSIDE THE ANKLE JOINT BY ANTERIOR ACCESS

FROM **outside** THE ANKLE JOINT

ANTERIOR TALOFIBULAR (Fig. 185).

DORSAL. TALONAVICULAR (Fig. 182)

FROM **inside** THE ANKLE JOINT

Lateral Talocalcanean
(The fibulocalcanean overlies this and may become detached too, Fig. 185.)

Cut after twisting the foot medially.

Deep part of the Medial (Deltoid) Ligament of Ankle (Fig. 182).

Cut after twisting the foot laterally.

Medial Talocalcanean
May be absent or blended with the posterior deep band of the deltoid ligament which crosses and covers it. Its fibres join the medial talar tubercle of Stieda to the back of sustentaculum.

Interosseous Talocalcanea
plus its pivotal
(Fig. 183, A)

Cut by inserting th
tip at the outer
sinus tarsi and wor
and heelwards thro
tunnel.

ridging the Sulcus for is Tendon

are derived two inter- s septa that m the deep lexor retina- The posterior nean liga- lso contri- To cut these ep the con- of the blade e proximal lus. Engage of the blade posterior Then, turn to hug the all of the Cut heel- ith the short ning edge 183, D).

With hallucis tendon free draw the talus forward and thus bring the next three moorings to the knife.

Posterior Talocalcanean

is overlain by the next and, like it, is attached to the tip of the 'trigonal' tubercle.

Posterior Talofibular

Its end reaches the tip of the 'trigonal' tubercle; it also has a long attachment to the outer side of the tubercle (Fig. 183, B and D).

Peroneo-talocalcanean

ligament of Rouvière and Canela derived from deep fascia, it thus lies heelward of posterior talofibular and so is detached with it (Figs. 183, D, and 184)

Of these three ligaments the first is deepest; the second intermediate; the third superficial. They may thus be detached *en masse* from the end of the trigonal tubercle when forceps draw the talus forward. Part of a *widespread* peroneo-talocalcanean sheet may escape and require separate division.

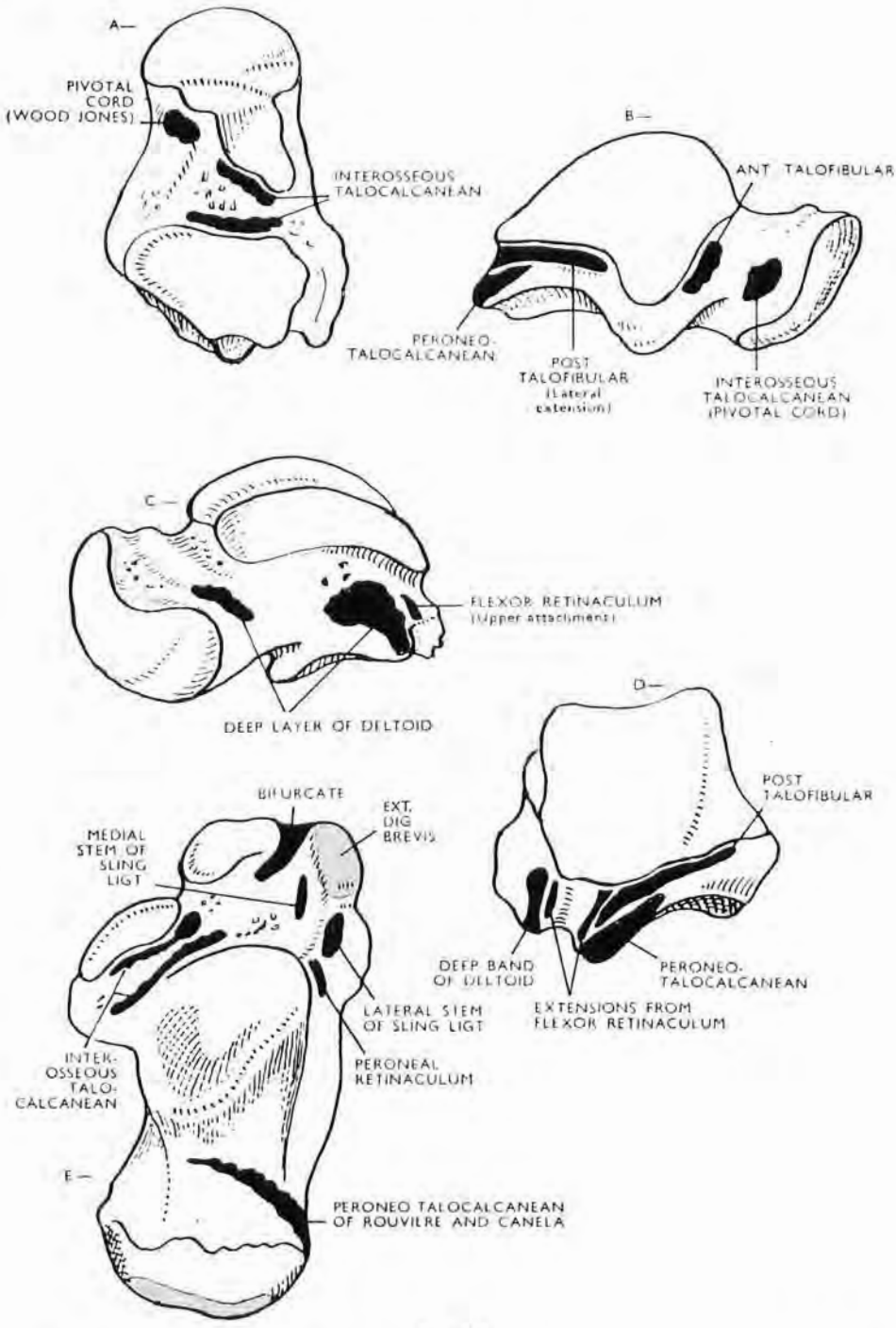

Fig. 183

These tali and the calcaneum are all of the **right** side. Ligamentous attachments are marked in black, muscular attachments in colour.

A. **Inferior aspect.**—The strong pivotal cord was not described by Wood Jones, but he has emphasised its function in relation to Inkster's work on talocalcaneo-navicular movements.

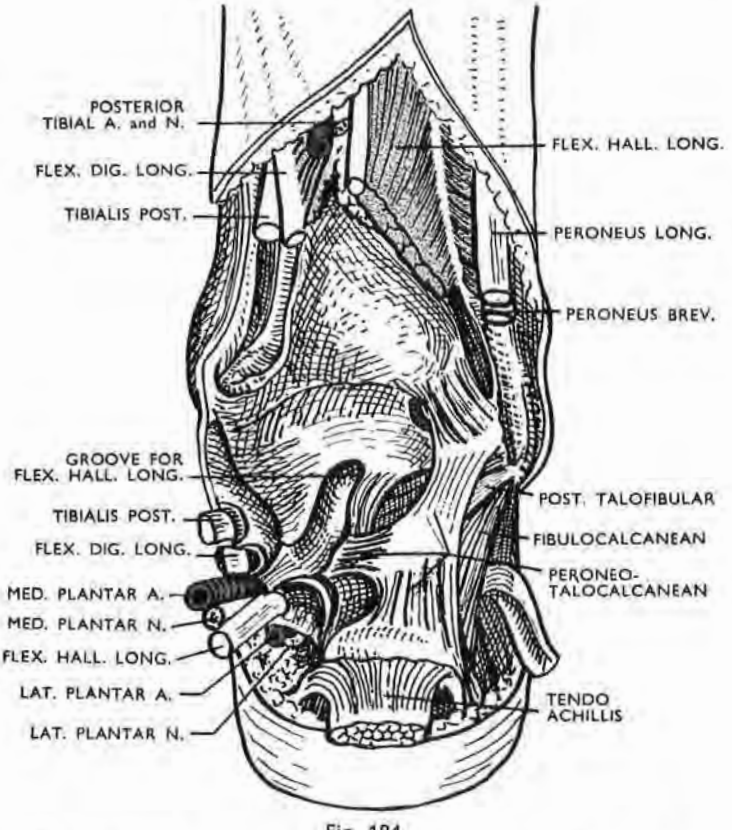

Fig. 184

The extrinsic peroneo-talocalcanean ligament (after Paturet)

This fascial derivative is fixed above to the lateral malleolus and to the postero-inferior tibiofibular ligament. Descending, it gives a process to the trigonal tubercle of talus and then goes on to join calcaneum. Only part of the sequence of ligaments from surface to depth is seen—peroneo-talocalcanean overlies posterior talofibular; the deepest ligament—posterior talocalcanean is concealed.

Fig. 183 (*continued*)

B. **Lateral aspect.**—Note the long lateral attachment of the posterior talofibular ligament and also the site of the pivotal cord which is lodged here in a bony pit.
The peroneo-talocalcanean ligament of Rouvière and Canela is seen in full in Fig. 184. Paturet describes it as an *extrinsic* ligament, derived from fascia, and belonging to two joints —tibio-tarsal and posterior talocalcanean.

C. **Medial aspect.**—This shows the attachments of the *deep* layer of deltoid ligament which is fixed *solely* to talus. The posterior attachment is particularly strong; it clothes the medial face of Stieda's tubercle—the inner boundary of the groove for the tendon of flexor hallucis longus. Fibres of this ligament may escape section till the talus is drawn forward.

D. **Posterior aspect.**—The long attachment of the posterior talofibular ligament runs out and forward from the trigonal tubercle—the outer boundary of the groove for flexor hallucis longus tendon. The bundle lies behind and medial to the tendon, p. 283.

E. **Right calcaneum, upper face.**—The bifurcate ligament forks in front to reach navicular and cuboid. The two stems of the sling ligament—the frondiform of Retzius and the inferior part of our extensor retinaculum—sandwich the origin of flexor digitorum brevis. The pivotal ligament has no separate attachment to calcaneum in this specimen, for it has sloped down and merged with the anterior sheet of the interosseous talocalcanean, a sheet described in Gray's *Anatomy* as the " posterior ligament of the talocalcaneo-navicular joint."

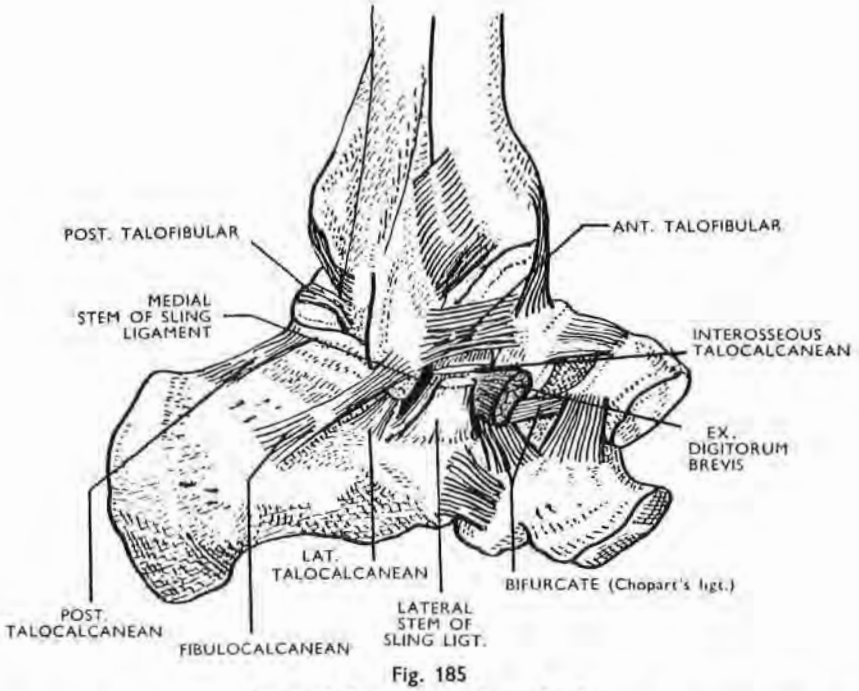

Fig. 185

Lateral view of moorings of talus

One of the two ligaments divided from *outside* the ankle joint is visible—anterior talofibular. The fibulocalcanean is often cut in company with a true talar mooring that lies on a plane deep to it. (The double stem of the sling ligament has been divided along with the origin of extensor digitorum brevis at an early stage in the operation—of course *outside* the ankle joint.)

Note that the pointer to *interosseous talocalcanean* lies just too low and touches instead the medial stem of the sling ligament.

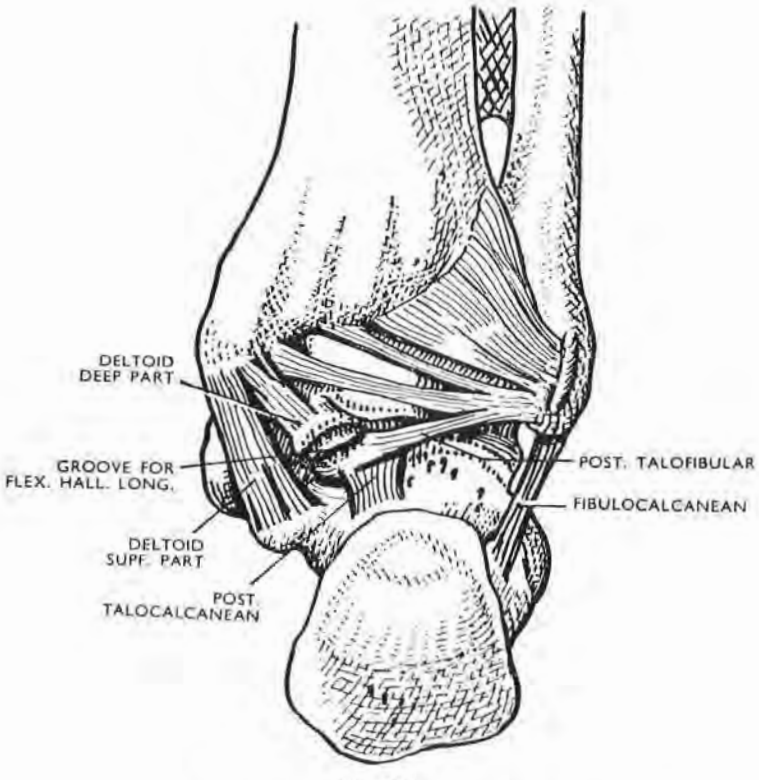

Fig. 186

Posterior view of moorings of talus

The hindmost band of the deep deltoid layer is seen attached to Stieda's tubercle. Fibres of this band may escape section until the talus can be drawn forward in the last stage of liberation. The fibulocalcanean ligament is sometimes cut in company with the lateral talocalcanean.

EXPOSURE OF THE FIBULA AND NERVES RELATED TO IT [1]

ANATOMY

The neck and upper third of the fibula are in direct contact with nerves. Muscles surround three-fourths of the shaft.

The relations of the nerves to the upper part of the bone are insufficiently described in many text-books, which give the impression that only the *neck* of the fibula is in contact with the branches of the external popliteal nerve (common peroneal B.N.A.). A glance at Fig. 187 modified from that which accompanies Poirier's excellent account of the peroneus longus, shows in diagram the true extent of this contact (*Anatomie Humaine*, 2ème Edn., vol. ii, fasc. 1, p. 251, Paris, 1901).

It is, of course, at the fibular neck (where the nerves are thinly covered by the origin of the long peroneus) that they are most often exposed to violence; but the surgeon whose intervention is not to come within this category should be familiar with the true anatomy of the region.

The lateral popliteal (common peroneal, B.N.A.) gives off its last three branches as it lies upon the fibular neck: first, the recurrent tibial nerve, which is often double; then, anteriorly, its deep (or anterior tibial) branch; and, posteriorly, its superficial (or musculocutaneous) branch. This last nerve descends almost vertically along the shaft, separating the diaphyseal origin of the long peroneus into anterior and posterior moieties, and keeping contact with the upper third of the shaft. Distal to this the peroneus brevis separates the nerve from the bone.

Exposure of the upper half of the fibula requires a full mobilisation of these nerves. This can be safely done by defining the trunk of the common peroneal as it descends behind the head of the bone (Fig. 189). When the nerve is raised, it leaves a shallow groove which separates the muscles of the calf from the fibular head. This groove is a strategic point, and gives the surgeon entry to a plane of cleavage which allows him to separate the peronei from the soleus muscle, and thus expose the bone with least damage. In exposing the distal half of the fibula a plane of

[1] Except for the addition of a final paragraph (and the correction of a slip) the text of these pages on the fibula is copied from *Exposures of Long Bones and other Surgical Methods*, Wright and Sons, Bristol, 1927.

cleavage between the peroneus brevis and the extensor muscles can easily be found at the apex of the triangular subcutaneous area, but an exposure along this line should be limited to the distal half of the bone.

The following is a description of a complete exposure of the fibula.

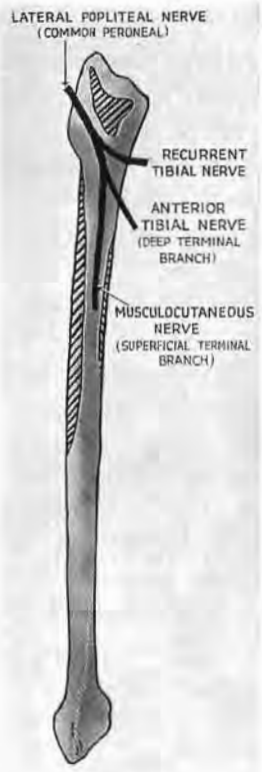

Fig. 187

Diagram of right fibula (modified from Poirier) showing extent of bone in direct contact with nerves. The shaded areas are the three fibular origins of the peroneus longus. (No other muscle is represented.)

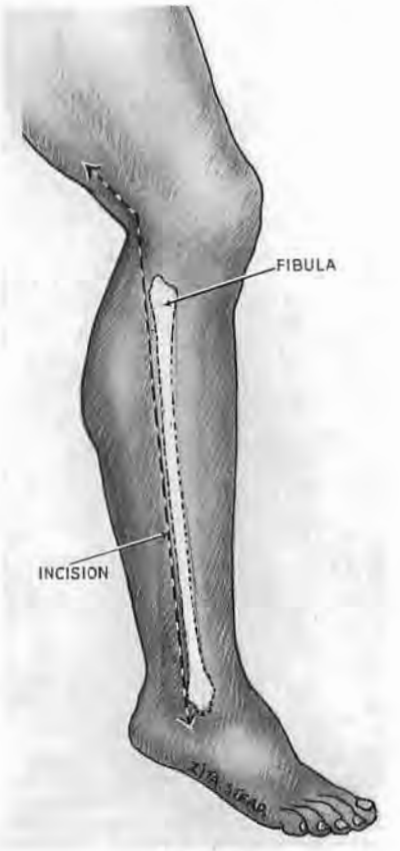

Fig. 188

Divide skin and superficial fascia from the back of external malleolus to the back of fibular head. Continue the incision one handbreadth along the biceps tendon.

THE OPERATION

Position.—The patient lies on the sound side with the sound limb extended. Place the knee of the affected side just in front of the other knee so that the heel of the affected side rests upon the other shin (as in Fig. 137).

Incision.—(Fig. 188). Divide the skin and superficial fascia from the back of the external malleolus to the back of the fibular head; continue the incision along the biceps tendon for one handbreadth beyond this. Open the deep fascia proximally, at the medial edge of the biceps tendon; continue its division with blunt-nosed scissors down behind the fibular head. Find the common peroneal (lateral popliteal) nerve where it lies flush with the tendon at the inner side of the biceps insertion. The tendon overlaps the nerve in the proximal part of the wound (Fig. 189). Mobilise the nerve proximally till a loose loop of it can be drawn out across the tendon and the fibular head. Slip one blade of the scissors down along the groove which the nerve has left. Divide the deep fascia in the direction of the groove, and thus open the plane of cleavage between the soleus and the peroneal muscles.

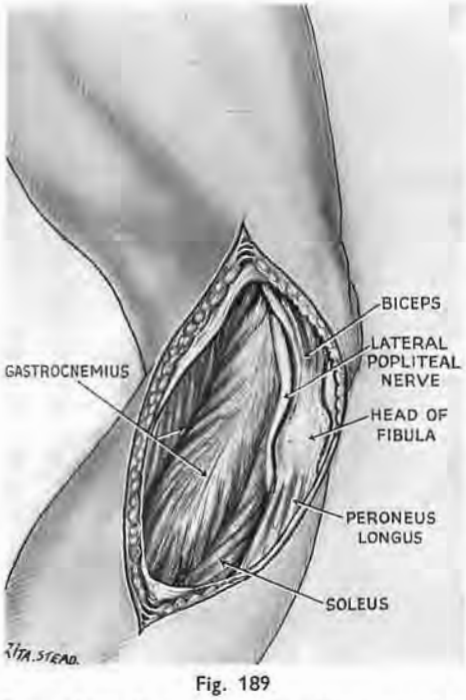

Fig. 189

Open deep fascia over the biceps tendon. Expose the distal end of the outer popliteal nerve (common peroneal); it lies in a groove which separates soleus from the fibular head. **This groove is the key to the plane of cleavage between the peronei and calf muscles.**

Next, draw the nerve-loop distally (towards the foot); turn the knife's edge away from the nerve against the lower border of the fibular head, and divide the thin slip of peroneus longus which bridges the nerve as it branches upon the fibular neck (Figs. 189 and 190). The nerve-loop can thus be drawn still farther out and away from the bone, while the peronei are raised after it and turned forward.

Stripping the rest of the shaft.—When we have safely bared the upper third of fibula the major task is done, but we should finish well and leave no scarecrow, distal spectacle of ragged bone and tattered tissues. Two sets of things demand and rarely get attention: the different stripping angle for muscles and interosseous membrane; the close adhesion of the peroneal vessels

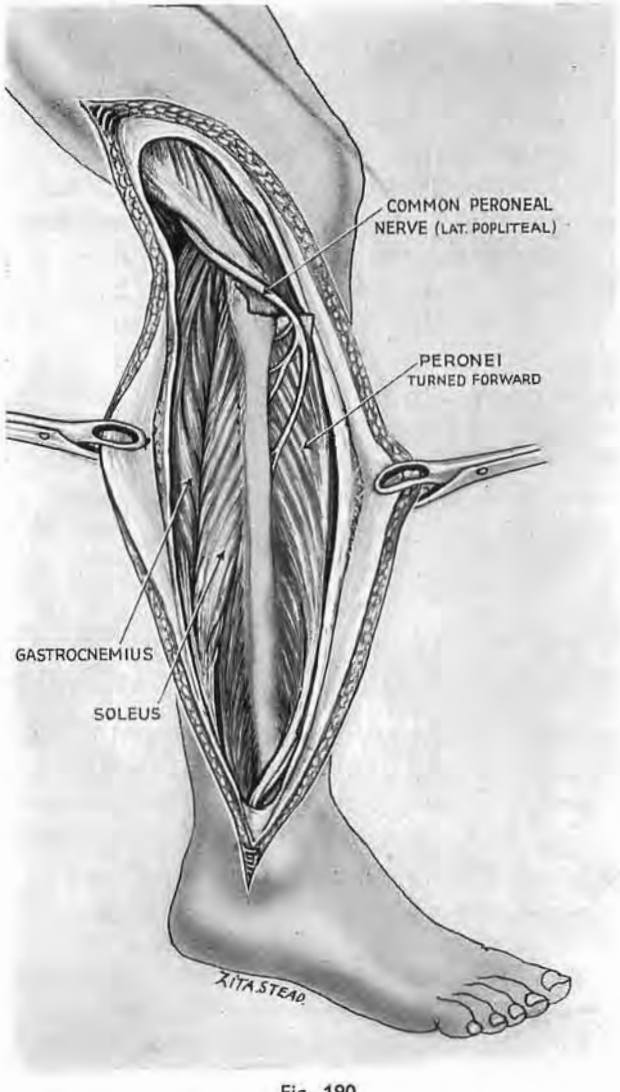

Fig. 190

Mobilise the nerve and lift it from the groove behind the head of fibula. Slip one blade of blunt-nosed scissors into the groove and divide the deep fascia throughout the wound. Separate soleus from peroneus longus. Draw the nerve-loop forwards. Turn the knife edge away from the nerve, and cut through the thin slip of peroneus which bridges it. Detach the peronei and turn them forward, keeping the nerve-loop taut.

to periosteum—a contact that begins about a handbreadth distal to the knee.

The *muscle fibres* from the fibula stream towards the foot; the edge of the rugine should therefore travel kneewards, into their narrow angle with the shaft. At the fibular malleolus, pass the rugine deep to the tendons of peroneus longus and brevis *from behind*. Used from in front and working up the limb the handle of the instrument might strain emerging branches of the musculocutaneous (much better called the superficial branch of peroneal), just where the nerve is liable to form neuralgic trigger-spots.[1]

The *peroneal artery and veins* are seen to hug the lateral malleolus just medial to its hinder edge. A lengthwise cut through periosteum lets the rugine displace them safely from the shaft in company with flexor hallucis. Clean the whole shaft of muscle, working towards the knee. Till that is done do nothing to the *interosseous membrane*; its fibres slope in the reverse direction; so you can strip the membrane *down*, towards the foot.

THE ELKIN-DUVAL METHOD OF EXPOSING THE ANTERIOR TIBIAL ARCH BY FIBULAR RESECTION

Elkin and his colleagues have made new and admirable use of a means that was first but only once employed by Pierre Duval (p. 272)—a means by which the awkward lodgment of the arch becomes an open field. But while Duval's objective was the arch itself, Elkin bares it incidentally in course of dealing with communicating aneurysms at any part of the upper two-thirds of the leg.

Where such communications flourish, anastomoses open, neighbouring vessels dilate, and even small twigs that pierce the interosseous membrane enlarge and grow dangerous. For should they break under traction, they may withdraw through the membrane and bleed on its farther side—remote perhaps from an approach which enters only *one* of the leg's three osteofascial compartments.

[1] *Mononeuralgia in the superficial peroneal nerve.*—In 1941 I saw three patients thus afflicted whose *only* pains were in that distribution. These were made worse by turning in the foot with plantar flexion—an act which stretched the nerve; and, during lulls, pains could be sharply reproduced by pressing on it near but distal to its exit from deep fascia. The nerve just there is clothed in fat, and this—in all three patients—was full of hard and tiny nodules, each very sensitive to needle-prick.

These patients all attributed their pains to sudden twists of foot or ankle. Two were sufficiently improved by procaine; the third for whom injectional relief had shrunk from weeks to hours, was cured by nerve resection at the trigger-spot.

Elkin and Kelly (*Annals of Surgery*, 1945, **122,** 529) stress the need for " direct visualisation of these transmembranous branches." They therefore open all three compartments ' at a stroke,' widely and together. This they do by resecting the upper two-thirds of the fibula.

These authors have generously acknowledged the assistance gained in fibular resection by looping the lateral popliteal (common peroneal) nerve forward off the fibular neck in the way described above.

THE OPERATION

This procedure—which comes so simply from the practised hand of Elkin—for me was full of pitfalls, and could, I know, humiliate when first attempted. I have accordingly endeavoured to provide myself and other tyros with aids, such as the following.

When the nerve is mobilised and looped the muscles and interosseous membrane can be safely stripped from the fibula. Avoid injuring the anterior tibial arch and the peroneal vessels by keeping really close against the bone. Move the rugine upwards to strip the fleshy fibres of the muscles. Work round successively from front to back *without* detaching the interosseous membrane ; otherwise the membrane, whose stripping angle (p. 4) is *opposite* to that of the muscles, will tear and strip raggedly and thrust the rugine off from the bone, endangering the vessels. Detach the membrane last, moving the rugine *down* along the bone. (A leaf likewise strips best if you direct force into the *sharper* of the two angles it makes with the stem.)

Turn the stripped peronei forwards. Turn the soleus attachment back and with it the weak fibular prong of the cleft at the top of tibialis posterior muscle—the cleft which transmits the arch of anterior tibial vessels. Cut the biceps tendon close to the fibular head, leaving it in fascial continuity with peroneus longus (Fig. 191).

Divide the bare shaft a span below the upper tibiofibular joint. Then, with the biceps tendon cut, we have a mobile bony rod that we can twist on its long axis so that each ligament comes in turn for section, and so sets free the upper part of fibula.

A landmark and a clue.—The articular facet now seen upon the lateral condyle of tibia is a good landmark ; the arch of anterior tibial vessels lies two fingerbreadths below it. The clue—which is the anterior tibial nerve—comes (before displacement) obliquely down and inwards from the neck of fibula ; it joins its fellow vessels three fingerbreadths below the facet (Figs. 191 and 192).

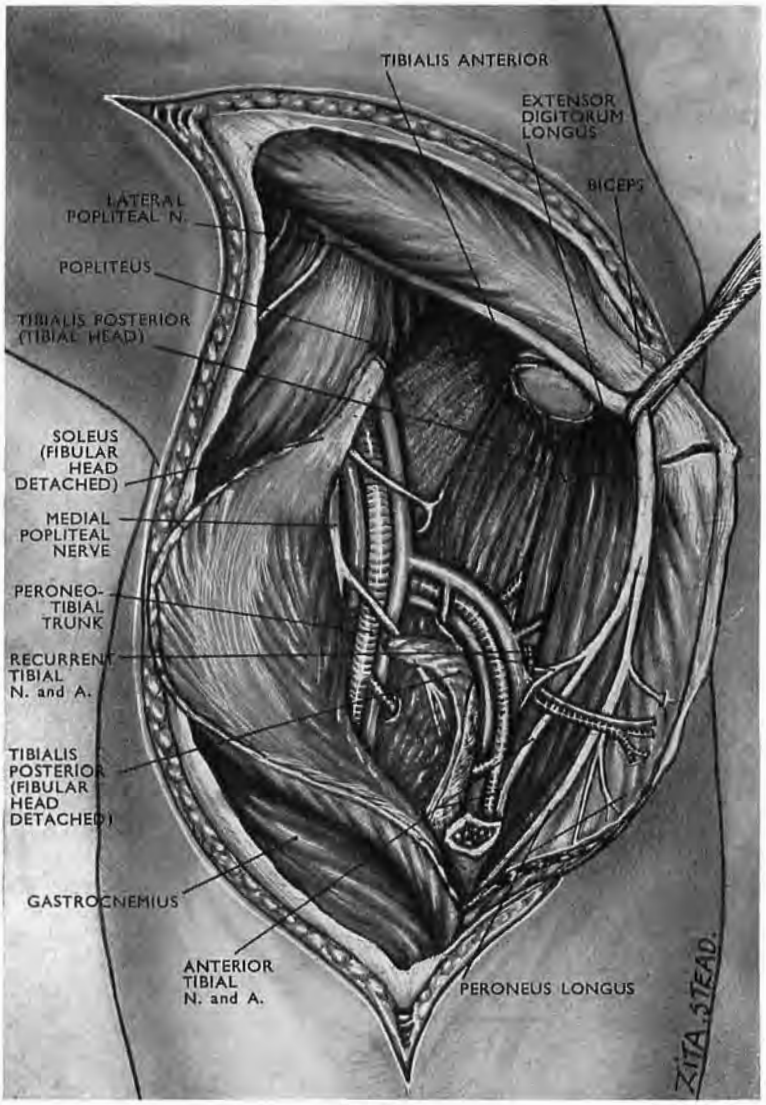

Fig. 191

Exposure of the arched segment of anterior tibial vessels by fibular resection

The lateral popliteal trunk and (in this subject) its *bisection* into anterior tibial and musculocutaneous branches have been freed and turned forward as in Fig. 190 after dividing the fibrous arcade with which peroneus longus covers these nerves as they lie against the neck of the fibula. Traction on the clue provided by the anterior tibial nerve has at once retrieved its fellow artery from the flat unfeatured field left by fibular resection, and so has led to the detection of the arched segment of anterior tibial vessels.

In the figure the anatomical elements have been separated and labelled "for information," but not "for necessary action." Still, if it's anatomy you're after, be careful to mark the interosseous membrane with recognisable forceps before you part it from the fibula ; otherwise you may lose the distinction between front and back compartments of the leg.

(The pointer to peroneus longus also indicates musculocutaneous nerve.)

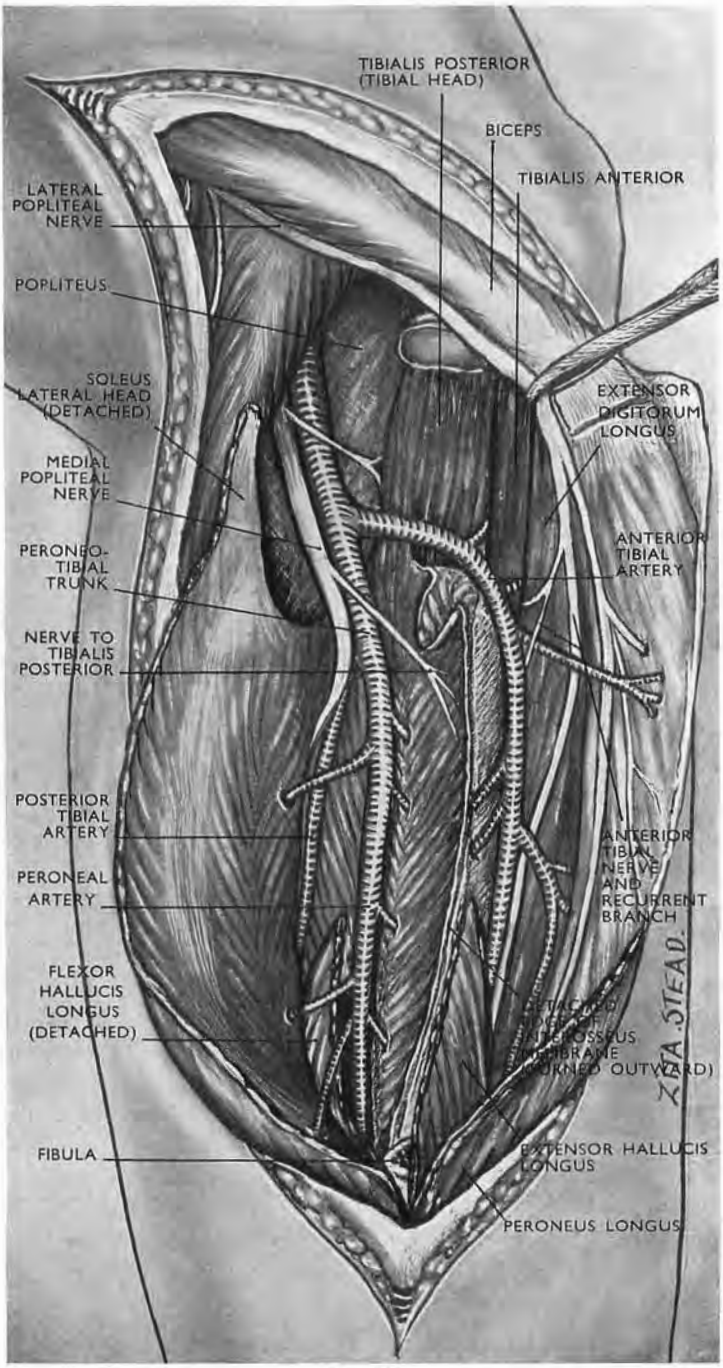

Fig. 192

A greater length of fibula has been removed than in Fig. 191 so that the long extensor and the long flexor of the big toe are detached.

This neurovascular junction is the guide to the otherwise precarious exposure of these vessels: without its location they are easily missed or cut in the flat unfeatured surface left by fibular resection (*legend* to Fig. 191)—a surface thoroughly delusive 'in the raw.'

The safe course is to neglect the arch until our clue has led us to the neurovascular junction. This it will do if we pull gently upwards on the freed loop of lateral popliteal trunk: the trunk pulls on our clue (its own anterior tibial branch); the clue pulls on and reveals its junction with anterior tibial vessels. The junction lies a fingerbreadth below the arch, and thus locates it.

INDICATIONS FOR USE OF THE TWO METHODS OF EXPOSING THE ARCH

The paper by Elkin and Kelly implicitly assigns respective roles to either means of exposing the anterior tibial arch—the fore-and-aft method (p. 272) and their own. In presence of a communicating aneurysm even the light pull that draws the arch back into the hinder wound might tear enlarged transmembranous twigs.

The Elkin method, therefore, is the one for aneurysm; and we may link the fore-and-aft exposure with *recent* local bleeding when routine search incriminates the arch.

EXPOSURE OF PLANTAR STRUCTURES

Except for pointing abscess, incisions through the sole are best avoided; they give no comprehensive view, and cicatrise at times with deeply creviced, cornifying scars. Convenient and benign approach is made from the inner side of the foot, or is continued there from the leg (p. 268, and *legend* to Fig. 196).

ANATOMY

The muscle.—Seldom do we find so many grouped as if to aid the memory; and here, yet once again, *muscles* (and their tendons) are the key to surgical exposure. They lie in layers—1, 2, 3, 4, counting from skin to bone. Layers 1 and 3 (the odd numbers) are both triads: each consists of three muscles—a central belly flanked by two companions. Layers 2 and 4 (the

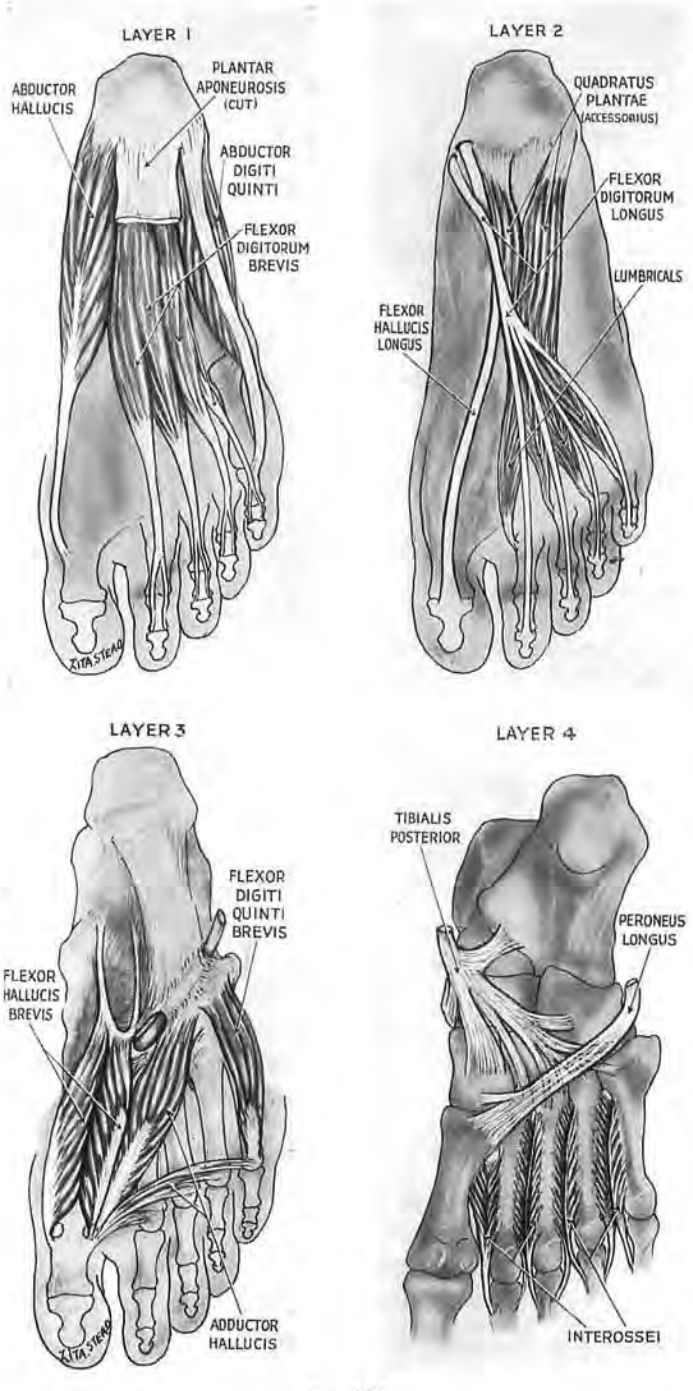

Fig. 193

The four plantar layers

The odd numbers, 1 and 3, are symmetrical with central and flanking bellies; the even numbers, 2 and 4, have each two long tendons and short muscles. Layers 3 and 4 lie to the *front*—except for slips from tibialis posterior. The transverse adductor springs from ligament, not from bone (Wood Jones). (To fit the plan on p. 302 the two adductors are counted as one.)

even numbers) differ from 1 and 3 but are themselves akin: each consists of two long tendons plus short muscles (Fig. 193). The layers alternate as follows:—

Layer 1 (a triad)
ABDUCTOR OF GREAT TOE — FLEXOR DIGITORUM BREVIS — ABDUCTOR OF LITTLE TOE

Layer 2 (Two long tendons + Short muscles)
Flexor hallucis longus — *Lumbricals*
Flexor digitorum longus — *Quadratus plantae* (=*accessorius*)

Layer 3 (a triad)
SHORT FLEXOR OF GREAT TOE — ADDUCTOR HALLUCIS — SHORT FLEXOR OF LITTLE TOE

Layer 4 (Two long tendons + Short muscles)
Peroneus longus — *Interossei*
Tibialis posterior

It must be noted that (with one exception) the various components of layers 3 and 4 are placed towards the *front*, and are related thus to metatarsal bones and to the distal row of tarsus. So, in the hinder portion of the foot (where 3 and 4 are absent), constituents of layer 2 must lie next ligament and bone, with here and there an intervening slip of tendon from tibialis posterior (Fig. 193)—the one exception just referred to.

The door of a cage.—The foot when standing on a level surface forms with its skeleton a vaulted cage that opens widely at the inner side. The door which keeps it closed is the abductor hallucis of layer 1 (Fig. 194); and if we free the upper fastenings of abductor and hinge the belly solewards, then we can reach the contents of the cage; though, for the moment, these may be screened by fascia; and even when we open it the muscles are so packed and linked that, till we part them cleanly, the view is worthless.

The long tendons of laver **2 and** hallucis **brevis.**—These are the bonds which hold the plantar layers close against the tarsal vault and bind them to each other. The master knot controlling this assemblage is found about a thumbwidth lateral to the navicular tubercle. Here, where the tendons cross (with hallucis above the digitorum), they both are tied against the summit of the vault. Here, too, and just outside the crossing of the tendons, the origin of flexor hallucis brevis (Figs. 195, 197 and 198) suspends its fellow structures; for this intrinsically trifling belly procures

through its relations a veritable nexus of the first three layers—the three which chiefly count in this approach.

It happens thus. The tendon of flexor hallucis longus lies in a lengthwise groove on brevis' belly and straps it to the plantar face of first metatarsal. Next to, and sometimes joining with, the inner side of brevis is abductor hallucis of layer 1—an intimate relationship which often leads to tearing of the brevis belly during the opening of the cage. Then, on the outer side, abductor hallucis

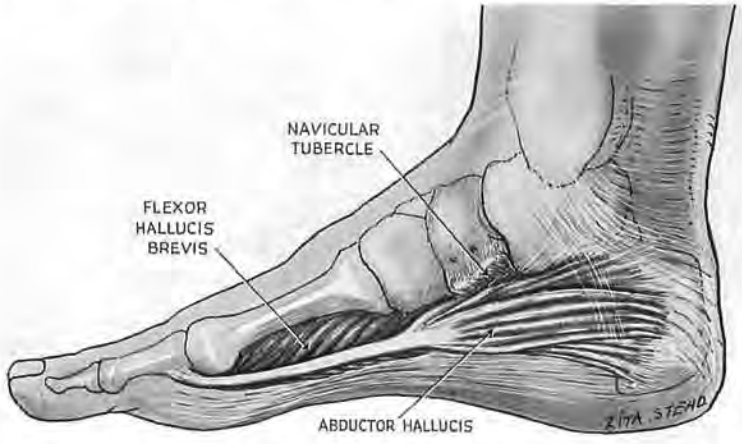

Fig. 194
The cage door
The cage is opened by hinging abductor hallucis down through a right angle on a plantar hinge. Note the relation of abductor with flexor brevis. Deep to abductor is a sheet, more aponeurotic than fascial, which sometimes comes away with the belly but often stays behind and partly screens the cage.

is sometimes linked with flexor brevis—a chance event that turns to our advantage and lets us move both muscles solewards as a *sheet* which bears off on its plantar face (besides the tendon of hallucis longus) the lumbricals arising from the fan of longus digitorum tendons.

If therefore, working on the master knot, we first set free the two long tendons of the second layer, and then the origin of flexor hallucis brevis, we can at once retract a major bulk of muscle from the tarsus and leave the plantar ligaments exposed.

THE OPERATION

Position.—The foot lies on its outer edge; the knee is partly flexed.

Incision.—Divide the skin and superficial fascia at the inner side of the foot, from the ball of the great toe to the heel, by an

incision curving up to cross the tuberosity of navicular (Fig. 196). Identify and catch the veins.

The guide to the cage door.—Find the tendon of abductor hallucis at the inner side of first metatarsal. Mobilise the tendon, taking care to leave intact adjoining fleshy fibres of flexor hallucis brevis. Use the tendon as a guide for separation of the less distinctive margins of abductor belly. Detach this belly, first from its fascial bond with the navicular tuberosity, then from the indefinite anterior part of the vague annular 'ligament' (laciniate of B.N.A.).[1] Continue the detachment down to the inner tuberosity of calcaneus. *Then* you can hinge the muscle solewards through a full right angle (Fig. 197), taking care to save the pair of twigs it gets from the medial plantar nerve. Both twigs lie fortunately close to the hinge, two and three fingerbreadths respectively behind the tuberosity of navicular.

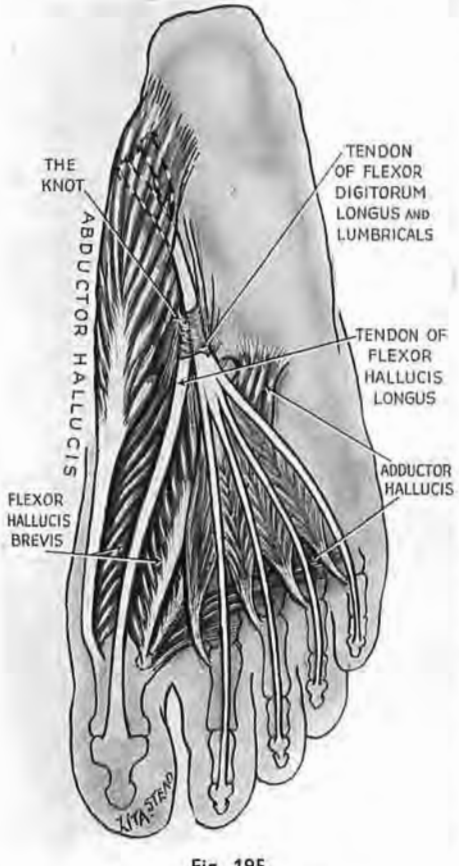

Fig. 195

Flexor hallucis brevis

A vital link of layers 1, 2 and 3. Note the relations of the belly. Its tarsal *origin*—by means of tails, or by a fusion with the fibrous screen *deep* to abductor hallucis—shares in the master knot that fastens long hallucis and digitorum tendons to tarsus.

The screen, the 'knot' and the neurovascular bundles.—When that is done we see the partial screen of fascia, rough perhaps with broken fibres of abductor. The fascia is defective fore and aft, and aft of it we can locate the plantar nerves and vessels. These form two bundles, medial and lateral. Find where

[1] "Its proximal border . . . is very imperfectly defined. Its distal margin but little more distinct, being continuous more or less with the tendinous origin of the abductor hallucis which arises from it." (T. H. Bryce in Quain's *Elements of Anatomy*, 1923, 11th edn., p. 248.) This band is now appropriately termed *flexor retinaculum*.

they first diverge, three fingerbreadths behind the tuberosity of navicular; then they are covered by the screen, and this we must divide.

Next we cut loose the master knot, a thumbwidth lateral to the tuberosity of navicular, dividing first the fibres which attach the two long second-layer tendons to the vault, and after that (a trifle farther out and forward) the strap-like origin of flexor hallucis

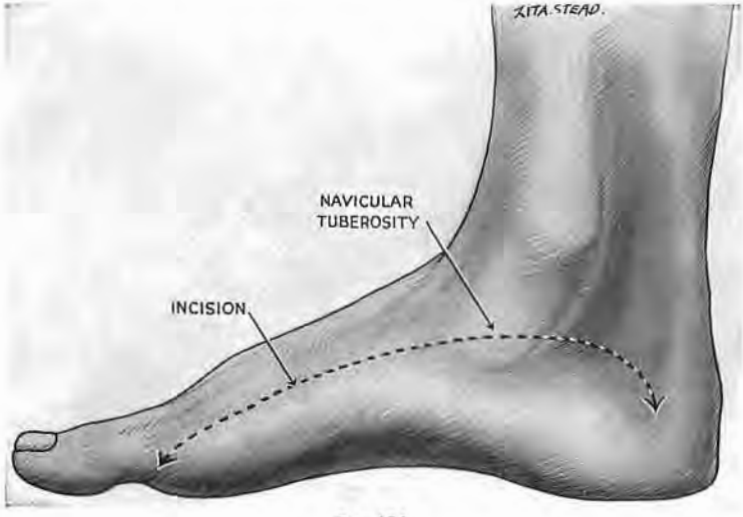

Fig. 196

Divide skin and superficial fascia from the ball of the great toe to the heel. The highest part of the incision crosses the scaphoid tuberosity. Reflect the skin flap downwards and find the tendon of abductor hallucis at the inner side of first metatarsal.
Should there be need to trace nerves or vessels from leg to sole, turn the incision *up the leg*, instead of down the heel. This will leave ample room for skin reflection—sufficient even to ' decorticate ' calcaneus.

brevis. Then we can draw the muscles solewards and trace the nerves and vessels on the dorsal side of layer 1.

The *medial bundle* skirts the inner aspect of the long hallucis tendon, and after that runs forward in a gutter thinly roofed by fascia. This gutter lies upon the *dorsal* face of layer 1—between abductor hallucis and flexor digitorum brevis. The *lateral bundle*, slanting out towards the base of fifth metatarsal, skirts the inner surface of quadratus, then lies within a fellow gutter bounded here by flexor digitorum brevis and abductor digiti quinti. Reaching the outer metacarpal base, part of the bundle curves once more, but this time inwards. A portion of the outer bundle, therefore, passes *twice* across the sole: first out, between layers 1 and 2; then in, between layers 3 and 4. The fact, perhaps, of chief

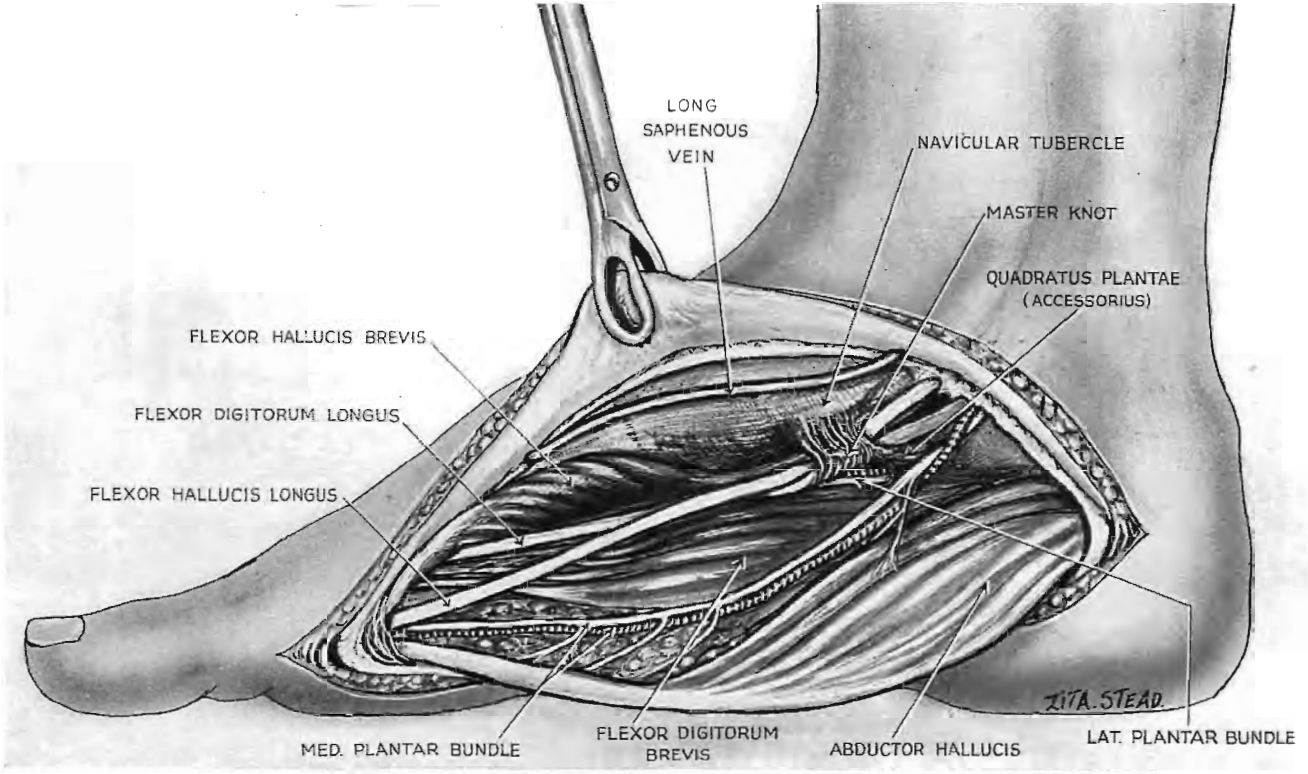

Fig. 197

Plantar exposure

Abductor hallucis has been hinged down through a right angle ; with it has come the fibrous screen. When that occurs you see *at once* the crossing of the two long tendons (flexor hallucis and digitorum), a thumbwidth lateral to navicular tubercle. Take care not to injure the medial plantar bundle near the hinge. The parting of the bundles lies three fingerbreadths behind the tubercle.

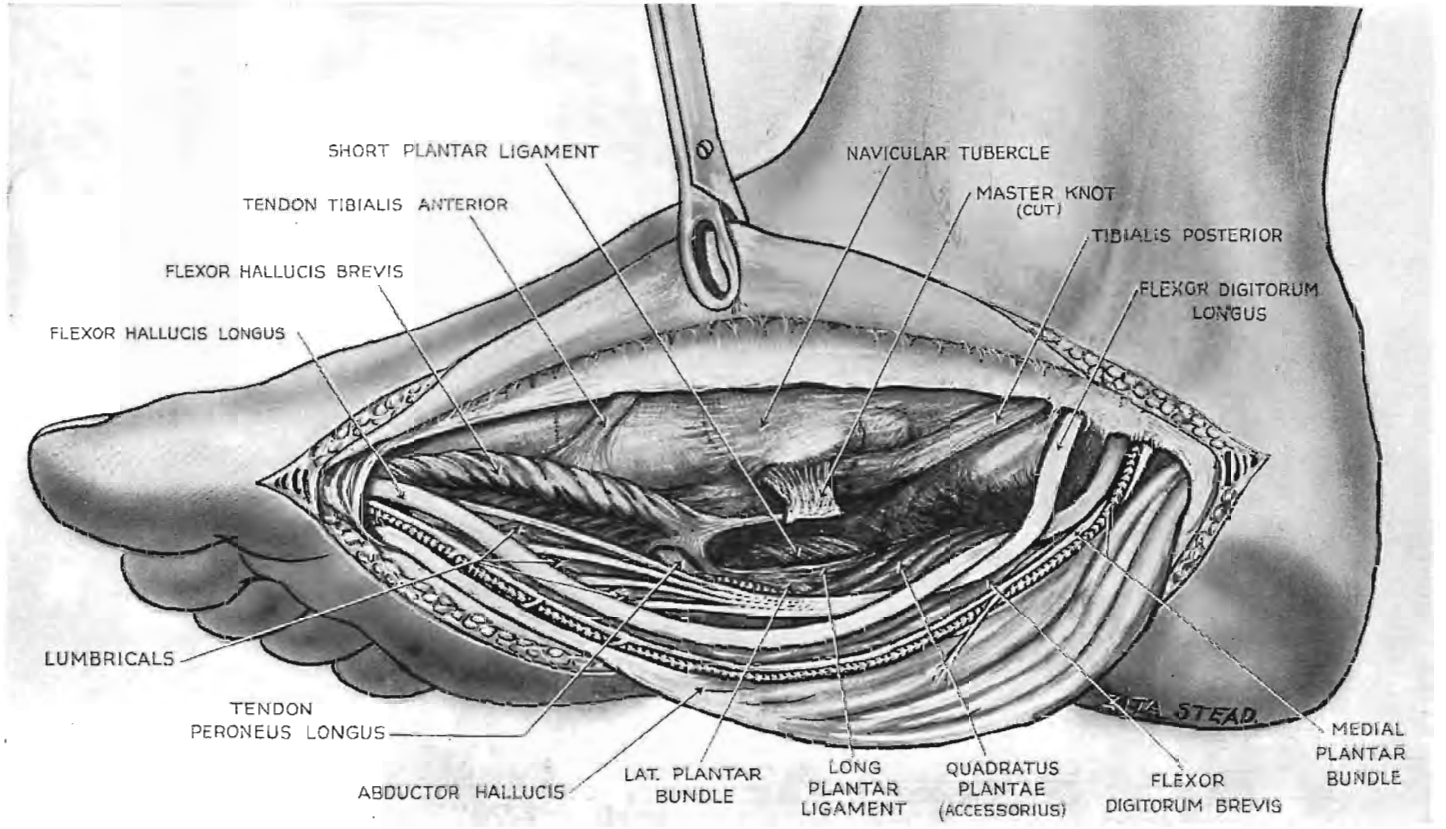

Fig. 198

The exposure continued

The master knot consisting of fibrous derivatives (from screen or from flexor hallucis brevis) has been detached from tarsus letting us retract layers 1, 2 and 3 sufficiently to show ligaments. Most obvious of these is the short plantar. Only the hinder end of hallucis brevis has been disturbed.

importance is that both the plantar bundles (in the especial segment of their course which can be mobilised most easily) are linked *as satellites* with layer 1. So, when we part this layer from the tarsal vault the bundles too will move away.

Ligaments.—The first to come in view is the *short plantar*; its fibres slant towards the great toe between the *long plantar ligament* laterally and the '*spring*' *ligament* medially (Fig. 198). This last (the inferior calcaneonavicular), by fusing at its inner edge along the base or distal margin of the deltoid ligament, forms a resilient hanging shelf suspended from the medial malleolus. The strap-like tendon of tibialis posterior loops round beneath the shelf, and thus combines to bear the weighted head of talus.

The structures of the sole are now at our disposal and further steps will vary with the object of procedure. Whatever that may be take care to leave the field as dry as though it were the site of toxic goitre: the sponge of venules which infests the foot tends, if it can, to seep in aftermath. And so where circumstance allows, and if you have the right to treat the individual and not the mass, drain, when you close the wound, as you would drain deceitful dryness in a thyroid bed, and raise the fixed and firmly bandaged foot. Then, in a day or two, when drains are out—but not till then, unless you tolerate or disregard *occasional* calamity—then only will you seal the limb in plaster.

It is the fate of detailed 'practical' descriptions to wear the desultory look of curves mapped out with points: each is a series of related but disjoined minutiæ—the "static snapshots" which the mind demands before it can proceed to the direction of a complex, uninstinctive act. So, it is both a consolation and a stimulus to be aware that in the due performance of the act itself (as in the swift, unhurried hands of surgeons like de Martel) "there is no detail." And closing thus these pages have acquired merit; they chance to link the memory of two great gentlemen—de Martel and Roy Dobbin.

INDEX

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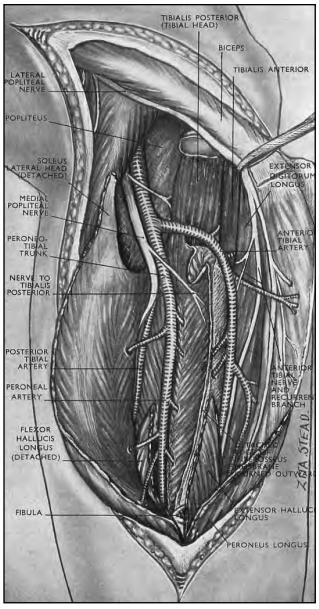
P

This book is a surgical classic -- it is famous for what a reviewer described as its “use of the English language and its literature to present cold fact with such warmth and life”. It has been unavailable for some time, but is now available as a facsimile of the second edition with the addition of a short bibliographical note by Arnold K. Henry himself.

An exposure is the route by which the surgeon gains access to the structures on which he or she wishes to operate, and the exposures can be extended if necessary (hence the term “extensile exposures”). Many of the exposures described in this book are still in use, but it will mainly be obtained for the literary pleasure of reading.

As it has been out of print for some time, many surgeons will be pleased to have the opportunity of adding this famous work to their libraries. The Lancet: “There is no pleasanter way of revising anatomy”. British Medical Journal: “The distinguished author is to be congratulated on this further development of a masterpiece”.



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