I. LEVELS OF AMPUTATION AND LIMITING FACTORS

by

George Murdoch

WHATEVER THE INDICATION for amputation, the result is a limb stump. In the case of a hindquarter amputation for chrondrosarcoma of the pelvis the stump as such is non-existent but the level of limb section is mandatory. In other situations and particularly where the pathology is more distal in the limb the precise level of limb section is selected ideally within relatively narrow limits and hopefully after due consideration of all the relevant factors.

As to the surgery itself the surgeon will have a choice of hundreds of procedures. Some of these operations have well founded reputations with a long history of usage and acceptance. Others are somewhat fanciful and a few, in the light of hindsight, frankly comical. At the present time some 70–80 per cent amputees lose their legs because of vascular disease, in particular, atherosclerosis. It is possible to make broad classifications of the patterns of vessel pathology, but consideration of the individual patient still deserves a decision individually tailored to his needs. Usually the question to be answered is whether the amputation should be above-knee, through-knee or below-knee. If the surgeon's interest is solely that of primary wound healing then the level of limb section will be above-knee in nearly all cases. Indeed there are still some surgical units where the problem of amputation level in atherosclerosis has been rendered down to an axiom which states that if the gangrenous process is proximal to the toes then above-knee amputation is obligatory. There is little doubt that evidence could be produced to support such an axiom if, and only if, we look at the problem against a background of crude and inaccurate methods of assessing tissue viability, " conventional " amputation surgery performed by relatively junior surgeons, primary wound healing as the sole criterion of the success of the operation and finally a total disregard for the patient's needs.

Close consideration of the subject of leg amputation leads one directly to the conclusion that this is a medical situation with unique implications. Prosthetic replacement of other parts of the body, at least at this time, poses quite different and usually simpler problems. For example, the removal of an eye, an ear or breast requires a prosthesis which depends solely on the cosmetic art (spectacles are not prostheses but rather sophisticated technical aids). The excision of the head and neck of femur and its replacement with a prosthesis also presents a quite different philosophical situation. In this instance, the design of the implant, the materials employed and its method of fixation may all have been devised on a basis of the knowledge of the forces involved in human locomotion, the functional properties of joints, tissue reaction to different substances and the be-

haviour of bone in response to varying loads. Even if this were so, the surgeon himself fits the prosthesis and performs his surgery precisely with prosthetic replacement in mind. Other examples of this kind can be quoted.

Perhaps the clinical situation closest to leg amputation is found in the field of dentistry. The days when wholesale removal of teeth was followed by the patient's purchase of a set of " store " teeth are long since past. The dental surgeon to-day is now strongly conservative and when dental extraction is inevitable or desirable the prosthetic replacement (which is both cosmetic and functional) is very much in his mind. More than that, he devotes a large part of his training to learning about the cosmetic and functional requirements of the prosthesis, how to take casts of the " stump ", what materials are available and even constructs a prosthesis. He supervises and works closely with his " fitter ", the dental technician, and is able to do this because of the broad area of common knowledge and experience.

Leg amputation, on the other hand, is performed by a man who is unlikely to possess any fundamental knowledge of human locomotion. He knows little about socket design or the limited functional characteristics afforded by prosthetic devices. He might well never have met a limb-fitter in his life. It can be argued that he is not equipped to determine exactly the level of amputation, however deep his knowledge of pathology and no matter how surgically expert he may be.

Hopefully, reorganization of undergraduate training and of the limb-fitting service itself will go some way towards effecting a remedy for these deficiencies. Meantime the amputating surgeon would be well advised to establish close contact with the regional limb-fitting surgeon and his team of limb-fitters and become an integral member of the Clinic Team.

This is indeed our main trouble. The surgeon, the patient, the limb-fitter, the limb-fitting surgeon, all look at this problem from a different viewpoint. The prosthetist sees as his problem the patient with his stump; the patient may be astounded and frightened by the mutilation that has occurred, and the surgeon, depending on his views, may regard it as nothing more than a surgical exercise or refer the matter to the Registrar or house surgeon.

Not so long ago surgeons were urged to perform amputations at so-called sites of election; levels determined largely by the prosthetic considerations of the day, and a knowledge of the survival of amputation stumps at different levels. This advice, which was fostered by some powerful protagonists, had a considerable influence on surgical practice in this country and had in my view two important effects. The first was the depreciation of certain very valuable procedures such as the knee disarticulation and the Syme's amputation, and this was due largely to semantic laxity in the assessment of large numbers of amputations per-

formed during the 1914–18 War. The second effect, the removal of a very large part of the surgeon's responsibility for his patient and the effects of his surgery is a regrettable although perhaps inevitable result of a service which has failed to modify with changing needs.

I believe the amputee has over these years suffered from this dis-association of responsibility. The projected removal of part of a patient's body is not to be treated lightly, or undertaken in ignorance, even though supported by considerable expertise in one's own field. Our purpose, therefore, is to do several things: to decide whether amputation is the correct form of treatment, to define the correct level of amputation and, most important, to define the objects of the operation. The event, amputation, marks not the end of a story but rather the beginning. If the surgeon's sole objective is the certainty of primary wound healing, then the patient's aspirations in terms of locomotion may be frustrated. The pathology, therefore, is not the only factor to be considered in determining the appropriate level of amputation. One might express the relevant factors as being:

Pathological
Anatomical
Surgical
Prosthetic, and
Personal, e.g. sex, age and occupation.

Each of these will play some part in the decision to ablate the limb at a given level, with varying emphasis according to the clinical situation. The simpler decisions will tend to be those involving new growth at a high level and the complicated deliberations those concerned with elective ablative surgery which is not obligatory. As each of the amputation levels in different pathological situations is discussed the cogency of the different factors should emerge. At any rate a close consideration of these factors will permit us to select one of the following levels of limb section:

Hindquarter
Hip disarticulation
Thigh amputation
Knee disarticulation
Below-knee amputation
Syme's procedure
Distal amputations.

A listing of this sort needs some comment because to some there may appear to be important omissions. For this reason each level is considered in a little more detail.

Both the *hindquarter amputation* and the *hip disarticulation* require little comment because those levels are determined almost entirely by the pathology. It should be pointed out that there is no longer any need to

attempt to leave an inch or two of femur at hip level because of advances in the prosthetic art.

The above-knee amputation should be as long as possible subject to the pathology. Two prosthetic factors require consideration, viz. hip flexion deformity and the need to provide space for prosthetic devices. If the hip flexion deformity is considerable, e.g. 30–40°, it may not be possible to fit the patient with an artificial limb at all; and if less marked it may well affect the level of amputation. The strain on the lumbar spine brought about by the presence of a hip flexion deformity and responsible for limited capacity and disabling back pain in a whole person can prove intolerable in the amputee. Furthermore there is a limit to the hip flexion that can be accommodated in the prosthesis: these thresholds can be seen from the cosmetic point of view and from the biomechanical aspect at the socket brim, where location of the bearing areas and containment of the anatomy may prove impossible. In general, if there is a hip flexion deformity, limb section will require to be more proximal than the pathology itself would suggest.

The other factor requiring consideration is the need to accommodate prosthetic devices above the artificial knee axis. In all but the frail we will wish to have the patient walking with a mobile knee and to introduce one of these devices to help or control function during the stance or swing phase of gait. This requires that the stump should terminate at a level which will leave a gap of $4\frac{1}{2}$ to 5 inches between stump end and the knee axis.

Finally, reference has to be made to the surgical technique employed. I have already referred to the " sites of election ". These levels have been arrived at on a very large experience of stump survival and point to the main problem of terminal ischaemia. In the thigh the " ideal " level, 10 to 12 inches from the trochanter, has long been accepted as the site of election in the United Kingdom and was confirmed by the countries of the Brussels Treaty organization in 1953 (*Brit. med. J.* 1953). At a conference under the auspices of the World Health Organization, held in the following year, it was stated that " The Conference considered these recommendations too rigid and drew attention to more functional methods of stump-length determination ". The report of this conference (W.H.O., 1955) goes on to urge that all relevant factors should be considered in arriving at the " site of election " for the individual patient. The surgical technique itself has emerged in recent years as an important factor stimulated by the work of Dederich (1963), Ertl (1949) and Mondry (1952). Their contributions suggest among other things that the distal circulation in the myoplasty procedure is superior to that found in stumps following " conventional " surgery. What is unquestionable is that they are prosthetically more satisfactory; the stumps are more powerful, they provide better adherence to the socket, and problems produced by a prominent bone end are eliminated.

Amputations performed at or about *supracondylar* level, e.g. Slocum, Gritti-Stokes, are not recommended. This view is based on the fact that they are not truly end-bearing on one hand and, on the other, they fail to leave sufficient space for the insertion of knee control devices in the prosthesis. Perhaps a special comment is required on the Gritti-Stokes amputation as it has a measure of residual popularity. Undeniably it has merits in terms of wound healing and in ease of performance, but in this procedure a " fracture " is created, time must elapse for the " fracture " to heal and, as happens in a significant number of cases, the patella fails to be firmly located at the end of the stump and can prove troublesome in socket construction (Vitali, 1966).

The *knee disarticulation or through-knee amputation* has proved an excellent procedure and increases in popularity because it is an easy, relatively bloodless operation where the great majority of the thigh muscles retain their normal insertions. It provides a long strong lever and a large (up to 20 square inches) bearing surface with excellent proprioception. It is particularly applicable during the growth period as the distal femoral epiphysis is retained, and in the elderly where its end bearing properties with better ability to balance is greatly appreciated. Because of the stump length the arguments regarding the influence of a hip flexion deformity are even more cogent, and significant flexion deformities preclude amputation through the knee. The prostheses available for the stump following knee disarticulation are not entirely satisfactory from a cosmetic viewpoint. In the case of a young adult female the writer would perform a low thigh amputation using a myoplasty technique because of the cosmetic advantages even if all other factors permitted a knee disarticulation.

Amputation at below-knee level has usually meant ablation at a point 5½ inches from the tibial plateau. Certainly the division should not be made lower than the musculo-tendinous junction of the calf muscle and, although shorter stumps have proved functional, can rarely be effective shorter than 3½ inches, again measured from the tibial plateau. If the insertions of the hamstrings do not encroach too much on the stump and bone division leaves a broad expansive bone end capable of end bearing, then short below-knee stumps can be remarkably successful. Surgical technique again plays a part in survival of the longer below-knee stumps and any of the procedures which ensure a secure attachment at the bone end for the muscle groups under some tension will also ensure a better terminal circulation. The osteo-myoplasty of Ertl (1949), described by Loon (1962), or the technique used by Burgess (1966) of Seattle are good examples of these procedures. Again joint flexion deformity may influence the level of ablation. I question whether a knee flexion deformity of more than 15° can be accommodated satisfactorily by the prosthesis and this is especially true in the case of the very long stump.

The next recommended level of limb ablation—*the Syme's amputation*—provides an excellent stump with good end bearing properties and in

certain circumstances allows locomotion in the absence of a prosthesis. Since the first description (Syme, 1843) of the procedure Syme's amputation has enjoyed a variable popularity. Its loss of popularity in this country following the 1914–18 war was due largely to a poor survival rate in stumps described as Syme's amputations. Many of these operations were performed under adverse conditions, the tissues of the heel flap were often deeply scarred and a proportion were in fact the result of Elmslie's modified Syme's amputation (Elmslie, 1924). When properly performed with the knife dissecting against bone throughout, removing only a thin slice of tibia and ensuring proper location of the heel flap, there is no better amputation (Harris, 1956). As in the knee disarticulation it is particularly applicable in the growth period and in the elderly, but cosmetically is not entirely satisfactory and may not be acceptable to an otherwise attractive young woman. I would condemn the Pirogoff and Boyd procedures: the stumps are too long, the heel anatomy is distorted and in both the weightbearing is delayed. All the procedures in the hind foot and the mid-tarsal region, notably the Chopart, are subject to a problem of muscle imbalance. Even in those cases where tendon transference has been carried out, e.g. of the tibialis anterior, muscle imbalance persists and the stump becomes deformed, with resultant equino-varus and painful sores.

In my view there is no place for any procedures which fall between the Syme's amputation proximally and the amputations through the metatarsals distally. This opinion can be properly modified when we consider communities where no prosthetic services exist and stumps resulting from procedures such as the Pirogoff operation may assume real validity.

It is appropriate at this point to consider the several indications for amputation. They may be listed thus:

1. Vascular disease
2. Tumours
3. Trauma
4. Chronic infection
5. Paralysis / Deformity / Limb discrepancy
6. Congenital limb deficiency.

Of these indications far and away the commonest reason for amputation in North America and Northern Europe is vascular disease. This provides the largest and unfortunately the most difficult problem and remains for consideration later.

So far as *tumours* are concerned, elective sites of amputations remain controversial; clearly the management of the patient will be determined by a number of factors including the place of limb ablation itself, the nature of the tumour, and the presence or absence of metastases. The

practice generally accepted, if we take the typical example of an osteosarcoma, is to have a joint intervening between the tumour and the amputation site. One might regard amputation in tumours as a wide excision: the amputation then being contingent on the involvement or proximity of the tumour to the nerves, vessels or supporting bone.

In the case of *trauma* the rule is to save all possible tissue: elected procedures, such as myoplasty, should be performed later.

Chronic infection remains an indication for surgery, where all systemic and local antibiotics have failed, the systemic effects of infection are feared or evident, and reconstructive surgery is not possible. A review of the 1,400 amputees who attend Dundee Limb Fitting Centre suggests that a small but significant number of amputations have been performed since the beginning of the antibiotic era in the presence of chronic infection for the best of reasons but at too high a level. Caution should be tempered by a cool appraisal of the needs of locomotion in the light of the extensive therapeutic armamentarium. My experience suggests that it is possible to do the amputation through the affected bone but proximal to the infection. It is preferable to close the wound. If any doubt exists then one may fashion one-piece flaps with minimal dissection and suture them loosely over a pack; secondary suture can be performed two or three weeks later.

The next indication comprising and possibly combining the disabilities of *deformity, paralysis and limb discrepancy* is perhaps the most difficult to define. Amputation in these circumstances is never a life-saving procedure or indeed necessary to permit locomotion; many factors have to be considered and some of these involve matters which the surgeon rarely is required to consider. These matters might well include the influence of fashion (known to be fleeting), the individual sexuality of the patient, the occupation of the patient and family relationships. In the male the decision may well rest solely on functional considerations although not necessarily so. In the female, cosmesis is of great importance especially during the second and third decades of her life. At the same time one must not replace static disfiguration with dynamic ugliness. The decision in the long run will depend on an intimate knowledge of the patient, her parents, her desires and aspirations and, most important, a fundamental appreciation of the biomechanical and prosthetic possibilities. The operating surgeon is strongly recommended to consult his local limb-fitting surgeon.

Very rarely one has to consider amputation on cosmetic grounds alone. Figure 1 illustrates such a case: a teenage girl, who some years before had been run over by an omnibus with gross degloving. She survived with a leg of very unpleasant appearance. Nevertheless, despite the appearance, absolute limb shortening and overgrowth of the femur she walked well without discomfort and had excellent foot and ankle function. Because of her ugly leg the girl, on leaving school, refused to venture outside her

home and always wore slacks. After many discussions with both patient and parents an above-knee myoplasty was performed. Despite marginally reduced function, this young girl is now much happier with limbs of equal length and appearance and is well on her way to being a fully integrated member of the community.

Congenital limb deficiencies present similar surgical, functional and philosophical problems. Unless working specifically in this field the amputating surgeon is unlikely to build up a sufficiently large experience of these cases on which to base a competent opinion. He would be well advised to seek advice from doctors working in the speciality of prosthetic replacement before undertaking any irrevocable step. Perusal of the literature (Aitken, 1959; Hall *et al.*, 1962; Kruger and Talbott, 1961) might suggest that, for example, in a case of congenital absence of the

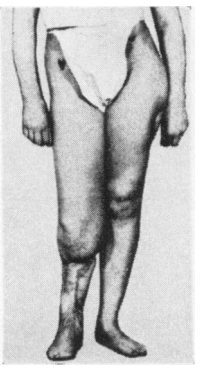


Fig. 1. Very ugly leg with good function. Amputation for cosmetic reasons.

fibula, ablation of the foot is the standard procedure. This may not always be so as McKenzie's (1957) experience demonstrates.

These then are the main pathological situations, excepting that group which is responsible for most of the amputations to-day, viz. *peripheral vascular disease*.

As an orthopaedic surgeon I do not have full clinical control of all patients who require an amputation because of disease of the blood vessels in the limbs. Nevertheless as the surgeon responsible for prosthetic replacement I am familiar with the case histories of those patients presented for prosthetic prescription and with a significant number prior to surgery. The vascular catastrophes, such as embolism and acute vessel thrombosis, and special cases, such as frostbite and chemical gangrene, are not considered in this contribution.

The disease responsible is atherosclerosis, affecting mainly the older age groups and males significantly more than females. Atherosclerosis may affect the whole vascular tree, and conditions such as coronary thrombosis,

cerebral vascular lesions or amputation of the other leg may complicate the clinical picture or loom ominously in the future. The great majority of these patients are over 60 years of age and other diseases such as blindness, arthritis and diabetes are all too common.

Except in cases of ischaemic nemopathy with extreme pain (Smith,[1964), evidence of frank tissue death is usually present before amputation is considered as the first line of treatment. The patient is faced with amputation and the surgeon in his wisdom with a critical decision as to the level of limb ablation.

Over the years several ancillary methods of assessment of blood flow have been evolved. These include:

Plethysmography
Oscillometry
Skin temperature tests
Arteriography.

There is little unanimity regarding the value of these techniques and in my experience arteriography allied to the clinical examination is likely to give the most realistic assessment of tissue viability. Even so, the techniques available are crude and it is hoped that more sophisticated and refined methods will become available with advances in the field of bioengineering. There is little question that certain gifted radiologists can with sufficient experience produce arteriograms which may offer valid information regarding collateral and distal vessels to a degree not normally produced in standard arteriographic procedures. One thing is certain: any arteriographic representation demonstrates the real vascular picture at a disadvantage; it cannot do otherwise.

The picture most commonly seen after all investigations have been made is one of distal gangrene, a proximal main arterial block and a variable pattern in the more distal vessels. The discerning surgeon will be interested in determining the degree to which the distal vessels and collateral vessels have been invested by the basic disease.

In this disease there is an unfortunate paradox. The earlier the onset of the disease the more slowly its progress and the more chance there is for the development of a useful collateral circulation. Furthermore this is more usually the picture in the younger patient and more distal amputations are feasible. The later the appearance of atherosclerosis the more rapid the progress and the less chance there is for the development of a collateral circulation. Unfortunately this is the clinical picture commonly seen in the elderly patient and the more proximal is the amputation performed. Yet the younger patient is more able to overcome the considerable locomotion disability that derives from a high amputation whereas in the elderly there is correspondingly less chance to achieve a satisfactory rehabilitation.

It behoves us, therefore, to perform limb ablation at the lowest possible level consistent with tissue viability and useful function in the retained joints. There is a clear and observed advantage to the patient to retain the knee joint or to have preserved the broad end-bearing surface of the femur as in the knee disarticulation. Whatever help we may obtain from arteriography, and in certain cases it may be invaluable, in the end the decision as to level of section will depend upon a clinical assessment. The features of this assessment will include the peripheral pulses, the extent of local sepsis and oedema, and the effects of ischaemic nemopathy in terms of the sensory deficit and absence of hair. In the majority of cases the dilemma will reside around the knee: should the amputation be above or below the knee or at knee level itself?

In selected cases vascular surgery will allow of a lower level of limb section and in such a case (Fig. 2) a below-knee operation was possible with sound wound healing and a functioning stump.

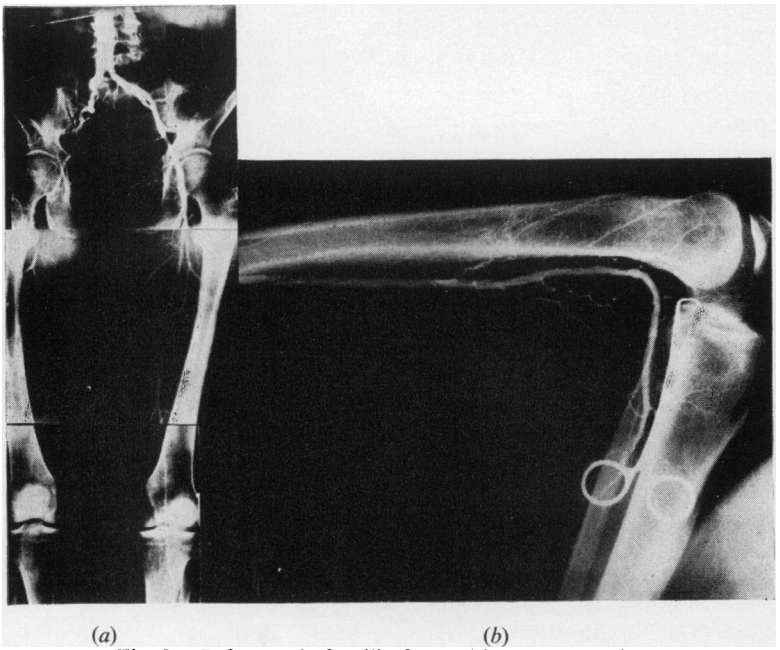
Diabetes is a major complication, affecting from 21 to 42 per cent of those patients subjected to amputation for vascular disease (Wilson, 1964). It plays a variable role: it may accompany an otherwise typical atherosclerosis, it may modify the disease pattern in atherosclerotic vessels, be itself responsible for disease of the vessels or by reason of neuropathy necessitate distal amputation. Whatever its role it should be carefully defined. Obviously the patient with forefoot gangrene, a palpable posterior tibial pulse and diabetes should not be subjected to above-knee amputation. In these circumstances if the sensory loss is proximal and there is an absence of pain then the tissue death is probably due to a neuropathy, the blood flow is liberal, demarcation is more rapid and precise and non-destructive distal amputations can be done. Conversely the presence of diabetes does not necessarily suggest a distal amputation. Each case deserves consideration on its own. The presence or absence of peripheral pulses, infection and the state of the skin at the line of demarcation of tissue death all provide clues to the circulation gradient and the level of limb section.

A lower level of operation may be possible if a number of general measures have been undertaken. Any diabetes should be properly stabilized, the general nutrition of the patient improved and physiotherapeutic measures instituted. A sound philosophy is that of preprosthetic training, where the patient is taught to walk in a special pylon with the knee flexed (Vitali, 1966). The most important of these preoperative measures is the correction of any anaemia because if it remains untreated then it will adversely affect wound healing and even the ultimate level of limb survival.

Despite a careful evaluation and pre-operative preparation there may still remain doubt regarding the level of amputation. In these circumstances I believe the patient should be told of the problems and possibilities

existing and a mandate for the operation obtained. If, for example, at operation below-knee amputation proves to be impossible then the surgeon should have permission to proceed to knee disarticulation or above-knee amputation.

The technique of operation itself will influence the ultimate level of limb ablation. It cannot be emphasized too often the need to ensure haemostasis at the end of the operation. Some other general principles in amputation technique are worth mentioning because they are directly applicable. The main arteries and veins should be ligated separately and



(*a*) (*b*)

Fig. 2. Before and after ilio-femoral by-pass procedure.

low to ensure the survival of the maximum number of collaterals. Conversely the nerves should be divided high and cleanly to reduce the chance of leaving ischaemic, dissociated nerve fibres (Smith, 1964), thus preventing unnecessary stump and phantom pain. Similarly proper muscle suture and the treatment of the bone end play an important part in the final survival of the stump. The question of drainage is often debated. From my own operative experience and from some 12 years' experience in amputee clinics it is possible to say that well over 50 per cent of amputations performed without drainage present for prosthetic prescription with a frank bloody haematoma or a mass of scar tissue indicating an organizing haematoma. In my view drainage should always be used.

The management of the stump after operation will determine the extent

of the development of oedema. For the past six years I have employed a rigid plaster of Paris " dressing " and noted a decrease in oedema formation. The recent development of immediate post-operative fitting techniques have reinforced this observation. It seems clear that if stable pressure relationships are established between the stump and the " dressing " (plaster) then venous drainage is aided and oedema reduced if not eliminated (Burgess, 1966). The technique requires care, some knowledge of prosthetic principles and a complete avoidance of any proximal constriction. Considerations of this kind are important as failure to heal necessitates a re-amputation rate of the order of 20 per cent.

Once again I must emphasize strongly the importance of flexion deformities. One cannot avoid the conclusion that too often the flexion deformity is associated with prolonged ill-supervised bed rest prior to amputation. It is heart-breaking to see a patient with a below-knee amputation, obtained as a result of several months in hospital and an elaborate vascular operation, with a soundly healed stump but presenting with a crudely shaped tibial end blanching the skin and firmly established flexion deformities of hip and knee precluding any prosthetic management. I almost hesitate to mention the value of fracture boards under the mattress, but do so because their absence is all too often a major factor in the production of flexion deformities. The injudicious use of pillows under the knee is also to be condemned. If arterial surgery is considered then these matters require further emphasis solely because of the increased time spent in bed. It is imperative that the atherosclerotic patient when admitted to hospital is submitted to a programme of aggressive evaluation and treatment.

If the patient has already suffered from an amputation of one limb then this will bear directly on the selected level of amputation for the other. It is a complicated problem which has been well covered by Vitali and Harris (1964). It is sufficient here to say that if the patient has been fully rehabilitated following the first amputation, e.g. above-knee, then, all other factors considered, an amputation at a lower level, e.g. below-knee, may be a viable proposition. If, however, the above-knee amputee has never walked you will do him a disservice by performing a below-knee amputation. A through-knee or above-knee amputation will serve him sufficiently well to allow him to walk with rocker pylons when a long-leg management may well be impossible. A careful assessment of the patient's fitness and morale is required prior to operation.

In all these considerations reference has been made to skills which are not necessarily surgical. The author recommends strongly that the amputating surgeon realizes that the stump has no valid existence on its own and that to become functional a prosthesis is necessary, thereby implicating other disciplines. It is earnestly hoped that the surgeon will consider himself as a member of a team including, at least, the patient, the

limb-fitter, the physiotherapist, the nurse and the doctor specializing in the prosthetic field. As such I hope that he will involve all the members of the team as soon as possible to ensure a dynamic approach to a problem which for the patient is compounded of bewilderment, mutilation, often hellish pain and the frustration of ignorance.

Our object is clear—the patient should be returned to his own home without pain and able to walk and enjoy life in some degree with a measure of independence.

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II. EMERGENCY AMPUTATIONS

A. LOWER LIMB

by

H. Osmond-Clarke

THE OBJECT OF an emergency or provisional amputation, in the context in which we are discussing it in this symposium, is to save the life or to preserve the health of an individual by excising a damaged or a diseased limb. An important point to remember is that an emergency amputation is usually a provisional step and therefore it should be done at the lowest level consistent with viable tissues, so that when healed an elective amputation can be done at the best site. This is fundamental. Here I would underline what Mr. Murdoch has just said: the sites of election are through the interphalangeal joints, the toes, the metatarso-phalangeal joints, the metatarsals, the tarso-metatarsal and mid-tarsal joints, the Symes's through the ankle joint, the 6 inches below the upper border of the tibia for a below-knee amputation (or at the musculo-tendinous junction of the triceps surae), through the knee, and above the knee about 11 inches below the tip of the greater trochanter.