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Amputation for antipersonnel mine injuries of the leg: preservation of the tibial stump using a medial gastrocnemius myoplasty

ROBIN M COUPLAND FRCS
Surgeon

British Red Cross Society; International Committee of the Red Cross

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Summary

Antipersonnel mines are very commonly used in modern warfare. They produce a recognisable pattern of injury to the leg, which frequently spares the gastrocnemius muscle. Surgical amputation is often indicated. Medial gastrocnemius myoplastic below-knee amputation is suitable for these injuries. The technique permits cover and preservation of an acceptable tibial stump.

Introduction

The International Committee of the Red Cross (ICRC) has surgical hospitals for the wounded of many wars in developing countries. Injury by antipersonnel mines are universal during and after these conflicts, affecting both combatants and civilians. By design, the victims are often not killed but permanently disabled.

A surgical amputation is planned because of traumatic amputation, life-threatening infection or injury so severe that the limb cannot be salvaged *(1,2)*. The highest operative priority is excision of all non-viable tissue and foreign material. The amputation must be closed after an interval of 4 or 5 days. Conventionally, stump acceptability is considered later. The described technique of medial gastrocnemius myoplastic amputation takes into account the particular pattern of leg injury, involves complete wound excision at the time of initial surgery and gives an acceptable stump after delayed closure. It is most useful when the tibial stump is near minimum length or there is a loss of proximal skin.

In developing countries the basic prosthetic facilities do not permit through-knee amputation *(3)*. Above-knee amputation is the only alternative to an unsatisfactory, short, below-knee amputation. Every effort must be made to preserve the tibial stump and a functioning knee joint. This may be the factor which determines the patient's ability to earn a living and so maintain his whole family. The ICRC runs workshops in many countries where local employees are instructed in the manufacture of prostheses from locally available materials.

Correspondence to: Mr R M Coupland, 8 Belvedere Place, Norwich NR4 7PP

The injury

The victim of an antipersonnel mine receives a typical pattern of injuries. Whilst walking, he triggers the mine and receives a traumatic amputation or severe injury of the contact foot. Mud, grass and fragments of mine, shoe or foot are blown up into his genitals, buttocks and contralateral arm.

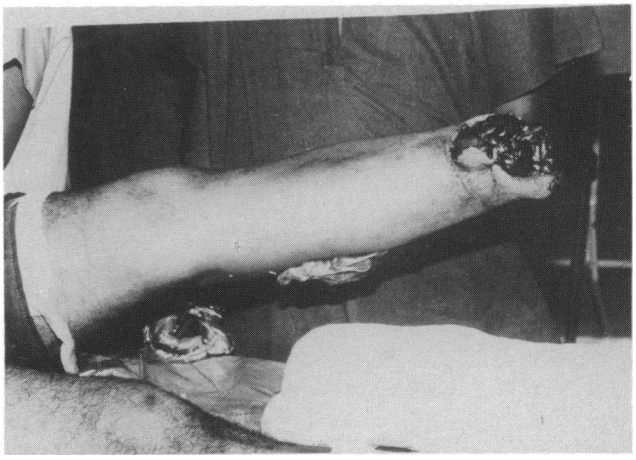

FIG. 1 Traumatic amputation of the left foot by antipersonnel mine.

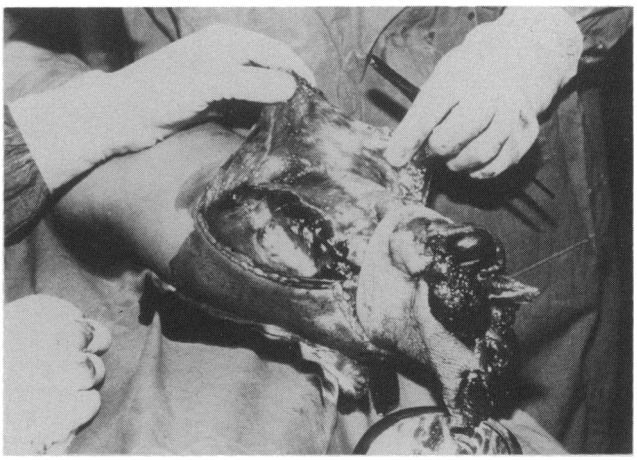

FIG. 2 Equal anterior and posterior skin flaps have been cut and are being reflected. The extent of proximal contusion is evident.

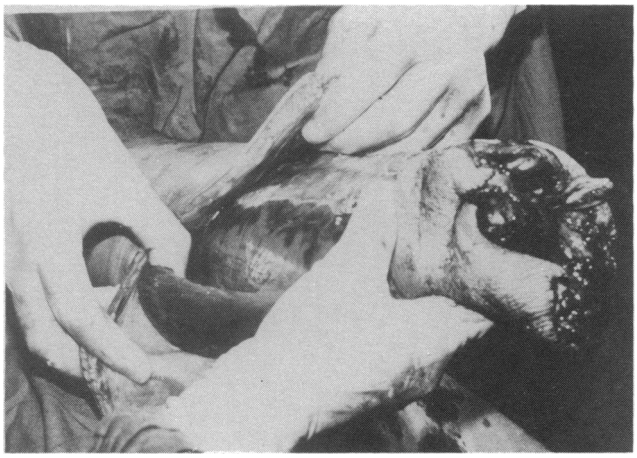

FIG. 3 The surgeon is demonstrating the intact medial gastrocnemius muscle being separated from the deeper, contused muscle.

When the lower tibia is shattered by explosive injury there is considerable, proximal soft tissue damage *(4)*. In particular, muscles of the anterior, lateral and deep posterior fascial compartments are severely contused and contaminated (Figs. 1,2). Skin loss is variable. The gastrocnemius muscle tends to be spared in such injuries (Fig. 3).

A medial gastrocnemius myoplastic below-knee amputation applicable to antipersonnel mine injuries

APPLIED ANATOMY

The anatomy of the medial gastrocnemius muscle explains its preservation in landmine injuries of the leg and its use in their management. It arises from the medial femoral condyle and supracondylar ridge, having no attachment to the tibia. The bulk of soleus and the long flexors separate it from the tibia and it is not contained in a tight fascial compartment. The muscle lends itself to myoplasty, being easily separable from the deep fascia and underlying soleus muscle. It is longer than the lateral gastrocnemius, and when extensively mobilised remains viable as the blood and nerve supply enter near its origin. This mobilisation permits greater utilisation of the muscle's length and breadth. The tibial stump is more easily covered by muscle if the myoplasty is placed from medial to lateral and not posterior to anterior as in other myoplastic below-knee amputations. It has an aponeurotic deep surface which holds sutures well. In a fit young man it is a bulky muscle.

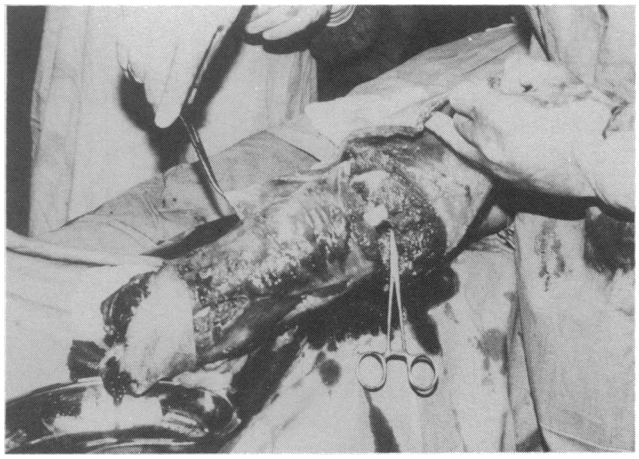

FIG. 4 The tibial and fibular sections have been made and the muscle of the anterior, lateral and deep posterior fascial compartments have, by necessity, been divided at the same level. The tendinous part of the medial gastrocnemius is held by artery forceps.

OPERATIVE TECHNIQUE

The medial gastrocnemius myoplastic below-knee amputation is shown (Figs. 1–7). The resuscitated patient is given an anaesthetic and a pneumatic thigh tourniquet is applied before the field dressing is removed. The intact skin is cleaned. All non-viable skin is excised. The remaining skin is incised, with deep fascia, as equal anterior and posterior flaps and reflected proximally (Figs. 2,3). The flaps are frequently determined by the injury. The level of tibial section is determined by the remaining soft tissue. All muscles are divided, near the elected level of tibial section or above if the injury so dictates. The medial gastrocnemius is the only muscle left distal to the tibial section (Fig. 5). Standard techniques are used for section of bone and division of nerves and vessels. The wound is washed with saline and a bulky dry gauze dressing applied, which is not removed until delayed closure.

At delayed primary closure the medial gastrocnemius is separated vertically from the lateral gastrocnemius

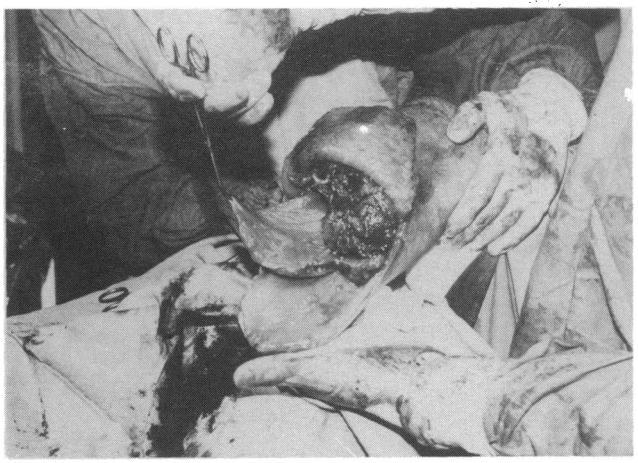

FIG. 5 The amputation at the end of initial surgery. The skin flaps and the medial gastrocnemius muscle, in the artery forceps, are the only structures left distal to the bone section.

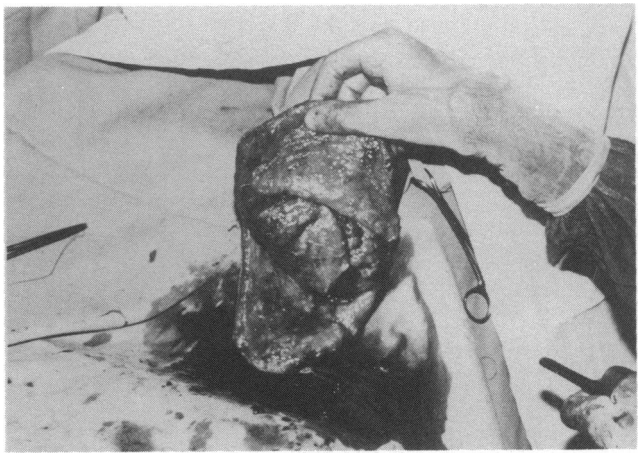

FIG. 6 The amputation at the time of delayed primary closure. The medial gastrocnemius has been flapped across the tibial section. The skin flaps will approximate independently.

FIG. 7 The amputation after delayed primary closure.

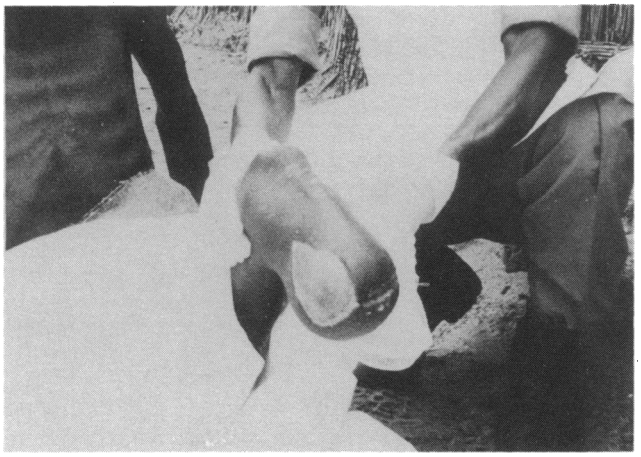

FIG. 8 Photograph of a myoplastic below-knee amputation of the left leg taken 1 week after delayed closure. There was considerable skin damage and both anterior and posterior flaps were deficient medially. The myoplasty has been placed over the tibia and left exposed.

and mobilised by proximal blunt dissection. The muscle easily covers the tibial section (Fig. 6) and its aponeurotic deep surface is sutured to periosteum or deep fascia with a fine absorbable suture. Alternatively, it can be held in place by a monofilament suture passed through the skin and tied over a 1 cm piece of drain.

The skin is closed with minimum tension (Fig. 7). When one or both of the flaps are insufficient the skin is approximated where possible and the myoplasty, placed to cover bone, is left exposed (Fig. 8). A split-skin graft is applied then or at a later date which may subsequently be excised when the postoperative swelling has settled and the muscle wasted.

Discussion

Whatever method of amputation is used, the injury determines the skin flaps and the level of bone section by the degree of soft tissue damage. At delayed closure of a standard amputation, muscle approximation may not be possible because it is too short in relation to the bone, or is too oedematous, and therefore achieving adequate stump soft tissue cover is difficult. Failure of delayed primary closure is due to wound infection or incorrect initial surgery. A common operative mistake is to leave insufficient soft tissue in relation to bone. To achieve cover a higher bone section is necessary. In the period between amputation and delayed closure transected muscle swells, becomes friable and so does not readily hold sutures. In the same period the skin retracts up the stump. It is stressed that the swelling of transected muscle is considerable and must be accounted for at initial surgery. The practice of placing a few large tension sutures to hold a compress between the flaps to prevent skin retraction is dangerous; it causes strangulation of skin and muscle. A long posterior myocutaneous flap is rarely feasible under these conditions as the injury involves the skin and tendinous gastrocnemius that would form the tip of the flap. Wound infection of a standard amputation usually results in exposure of bone.

Medial gastrocnemius myoplastic below-knee amputation is only possible when the gastrocnemius muscle is left intact by the injury. Its division is not necessary at the time of initial surgery and so it does not become oedematous and friable. There are many advantages of this method of below-knee amputation in war surgery. A stump which permits knee function above a prosthesis can be fashioned when there is insufficient soft tissue to do so by conventional methods. Closure of skin flaps or remaining skin is not dependent on the myoplasty in contrast to a long posterior myocutaneous flap. Bone exposure and subsequent chronic infection are less likely should the wound break down *(5)*. When, due to the injury, there is insufficient remaining skin for complete closure, the length of the tibial stump can be maintained by leaving the myoplasty exposed. A theoretical advantage is the proprioception that is brought to the stump.

The disadvantages relate to the positioning of the suture line or skin graft over a weight bearing part of the stump. This is usually unavoidable and is determined by the original wound.

Surgical follow-up in the situations where the ICRC is working is not feasible. Statistical results cannot be included as the technique evolved through trial and error, with a personal experience of approximately 150 antipersonnel mine injuries from three separate conflicts. Many required lower limb amputation. A few were suitable for the described amputation. No myoplasty became necrotic after delayed closure and, although wound infection was common, bone was never exposed. The author can give no account of long-term difficulties with this technique. Many stumps of conventional below-knee amputations for war injuries have been seen in the process of healing or with complications, and the results of the myoplastic amputation are not obviously inferior. The technique is recommended for below-knee amputation in war surgery when preservation of a good tibial stump is difficult.

The use of the medial gastrocnemius myoplastic amputation may have application in civilian surgery when there is a shortage of healthy distal soft tissue and a tibial stump of acceptable length is important. A similar technique, the skew amputation, has proved useful in arteriopathic patients *(6)*. The amputation described here involves a more extensive mobilisation of the medial gastrocnemius so it can be used to cover the bone section and as a substitute for deficient skin flaps.

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Notes on books

Anorectal Malformations in Children: Update 1988 edited by F Douglas Stephens and E Durham Smith. 604 pages, illustrated. Alan R Liss, New York. $150.

An international team of specialists in paediatric surgery contribute 25 chapters on anorectal malformations in the young. The editors, both from The Royal Children's Hospital, Melbourne, write about half of these. Detailed and authoritative, the book will appeal to paediatric surgeons and others who work in this highly specialised field.

Pancreatic Transplantation edited by Carl G Groth. 413 pages, illustrated. W B Saunders, Philadelphia. £50.00.

It may not be widely known to readers that the first clinical pancreatic transplant was performed as long ago as 1966. The graft worked for some two months. Throughout the late 1960s and 1970s small numbers of transplants were performed, but during this decade the numbers have risen dramatically, some 300 being carried out during 1987. The success rate is currently about two out of three. Against this background the editor has collected a team of international contributors, all experts in the field, to give an authorative state-of-the-art volume. Essential reading for all involved in this advancing field.

Contributions from St Mark's Hospital. Sesquicentennial Volume 1835–1985 edited by C V Mann. 590 pages, illustrated. Edition Nymphenburg Publishers, Munich. £50.00.

Coloproctologists the world over are aware of the enormous contributions that have been made to this specialty by the staff of St Mark's Hospital in London. This small specialist hospital recently celebrated its 150th Anniversary and the articles reprinted in this book represent some of the best and most important of the publications appearing during the last 50 years. Fifteen chapters, each covering a different topic, are contributed by the present staff and thirty-six historic papers are reproduced in their entirety.

This book is more than a mere history. It is an extremely useful review of many aspects of current thought in coloproctology and is recommended to trainees and established colorectal surgeons alike.

Surgery of the Foot and Ankle by Kenneth A Johnson. 303 pages, illustrated. Raven Press, New York. $162.50.

A single-author text giving a personal view of surgery of the foot based on his experience at the Mayo Clinic. Easy to read and attractively produced. The colour illustrations, which include many photographs, are particularly noteworthy and worthy of study.

Microsurgery of the Skull Base by Ugo Fisch and Douglas Mattox. 669 pages, illustrated. Georg Thieme Verlag, Stuttgart. DM 440.

Between 1967 and 1985, 1500 operations were performed on the skull base in the ENT Department of the University Hospital in Zürich. This impressive atlas of surgical technique reflects the enormous experience gained by the senior author when performing these operations. Many of the illustrations are based on line drawings carried out personally by Dr Fisch at the end of an operation and are supplemented by numerous high-quality colour photographs and X-ray reproductions. The printing is on thick glossy paper, elegantly laid out and in folio format. It will be an essential addition to the library shelves of ENT departments throughout the world.

Kidney Transplantation: Principles and Practice edited by Peter J. Morris. 3rd edition. 788 pages, illustrated. W B Saunders, Philadelphia. £56.50.

In the four years since the last edition of this book there have been many advances in renal transplantation necessitating a major revision of almost every chapter. In particular there is considerable expansion in the section devoted to immunosuppression, and chapters have been added on the immunopathology of rejection and the use of fine needle aspiration cytology. Already a classic in its field, this new edition will enhance its reputation even further and will be obligatory reading for all who wish to keep abreast of this ever-expanding subject.

Gastroenterology. Volume 2, Number 2. Peptic Ulceration edited by D W Piper. Illustrated. Baillière Tindall, London. £15.00.

Eight chapters on various aspects of peptic ulceration, the longest by far being that on anti-ulcer drugs. H_2 receptor antagonists, site protective agents, prostaglandins and analogues, omeprazole and antacids each have separate authors and are considered in detail. Eril Amdrup contributes the chapter on surgery and its sequelae.