

AMPUTATIONS OF THE LOWER LIMB: A MULTIDISCIPLINARY CONSENSUS

J Clasper

On behalf of the Lower Limb Trauma Working Group, Academic Department of Military Surgery & Trauma, Royal Centre for Defence Medicine, Birmingham

Introduction

As part of the development of the Academic Department of Military Surgery & Trauma (ADMST) the Defence Professor of Surgery has established four multi-disciplinary Working Groups in the Department. One of the roles of these Working Groups is to examine published evidence, gain cross specialty consensus and establish guidelines to inform an evidenced based military surgical practice. It is the intention that outcomes from the groups will be published as they report.

The Limb Trauma Working Group (LTWG) is a multidisciplinary group of Trauma and Orthopaedic, Plastic and Reconstructive and Vascular surgeons. On 16th May 2007 a meeting was held by the LTWG to discuss field amputations and with additional input from the Defence Medical Rehabilitation Centre at Headley Court (DMRC), civilian orthopaedic surgery from Selly Oak Hospital as well as orthopaedic and burns and plastic surgical nursing the following recommendations have been made.

These relate to the initial management of unreconstructable limb injuries and not to the definitive management in a base hospital.

In addition there are plans for the LTWG to review other aspects of limb trauma, the results of which may impact on these recommendations. Further developments and updated recommendations will be reported at a later date.

Pre-operative

When a traumatic amputation has occurred, or when a completely ischaemic limb remains attached by minimal soft tissue only, the decision to amputate is straightforward. In other circumstance the decision is much more difficult. Limb salvage scores have been described (1), but it is the panels' view that existing scores lack the specificity and sensitivity to determine the need for amputation in the military casualty. Several of the scores are designed for use in the ischaemic limb and most are unreliable when applied to the heavily contaminated military wounds that may be associated with other injuries, mass casualty situations and delays in presentation. This will be the focus of a specific study of the ADMST, the results of which will be published at a later date.

Traditionally lack of sensation on the sole of the foot has been considered a significant factor in the decision, but a recent study has reported return of sensation in over 50% of patients with neurological dysfunction, and advised that this should not be used as a criterion for limb salvage (2). The neurological and vascular status of the limb must be documented, together with the indications for amputation. It is widely accepted that whenever

possible a second opinion should be sought and documented prior to amputation.

Adequate documentation is vital, and ideally, pre and post amputation pictures should be obtained and for military patients the images included with the records for evacuation. In addition, unless the resulting delay would compromise the care of the casualty, radiographs may help to identify significant proximal contamination as well as the extent of bony injury may influence limb salvage (3).

Recommendations

- 1 - **The examination findings, together with the indications to amputate the limb should be documented.**
- 2 - **Existing limb salvage scores should NOT be used to determine the need for amputation.**
- 3 - **Whenever possible the decision to amputate a limb should be confirmed by a second surgeon.**
- 4 - **All wounds should be photographed.**
- 5 - **Radiographs should be obtained prior to amputation.**
- 6 - **Neurological dysfunction (particularly numbness of the sole of the foot) should NOT be part of the criteria used to decide amputation.**

Operative

All significant military limb wounds should be debrided, the aim of which is to excise all foreign and non-viable tissue, to reduce the subsequent infection risk. This includes amputations, and during debridement, viable tissue must not be excised to perform the amputation at an optimal site – this is performed at the time of delayed primary closure.

In general medial and lateral longitudinal incisions should be used to allow adequate exposure, but this is dependant on individual circumstances, particularly pre-existing wounds (Figure 1).

At initial debridement all viable tissue should be preserved even if bone length appears excessive, or excess soft tissue is present. This is to avoid compromising definitive closure, particularly if further skin or soft tissue necrosis occurs. Definitive flaps should not be performed at the initial debridement. This may result in the excision of viable tissue, which could be required for definitive wound closure, particularly if further excision is required or non-standard flaps are necessary. This is irrespective of whether the casualty is an allied serviceman, who will be rapidly evacuated or local personnel who may be retained in hospital until definitive closure.

The panel were unanimous on this view, despite it appearing to be at odds with the International Committee of the Red Cross (ICRC) (3-5), and other humanitarian surgical organisations (6) as well as US Forces operating in a humanitarian role (7). Their view may be related to the lack of local facilities, and the inability to evacuate casualties treated in ICRC or other humanitarian hospitals and lack of access to plastic and reconstructive surgeons.

Correspondence to: Lt Col J Clasper DPhil DM
FRCS(Orth) FIMC DMCC RAMC, 20 Hilder Gardens,
Farnborough, Hampshire, GU14 7BQ
email: jonclasper@aol.com

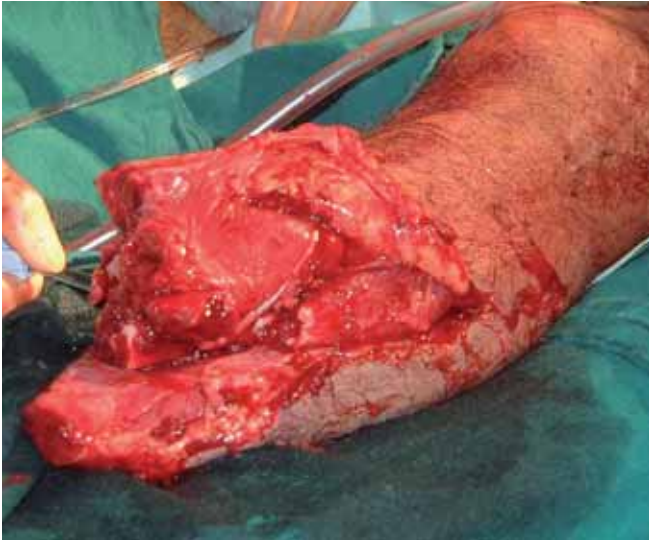


Figure 1 – Initial military trans-tibial amputation – non-viable tissue excised at lowest possible level with medial and lateral longitudinal extensions, all tissues have been cut at separate levels, no attempt has been made to create a definitive flap, and bone has not been left protruding.

This view would be consistent with the view of other authors who advocate preserving maximum soft tissue and bone (8-9). As with the soft tissues, the bone should not be cut at the proposed site of definitive amputation.

It was the view of the panel that excising bone more proximal than soft tissue may damage the vascularity of the distal soft tissue and compromise subsequent wound closure. Any bone protruding beyond soft tissue will require excision and the absence of soft tissue attachments will have compromised its blood supply and predispose to infection. This view is also at odds with the ICRC (3-5), and other humanitarian surgical organisations (6) who advocate performing the definitive bone cut at initial surgery, but conforms to the view that no flaps should be created at initial debridement. The optimal bone level will be determined at the time of definitive closure not at the initial operation, with consideration to maximising functional recovery, with remaining viable tissue.

When the foot remains viable, debridement of the wound, rather than amputation should be performed. Amputation, if appropriate, can be carried out following evacuation to a base hospital. This approach retains the possibility of reconstruction, even when significant foot injuries have occurred (8). When local facilities preclude complex reconstruction and evacuation are unavailable then initial amputation may be more appropriate.

Previously guillotine amputations were commonly performed in the military environment (6). A guillotine amputation is defined as skin, soft tissue and bone all cut at the same anatomical level utilising a circumferential skin cut. The panel believed that it would be very unlikely that all tissues will have been injured at the same level, and therefore either viable tissue has been unnecessarily excised (particularly skin), or deeper tissue has been inadequately debrided (particularly muscle, and following mine injury).

A guillotine amputation is not significantly quicker than an amputation excising non-viable tissue and foreign material if flaps are not fashioned at the primary operation. In addition subsequent stump fashioning can be technically challenging following a guillotine amputation. The panel therefore did not believe that guillotine amputations should be performed in the military environment. This is in agreement with the recommendations of the International Committee of the Red Cross (3), as well as the Leonard Cheshire Centre of Conflict Recovery (6), and members of the US Forces (7).

An exception to this guidance may be considered if the

amputation is required for extraction of a trapped casualty when access to the patient and limb is limited.

Difficulties may be encountered when a fracture is present, and traditionally teaching would be to amputate at the level of the fracture site. However, the panel disagreed with this and felt that viable bone distal to a fracture site may be reduced and fixed at definitive closure to allow for a better functional outcome, and, therefore, as long as bone was viable it should be preserved (Figure 2). Articular fragments should not be excised if soft tissue attachments remain. As with the fashioning of flaps this appears to



Figure 2 – Healed Y distal intercondylar fracture of the femur in a through-knee amputee following limited internal fixation. Had the limb been amputated at the fracture site a trans-femoral amputation would have resulted in significantly reduced function (Courtesy of DMRC, Headley Court).

be at odds with the ICRC (3-5). Again this may be related to the lack of local facilities, to perform open reduction and internal fixation of fractures at the time of definitive closure.

Following debridement, no part of the wound should be closed at the initial operation. Even if closed without tension, post-operative/injury oedema will occur and this may result in soft tissue swelling, ischaemia and necrosis (Figure 3). Bone does not have to be covered by soft tissue at the time of the initial debridement, instead soft tissue can be folded across and a moist dressing applied. Although successful primary closure has been reported (10) this was a retrospective review, with rapid evacuation, in a selected group of casualties, performed by experienced surgeons.

This view is in agreement with the recommendations of the International Committee of the Red Cross (3), Leonard Cheshire



Figure 3 – Soft tissue (skeletal muscle) closed at initial debridement and trans-tibial amputation. This was done to avoid exposed bone, but the resulting ischaemia will require further excision and may compromise definitive closure and impair function as require further amputation at a more proximal level.

Centre of Conflict Recovery (6), and members of the US Forces (7).

It is commonly believed that sutures should be inserted to minimise skin retraction. As has documented previously (5) skin retraction does occur, but was not felt to be a significant problem by the panel, and can be addressed at definitive closure. Attempts at closure to avoid retraction at initial debridement may result in ischaemia of deep tissues and further swelling resulting in further skin loss (Figure 4).

Recommendations

7 - The site of amputation should be at the lowest level possible.

8 - Guillotine amputations should not be performed.

9 - No fashioning of flaps at initial debridement.

10 - Bone should be cut at the most distal soft tissue levels.



Figure 4 – Skin sutured over stump resulting in soft tissue swelling giving a bulbous appearance. This may result in unnecessary loss of soft tissue.

11 - Amputation should not be carried out at the level of any fracture unless this is the appropriate skin/soft tissue level.

12 - No part of the wound to be closed at initial surgery.

13 - No attempt to be made to prevent skin retraction.

Definitive amputation

The panel discussed the place of the through-knee amputation. It was confirmed that modern prosthetics result in a better functional result than a trans-femoral amputation, and the cosmetic result is acceptable. Although it has been reported that through-knee amputation result in a worse outcome when compared to above-knee (11), others have stated that the more distal the level, the better the walking independence and functional outcome, and have noted that disarticulations result in end-bearing stumps (12). This opinion was confirmed by the DMRC at Headley Court.

The distal femoral condyles should not be excised, and Gritti-Stokes technique of attaching the decorticated patella to the distal condyles should not be performed (Figure 2).

Recommendation 14 - Through-knee amputation is acceptable if appropriate.

References:

1. Bosse MJ, McCarthy EJ, Kellam JF et al. A prospective evaluation of the clinical utility of lower extremity injury-severity scores. *J Bone Joint Surg* 2001; **83-A**: 1-14.
2. Bosse MJ, McCarthy ML, Jones AL et al. The insensate foot following severe lower extremity trauma: An indication for amputation? *J Bone Joint Surg* 2005; **87-A**: 2601-8.
3. Coupland RM. Technical aspects of war wound excision. *Br J Surg* 1989; **76**: 663-7.
4. Coupland RM. Amputation for antipersonnel mine injuries of the leg: preservation of the tibial stump using a medial gastrocnemius myoplasty. *Ann R Coll Surg* 1989; **71**: 404-7.
5. Dufour D, Kromann-Jensen S, Owen-Smith M, Salmela J, Stening JF, Zetterström. *Surgery for Victims of War*. 3rd Ed 1998, ICRC Geneva.
6. Mannion SJ, Chaloner E. Principles of war surgery. *Br Med J* 2005; **330**: 1498-1500.
7. Parr RR, Providence BC, Burkhalter WE, Smith AC. Treatment of lower extremity injuries due to antipersonnel mines: Blast resuscitation and victim assistance team experiences in Cambodia. *Mil Med* 2003; **168**: 536-540.
8. Selmanpakoglu N, Güler M, Sengezer M, Türegün M, Isik S, Demirogullari M. Reconstruction of foot defects due to mine explosion using muscle flaps. *Microsurgery* 1998; **18**: 182-8.
9. Khan MI, Zafar A, Khan N, Saleem M, Mufti N. Outcome of tissue sparing intervention in mine blast limb injuries. *J Coll Phys Surg Pak* 2006; **16**: 773-6.
10. Ate alp AS, Erler K, Gür E, Solakoglu C. Below-knee amputations as a result of land-mine injuries: comparison of primary closure versus delayed primary closure. *J Trauma* 1999; **47**: 724-7.
11. MacKenzie EJ, Bosse MJ, Castillo RC et al. Functional outcomes following trauma-related lower-extremity amputation *J Bone Joint Surg* 2004; **86-A**: 166-1645.
12. Pinzur MS, Gottschalk FA, Pinto, Magde S, Smith DG. Controversies in lower-extremity amputation. *J Bone Joint Surg* 2007; **89-A**: 118-1127.

Members of the Limb Trauma Working Group: Surg Cdr M Midwinter (Defence Professor of Surgery), Lt Col N Bennett, Lt Col P Hill, Lt Col P Parker, Wg Cdr I Sargeant, Surg Cdr S Stapley, Maj N Tai

Other Members of Consensus Panel: Capt K Brown, Lt Col J Etherington, Lt Col S Jeffery, Lt Col A Kay, Capt C Layfield, Lt Col R Russell, Flt Sgt L Thurlow