

**ASSESSMENT OF THE OUTCOME OF
LOWER LIMB AMPUTATIONS AS SEEN
IN
KENYATTA NATIONAL HOSPITAL.**

A ONE YEAR PROSPECTIVE STUDY.

A DISSERTATION SUBMITTED IN PART FULFILMENT FOR THE
REQUIREMENTS OF THE DEGREE OF MASTER OF MEDICINE IN
SURGERY, UNIVERSITY OF NAIROBI.

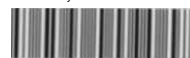
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By

DR. KIRSTEEN ONDIKO AWORI
M.B.,Ch.B. (Nairobi]

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DECLARATION.

This dissertation is my original work, and has not been presented for a degree in any other University.

Date: _____ day of _____, 2004

DR KIRSTEEN ONDIKO AWORI

(M.B.,Ch.B. (NAIROBI)

CANDIDATE.

This dissertation has been submitted for examination with my approval as the University supervisor.

Signature: _____ Date: _____ day of _____, 2004.

PROFESSOR JOHN E.O. ATING'A,

M/B, Ch.B., M.Med (SURGERY) (Nairobi), MCH, ORTHO (Liverpool).

CONSULTANT ORTHOPAEDIC SURGEON, KENYATTA NATIONAL

HOSPITAL AND

ASSOCIATE PROFESSOR. DEPARTMENT OF ORTHOPAEDIC SURGERY,

FACULTY OF MEDICINE, UNIVERSITY OF NAIROBI,

P.O. BOX 30197-00100 GPO, NAIROBI, KENYA.

DEDICATION

To my wife Victoria.

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LIST OF ABBREVIATIONS

AK	Above knee
AKA	Above-the-knee amputation
BK	Below knee
BKA	Below-the-knee amputation
DVT	Deep vein thrombosis
ELISA	Enzyme-linked immunosorbent assay
EWA	Early Walking Aid(s)
FBC	Full blood count
HBsAg	Hepatitis B surface antigen
HIV	Human immunodeficiency virus
KNH	Kenyatta National Hospital
LLA	Lower limb amputation(s)
PEM	Protein Energy Malnutrition
PVD	Peripheral vascular disease
TLC	Total lymphocyte count
UEC	Urea electrolytes and creatinine

SUMMARY

This study was designed to assess the outcome of lower limb amputations as managed at the Kenyatta National Hospital.

A prospective analysis of consecutive patients who underwent lower limb amputations at the Kenyatta National Hospital between July 1st, 2003 and June 30th, 2004 was performed. Data on the management and outcome were collected using questionnaires administered to the patients while admitted and in the follow-up clinics. The main outcome measures were the duration of hospital stay, duration of wound healing, need for operative revision, need to convert to a higher amputation level, degree of mobility and the thirty-day postoperative mortality.

A total of 74 patients (46 males) underwent 77 lower limb amputations. The mean age at operation was 44.4 years (range 7 months - 96 years). Ninety one percent were major amputations; 42 AKA (3 bilateral), 24 BKA and 4 hip disarticulations. Open amputations comprised 23% of the total. Extremity gangrene due to peripheral vascular diseases was the main indication for amputation (55%). Anaemia was the most common co-morbid condition (27%) followed by diabetes (18%), while stump infection was the commonest complication (33%). The thirty-day mortality rate was 13.5%. The healing rate for BKA was significantly less than for AKA, with a 21% rate of eventual conversion of BKA to AKA. Most of the patients (70%) were ambulating on crutches. The average duration of hospital stay was 29.3 days. There was no patient who was using a prosthetic limb during the study period.

INTRODUCTION

Amputation is the removal of an extremity in whole or in part, while disarticulation is amputation through a joint.¹

HISTORICAL BACKGROUND

Amputation is one of the most ancient of all surgical procedures. It was also a common punishment in some societies on religious grounds.

Early in the 16th century, amputation surgery and prosthetics were much improved by Ambroise Pare. Pare created more functional stumps and was the first to use ligatures to control bleeding after amputation. Morel introduced the tourniquet, and with the development of anaesthesia and aseptic technique, surgeons could carefully fashion sturdy and functional amputation stumps and reasonably anticipate healing without infection.^{2,5} Without true anaesthesia, it was not possible to perform other than the Guillotine-type amputations. It was Younge and Loudham's addition of a shot flap in 1679, which made closure easier. Today, Guillotine-type amputations are performed on grossly contaminated or infected limbs prior to definitive flap amputation, with control of the sepsis.¹³

EPIDEMIOLOGY

Incidence and prevalence.

Rates of lower extremity amputation vary significantly both between and within countries due in part by variations in clinical decision making.⁴ There are no statistics on incidence and prevalence of amputations in Kenya.^{5,6} Denmark has a National registry with more accurate data on amputations. The overall annual incidence quoted is 25.5 per 100,000 population. Published estimates in the United States of America put their annual incidence at 20,000 to 30,000 and prevalence at 350,000 to 1 million.⁷ A study comparing the epidemiology of lower extremity amputations in centres in Europe, North America and Asia by The Global Lower Extremity Amputation Study Group found the highest incidence rate at the Najavo area (U.S.A.) at 43.9 per 100 000 population per year, while Madrid, Spain had the lowest rate at 2.8 per 100 000 per year, for first major amputation in men.⁸

Age and sex incidence

Mbindyo⁹ in a seven-year retrospective study between 1970 and 1976 on lower limb amputations in KNH, found two peaks in age incidence; a teenage peak mainly due to trauma and osteogenic sarcoma and another one at 50 years and above, due to vascular diseases. The Global Lower Extremity Amputation Study Group, found age and sex distribution to be similar, despite great variation in the overall rates in the centres the study was carried out. The incidence of both major and minor amputations in both men and women rose steeply with age; the largest increases being between 40-59 and 60-79 years. Overall amputation rates were higher in men than in women except in one centre where crude rates were higher in women than men.

INDICATIONS

European and American literature site peripheral vascular insufficiency as the main indication for lower limb amputations.^{114,9} Mbindyo³ in a study of LLA at the KNH however, found neoplasms followed by trauma as the main indications. Similar results, were reported by Hassan¹⁰ in a retrospective study conducted at the Maiduguri Teaching Hospital in Nigeria. The pattern seen in studies conducted in the African setting has been attributed to late presentation of patients with malignancies partly due to poverty, stigmatisation of amputees and the eventual inability to afford a prosthesis, therefore making limb-preserving surgery impossible. Over the years however, there has been an increase in peripheral vascular diseases with or without diabetes in our setting , which is likely to have altered the above pattern.^{6,1114}

1. Trauma

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Injuries related to road traffic accidents (RTA) are the leading causes of LLA.

Other traumatic causes include, industrial and farm accidents, assaults and burns.

The injuries to extremities that necessitate amputation are usually associated with

complete damage of the main blood and /or nerve supply of the extremity. When

discussing massive lower extremity trauma, the prototype injury is the severe open

tibial fractures.^{1,13} Gustillo et al ¹⁶ sub classified these type (iii) open fractures to

better differentiate on basis of prognosis the outcome of these injuries. Type (iii)c

fractures are those associated with arterial injury requiring repair.

Caudle et al¹⁷ found that long-term results were poor with type (iii) c fractures of the tibia, and that most limbs (78%) eventually required amputation. Lange¹⁸ has shown that in extreme cases, the criteria of prolonged ischaemia (of more than six hours) and/or absent posterior tibial nerve function, are absolute indications of LLA. He however, found out that majority of patients do not fit the absolute criteria yet a decision to salvage or amputate the limb has to be made. He therefore, came up with a categorised system of patient variables like age and occupation, extremity ones like location of vascular injury and the associated variables like warm ischaemia time, to be used in decision making. Various authors have come up with a number of scoring systems to help determine which limbs can be salvaged and the ones to be amputated.^{19,20} Dirschl et al²¹ reviewed these systems and while they appreciated that all the systems have short-comings, and that none has been validated in studies involving large numbers of patients, they recommend their use, preferably the mangled extremity scoring system (MESS), as guides to the treatment of mangled lower extremities, but cautioned substituting these systems for the treating physician's clinical judgment and experience. In making the decision to salvage or to amputate a limb, the surgeon must also give strong consideration to the functional outcome and the cost of limb salvage attempts, as compared with amputation.²² Few published studies however, have directly compared the functional outcome and the hospital cost of early amputation and limb salvage in the lower extremity.^{15 26}

Bondurant et al²⁴ showed a definite cost saving if the decision to amputate can be made early in the treatment of major extremity trauma. Hansen²⁷ came up with similar conclusions and goes on to state that old patients, patients with multiple injuries, patients who have been in shock and those suffering from diabetes or other vascular diseases who generally have a smaller chance of survival and successful reconstruction of a badly damaged limb, should preferably be amputated. Williams²⁸ on the other hand looks at the long-term costs of salvage versus amputation and considers the cost of modern prosthetic devices to make amputation in some patients a more expensive treatment option during their lifespan versus the Ilizarov technique. He however, finds this technique to be very labour intense and to increase total treatment time.

(2) Neoplasms

Benign tumours rarely require amputation, but occasionally one is so large or is of such a nature that excising it locally would result into a functionless limb. For malignant tumours, amputation is done in the absence of metastatic spread or sometimes indicated even after metastatic spread has occurred to relieve pain or as a toilet procedure.^{2,3,5}

Studies performed in Africa, have found advanced skin cancers, especially squamous cell carcinoma as the leading cause of lower limb amputations followed by osteosarcoma of the femur and tibia.^{5,10} This pattern has been attributed to late presentation of patients suffering from skin cancers.

Up to the recent past, amputation has been the most common surgical treatment for osteosarcoma of an extremity.^{11,29} In most anatomical sites, the amputation is done through the bone or joint that lies proximal to the bone in which the tumour is developing. However, when the tumour is in the distal part of femur, some authors have recommended a trans-medullary amputation with neo-adjuvant and/or adjuvant chemotherapy.^{11,29,31} Limb salvage resection has recently become more popular than when it was first developed, and it is often chosen by patients who have osteosarcoma.^{12,14,32} Enneking et al¹³ came up with a system of staging musculoskeletal sarcoma. Based on this system, different varieties of tumour excision techniques have been described, from radical excision (disarticulation at proximal joint above the affected bone) wide and marginal excisions, to intralesional amputation. Although all authors agree that the primary tumour should be removed, there is controversy regarding the appropriate surgical margin and the indication for, or against limb salvage resection as compared with amputation.^{29,31,33} Some authors have recommended a wide en bloc surgery with neoadjuvant or adjuvant chemotherapy for high-grade malignant sarcomas among the several forms of treatment.^{33,34} Lane et al³⁴ have found that while limb-salvage procedures that use endoprosthetic implants are being performed more frequently, even in the best of circumstances, anywhere from 15-25% of patients with osteosarcoma still require amputation to achieve disease-free surgical margin.

3. Ischaemia

This is usually related to arteriosclerotic disease with or without diabetes.

Other causes include, thromboembolic disease and in our setting, trauma cases with delayed presentation resulting in compartment syndrome.³ It should be remembered that both arteriosclerosis and diabetes mellitus are systemic diseases that tend to occur in the elderly; making it of necessity to evaluate the status of the heart, kidneys and the cerebral circulation in this category of patients before surgery. Amputation is indicated in these patients either because of failed salvage vascular surgery or due to late presentation. Majority, present with rest pain, neuropathy, sepsis or gangrene of an extremity. These patients are a challenge to the surgeon because primary wound healing is a the main objective. However, due to lack of oxygen and nutrients delivered to tissues and therefore poor neo-vascularisation in granulation tissue, the wound heals slowly and also, there is reduced resistance against infection. Co-existent poor cardiac function and respiratory disease and anaemia or limb infection makes the situation worse.¹

4) Infection

Infection necessitating amputation may be acute or chronic, and must have been unresponsive to medical or other surgical measures. Fulminating gas gangrene is the most dangerous. Hyperbaric oxygen therapy may eliminate need for amputation or make amputation level more distal in this condition. In chronic infections, amputation is indicated because function has been so impaired by chronic osteomyelitis or an infected non-united fracture, that amputation and prosthetic fitting will improve function and allow more normal activities.^{1,3}

(5) Congenital

Surgical excision of part or all of a congenitally deficient limb may be indicated in infancy or early childhood, as a primary conversion for those conditions whose natural history is so well known that the surgeon can predict better prosthetic use and overall function after surgery; like in complete fibular hemimelia or tibia hemimelia.

In other conditions such as proximal femoral focal deficiency, surgery may be best performed as a secondary conversion after a period of prosthetic fitting around the deformity has proved that prosthetic use and overall function will be better after surgery. Almost 50% of congenital lower limb deficiencies will require either primary or secondary conversion.²

CHOICE OF AMPUTATION LEVEL

The most important requirement for successful amputation is skin healing, preferably by first intention. A major surgical effort should be directed to creating a 'stump' that is able to tolerate total contact and partial end-bearing. The ideal levels in the lower limb are those that allow an element of weight bearing. The decision about the level and type of amputation should not be taken during operation, since the degree of bleeding noted on incision of tissues at operation is a very poor guide to subsequent healing, being greatly affected by anaesthetic agents and transient hypotension.^{3,35}

Knee preservation affords greater mobility after rehabilitation.³⁵

Considering the increased energy consumption required to use a prosthesis, pre-existing medical conditions such as severe respiratory or cardiac disease, neurological problems, the presence of previous amputation (which now makes a patient a bilateral amputee), and the ability of the tissues to heal adequately enough to allow weight bearing, may make prosthetic fitting an unrealistic goal. Therefore, all the factors influencing outcome including physical and mental capacity of the patient to withstand re-amputation, and whether the patient is likely to make use of the increased mobility that a joint-saving amputation may afford should be considered in the final decision.^{3,36}

FACTORS IN LEVEL SELECTION

1. Prosthetic fitting

In the past, the case of fitting the limb for a prosthetic was a major factor. However, with the steady advance in material and design of prosthetics this is less so. It is also important to note that not all amputees are prosthetic candidates. The so-called 'ideal' stump, which rarely exists, consists of adequate length, sufficient strength, adequate proprioception, and full joint range of motion, sufficient nerve supply, intact circulation and sufficient skin sensation.³

Enough stump length allows for adequate leverage of the stump within the socket. It also ensures a more intimate socket fit during ambulation and sitting because the stump will maintain its socket position. Very short stumps have a tendency, particularly during sitting, to partially slip out of the socket, which then causes stump replacement problems when the patient stands to walk. The stump must have sufficient muscle strength within it to enable the patient achieve a stable and efficient gait through controlled forward motion of the socket and the ability to carry the weight of the prosthesis.³

2. The indication for amputation.

Amputations for malignancies in most anatomical sites, are done through the bone or joint that lies proximal to the bone or compartment in which the tumour is developing. For trauma however, you aim generally at a site as distal as possible, subject to the possibility of fitting a usable prosthesis. The open type of amputation is done when there is sepsis or gross wound contamination and the level chosen is through the healthy tissue, with fashioning of the flaps later when sepsis has settled.³

Ischaemia offers a great challenge to the surgeon. However, the site should be a balance between removing non-viable tissue and proximal a site sufficient enough to allow wound healing.^{2,3}

By and large, the indication for amputation is the main determinant of the level.

3. Nutritional status.

Mullen et al³⁷ found malnutrition to be rampant among surgical patients, while Dickhaut

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et al³⁸ have shown that even sub-clinical malnutrition makes wound healing slow. In addition to socio-economic deprivation, disease, injury and some diagnostic tests and even medical and surgical treatment may adversely affect patient's nutritional status.

Laboratory and anthropometric measurements have been used to calculate body composition.^{39,40} The triceps skin fold is used to estimate caloric fat reserve while serum protein deficiency is determined by measuring the levels of serum albumin, transferrin, pre-albumin or retinol binding protein. Serum albumin is used more frequently because of its ready availability and multiple physiological functions. Levels less than 30 grams/litre imply serum depletion. Total lymphocyte count (TLC) on the other hand, is an important indicator of the degree of anergy associated with malnutrition and loss of immune-competence as measured by anergy to recall antigens. Values less than 1500 lymphocytes/cm³ on the full blood count, are associated with anergy. Kay S.P. et al³⁹ in a study of 41 patients who underwent LLA proximal to the Syme level, showed using serum albumin levels and TLC, that malnutrition adversely affects the prognosis for healing of LLA, but it seems to be less detrimental to wound healing of the more proximal amputations.

Due to the increased risk of sepsis and poor healing in malnourished patients undergoing distal LLA, pre-operative diagnosis of PEM enhances the surgeons ability to accommodate the high risk of stump failure or correct malnutrition as part of the patient management.

METHODS OF DETERMINING THE LEVEL OF AMPUTATION.

1. Clinical assessment

Clinical judgement has the accuracy of 85% in the hands of an experienced surgeon in determining the level of amputation.⁴¹⁴²

The skin to form the amputation flap must be viable. Signs of demarcation, fixed staining or anaesthesia of the flap skin are obvious contraindications to its use. Excoriation, cellulitis and frank ulceration are relative contraindications, subject to adequate treatment of the infection. Subcutaneous tissues and muscle must be healthy, as the presence of deep tenderness or loss of function may signal necrosis of deep muscles or sepsis. The absence of a pulse at the next proximal palpation point has been said to be a contraindication to more distal amputation and vice versa, but this is certainly an unreliable sign.^{3'43}

2. Use of diagnostic tests to determine level of amputation.

Because of recent interest in preserving the knee joint and a significant failure rate of wound healing after the BKA, numerous non-invasive tests have been proposed as objective methods of assessing likely non-healing after various amputations.

These tests include transcutaneous oxygen tension measurement, doppler ultrasound, digital plethymography, fluorescein dye studies and Xenon 133 clearance.

There is no doubt that in the hands of enthusiasts, these techniques can allow the correct choice of amputation site in a larger proportion of cases than is probably achieved by clinical judgement alone.³ Tanzer et al⁴⁴ reported the accuracy of fluorescein dye studies in predicting amputation healing in BKA to be 85%. Oishi⁴⁵ in evaluating a number of these tests, concluded that transcutaneous oxygen tension measurement was the most accurate with sensitivity of 90%. Doppler studies have long had their proponents, but other studies have refuted the accuracy of this measurement in predicting the success of an amputation.⁴⁶ Moore⁴⁷ reported on the use of radioactive Xenon to measure pretibial blood flow in the skin. This method requires special radionuclear equipment and has therefore, not gained extensive clinical use.^{48,49} Despite transcutaneous oxygen tension measurement being probably the most valuable, no single technique has been shown to be sufficiently superior to the other, to attain widespread acceptance . In summary, these techniques require some degree of technical expertise not readily available in many hospitals.³

Arteriography and Duplex ultrasonography.

Arteriography is the gold-standard investigation for peripheral arterial disease.⁵⁰

While it gives an anatomical representation, it does not assess the functional obstruction presented by stenotic lesions. Because atherosclerotic lesions are often eccentric, the angiographic appearance may be misleading, especially only if unipolar views are obtained.⁵¹

The use of Duplex ultrasonography to assess peripheral arterial stenoses using the peak systolic velocity ratio (PSVR) across the lesion has been described, and is reliable in the aortoiliac and femoropopliteal regions in comparison with arteriography. Using this study however, there are occasional difficulties in differentiating between very tight stenoses and total occlusion.^{50,51} Kohler⁵¹ concluded that a normal duplex study virtually excludes significant occlusive disease (negative predictive value of 93%).

POST-OPERATIVE MANAGEMENT AND REHABILITATION

Many people regard amputation of a limb as a catastrophic disability; one which produces a profound emotional response due to its effect on the body image as well as a serious loss of functional ability. Therefore, it is crucial to managing prospective amputees that counselling be given prior to amputation on the possibilities of functional restoration and outlook for the future. The success of the procedure depends on the input of a multidisciplinary team and close liaison with the surgeon. The patient's knowledge of the rehabilitation process improves participation and helps determine outcome goals.²

1. Wound and stump management.

There are considerable differences in opinion on the dressing, bandaging and prosthetic fitting of amputation stumps. These differences stem from experiences of different specialists dealing with either predominantly amputations performed for vascular disease or for non-vascular conditions, and the management of these groups should probably be different.³

The dressings used are classified as either soft or rigid (plaster):

a). Soft dressing

This involves use of sterile gauzes and fluff, then an elastic bandage for compression of the stump. Some surgeons however, avoid compression in vascular disease as this may produce skin necrosis through tourniquet effect, or are used once wound healing is assured. The dressing is best left undisturbed if at all is well, and is viewed earlier if there is any sign of infection.³

Gentle exercises, should be encouraged by the physiotherapist within the limits of pain. The stump should be left until primary wound healing is well underway, usually two weeks or more, before trying a few steps under supervision in a pneumatic pylon or an early walking aid (EWA) to regain bipedal balance. Subsequent progression to an adjustable training prosthesis encourages early learning of correct gait with moulding and shrinkage of the stump and the final prosthesis can be fitted by six weeks.^{3,53}

b) Rigid dressing.

In this type, a plaster cast is moulded over the stump in theatre, and mobilization is commenced on the second day on pylon. Proponents of this type of dressing site better control of stump oedema and prevention of complications related to orthostasis as its advantages. The cast is changed usually by day 14 for BKA and Syme amputation, unless there is excessive pre-operative oedema or in obese patient; and day 7 to 10 in AKA and hip disarticulation. Stitches are removed at this opportunity.^{48,54}

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2. Exercises

Physical therapy activities start immediately following amputation surgery and exercise intensity gradually increases in order to prepare the patient for gait training and independence in activities of daily living. Exercise tolerance and energy consumption are interlinked with the patient's cardiovascular system and the body's metabolism. Patients with a peripheral vascular disease therefore, have to be monitored carefully to avoid undue fatigue following exercise. The amputee's basic needs include sitting, standing and walking balance.

These objectives can be achieved by selective general exercises for trunk and upper extremity strengthening, specific stump exercises and exercises for the remaining leg. The exercises are done at individual level or as a group to increase the amputee's morale especially after discharge from the hospital.

The physical therapist can apply other modalities to promote wound healing, to reduce stump pain, to provide the amputee with a feeling for body coordination, to increase circulation, and to encourage proprioception. These modalities include: Transcutaneous electrical nerve stimulation, use of vibrators, hydrotherapy, ultrasound, ultraviolet radiation, whirlpool and frictions.⁵⁵ In the KNH, physical therapy is often delayed and the exercise program is erratic, however, due to the relatively younger patients, outcomes are adverse.

3. Transfers.

These involve the earliest attempts to getting the patient out of bed. A firm bed permits correct body alignment and positioning. A soft mattress encourages a hip flexion contracture when the patient is supine, which will give the patient a stooped position when he is upright. Prone lying while resting is intended for the AK amputee. The overhead T-bar is generally not favoured because pulling on the bar strengthens the biceps rather than the triceps, which are necessary for use of any aids required for ambulation. Without this bar, any movements in bed strengthen these muscles. It is however, useful in bilateral amputees having difficulties attaining sitting position or when decubitus ulcers are a problem, when one arm can be used to hold the bar while the other acts as a pushing arm.⁵⁵

The most ideal chair for an amputee is an amputee wheelchair with the axis of the rear wheels set back to compensate for body weight loss in the front. The chair should have a firm sitting surface for pelvic support to prevent a pelvic drop and spinal scoliotic compensation, both which can lead to fixed contractures. The AK amputee merely needs a square sitting board, while the BK amputee needs a board with an extension, either left or right, and a spring mechanism under the extension, which will allow the board to be in a flexed or extended position.⁵³ Early walking aids (EWA) allow the patient to stand and start walking early with the physiotherapist. These aids can assist in control of stump oedema, improve standing and walking balance and morale. The maximum pressure allowed with the commonly used pneumatic post amputation mobility (PPAM) aid is 40mmHg. The stump should be examined before and after use of the aid. The amputation mobility aid (AID) allows knee flexion, and the femurette is used by patients who have had trans-femoral amputations and as an assessment tool.⁵³

4. Gait training

This is an indispensable phase in amputation rehabilitation that is preceded by an intensive and conditioning program. A controlled prosthetic gait is the safest; requires the least amount of energy output; and is, therefore, the most efficient. Although one always analyses and strives to improve gait, one has to realize that moderate gait deviations are acceptable provided the gait is safe and requires a minimum amount of energy consumption. These deviations may have been part of the amputee's previous gait habits.⁵⁵

5. Prostheses

Pylons have been superseded by EWAs, and early prescription of a modular prosthesis, cast as soon as wound healing or stump maturation has been achieved. Gait re-education and prosthetic supervision for adjustment to socket fit to accommodate the stump volume changes are essential.⁵³

Prosthetic development

Significant developments in prosthetic hardware have occurred, especially for younger and more active patient. Modern materials (e.g. flexible thermoplastic and urethane) and designs (e.g. total contact or suction) have been used in fabrication of sockets and liners. Knee mechanisms, incorporating pneumatic or hydraulic swing phase control in gait or the use of microchips and Energy storage feet have been developed. For elderly dysvascular patients, however, simpler but lighter and modular components are recommended. If necessary, an automatic knee lock should be incorporated for safety in prostheses to be used by patients who have had trans-femoral amputations. Other advances include the use of prostheses for activities such as running, golf or water sport or for cosmesis.⁵³

OUTCOME ASSESSMENT

The assessment of outcomes has been made necessary by the dramatic increase in health care costs and practice-pattern variations.⁵⁶ The outcome measures include generic measures; which are used to assess health status or health-related quality of life, condition-specific measures that are used to assess aspects of a specific condition or body system and measures of satisfaction used to assess various components of care for instance quality of care, health care delivery, patient-centred model of care and continuous quality improvement.⁵⁷

Following amputation, quality of life is assessed using variables such as the use of prosthesis, level of independence and the degree of ambulation⁵⁸ through specific mobility measures such as the Harold Wood- Stanmore Mobility Grades or the recently revised Special Interest Group Amputee Medicine (SIGAM) grades.⁵⁹ Since these disability tools are used to assess outcome in a walking amputee who is using a prosthesis, they are not applicable to majority of our patients who cannot afford these gadgets. Measures of satisfaction used include variables such as operative mortality, follow-up, survival, time to incision healing, secondary operative procedures for wound management and conversions to a higher level of amputation.^{58-59-60,61-62}

COMPLICATIONS OF AMPUTATIONS.

1. General complications

It is important to note that many elderly patients undergoing amputations have concurrent cardiac or pulmonary disease that affects the general and surgical management.

Amputations are also associated not only with social stigma, but also functional disability that makes the patient anxious about the surgery. Psychological preparation, examination and investigation for cardiac, pulmonary and renal reserve especially for elderly patients, should be done routinely to reduce intra-operative and post-operative morbidity.

Risks related to general anaesthesia such as aspiration, heart dysrhythmias, anaesthetic drug-related complications or even death have fortunately been reduced with advances in anaesthesia that include the use of regional techniques. Post-operative problems such as pneumonia, deep vein thrombosis and pulmonary embolism, dementia in the elderly can be prevented by early ambulation and prophylactic treatment."

2. Local complications

Early pre-prosthetic complications.

These include primary haemorrhage and haematoma formation usually due to venous oozing. Skin ulcers and flap necrosis occur due to delayed healing of the surgical incision especially in amputations performed for peripheral vascular disease. If the necrotic area is less than half of an inch wide, healing by secondary intention is usually sufficiently rapid to obviate the necessity for further surgery. Larger areas however, require surgical closure through wedge resection or re-amputation. Sometimes skin sloughing is only superficial and, a revision is not necessary other than a split thickness skin graft.'⁶³⁻⁶⁴

Infection, is usually due to *Staphylococcus aureus*, but other organisms such as *Clostridium spp.*, may be found particularly in ischaemic limbs.

Phantom sensations are experienced by nearly every amputee, and usually disappear over a period of months to years, especially if the prosthesis is worn regularly. Phantom pain in contrast to phantom sensation, does not normally occur after amputation. Phantom pain may be precipitated or intensified by any contact, not necessarily painful, with the stump or with the trigger area on the trunk contralateral limb or head. Nothing needs to be done about phantom sensations except reassurance to the patient. Phantom pain management on the other hand is challenging, but good stump care and psychological therapy is what is necessary initially. In a few instances, local excision of neuromas or myoplastic stump revision is done especially in cases where there are areas on the stump, which trigger phantom pain and which respond to local anaesthetic/steroid injections, but consistently recur.^{63,64} Disabling cases require complete psychological and physical evaluation including use of diagnostic tests such as local nerve blocks and differential spinal anaesthesia. Use of drugs such as Amitriptyline at bedtime, has been found to provide restful sleep. Elliott et al⁶⁵ found Carbamazepine to be useful in the management of patients who have disabling phantom symptoms. Other modalities of treatment include transcutaneous or direct electrical stimulation of nerves, which acts by spinal afferent nerve traffic modulation.⁶⁶

Stump oedema is common in amputation stumps that are not treated with rigid plaster dressing in the pre prosthetic period. Maintenance of a compression wrap on the stump, replaceable every six hours until a definitive prosthetic fitting is advised. Other methods include elastic stockinette drawn on the stump or using air inflated air boots.⁶⁴

Late pre-prosthetic complications.

These include adherent scar, stump neuroma, contracture and bone spur formation.

Adherent scar, is prevented by fashioning of good skin flaps over bone cushioned well by muscle. Frequent use of massages daily by the therapist and the patient sometimes decreases the adherence by promoting the development of subcutaneous fat. Some cases require wedge resection, and stump re-fashioning.⁶⁴ " Stump neuromas are common, but unless they lie under a point of pressure and a trigger is demonstrable, they rarely need excision. They can usually be managed by appropriate alterations in the prosthetic socket to avoid pressure or traction to the lesion. When conservative treatment fails, the neuroma should be excised and the nerve should be divided at a more proximal level. Martini et al ⁶⁵ proposes use of tissue adhesive put at the nerve stump end and sealed with the perineurium to prevent neuromas. Contractures on the other hand are preventable with aggressive and early physiotherapy involving measures to achieve proper stump positioning, and exercises to strengthen muscles and mobilize the joints. Mild to moderate contractures are treated, by appropriate positioning of the stump, gentle passive stretching of the joints and strengthening muscles around these joints. Severe and fixed ones may require wedging casts or surgical release. Fifteen degrees of flexion contracture at the knee is the maximum that is permissible for a reasonable prosthetic fitting.⁶⁴

Bone spurs are usually palpable underneath the stump skin. If small and are not presenting any problem such as pain, they are not an obstacle to the fitting of a definitive prosthesis. They are thought to arise from retained periosteal tags in the distal stump as a result of uneven trimming of the periosteum with the bone during surgery. Very rarely, they necessitate resection in a healed amputation stump.⁶⁴

Other complications include excess stump bulbosity and osteomyelitis with formation of ring sequestra that usually presents as a chronic sinus in a healed stump.

Post-prosthetic complications.

Skin complications constitute the majority of complications associated with prosthetic use. They include skin blistering and breakdown to ulceration. Stumps with undue prominences, grafted or adherent skin are at risk. Treatment involves ensuring good circulation through massage and wrapping to prevent local oedema. Persistent stump oedema may result in the so called verrucose hyperplasia especially after BKA.⁶⁴

Bony overgrowth occurs to a greater extent in every amputation in children, and in 8-12% of patients, one may require one or more stump revisions. It is rare following congenital amputations, but never occurs after disarticulation. Terminal overgrowth of a sectioned bone is caused by the apposition of new bone and is not related to growth of the physis at the proximal end of the bone. Treatment is by surgical excision of excess bone and it may help if you cap the resected bone end with a bone graft. Amputee children may also encounter problems related to growth such as anterior bowing in BKA, and hemiatrophy of the pelvis associated with coxa valga and elongation of the lesser

• AS
trochanter in AKA.

STUDY JUSTIFICATION

Lower limb amputations are associated with increased morbidity and mortality and therefore have a negative socio-economic impact in this country. There is an increase in the incidence of lower limb amputations in Kenya despite efforts to contain the risk factors such as diabetes mellitus.

This study was set to provide a database on the outcome of lower limb amputations in this country on whose foundation, strategies aiming at reducing the morbidity and mortality among patients undergoing amputations can be made and also help improve the rehabilitation of these patients.

STUDY OBJECTIVES.

Main objective

This was to determine the outcome of lower limb amputations in the KNH.

Specific objectives

1. To establish the current pattern of indications of lower limb amputations as seen in the KNH.
2. To establish how the following management factors affected the outcome of lower limb amputations in the KNH:
 - a). Pre-operative preparation.
 - b). Indication of amputation.
 - c). Amputation level determination.
 - d). Post-operative care.

MATERIALS AND METHODS.

Study design and setting.

This was a descriptive one year prospective study carried out between July 1st, 2003 and June 30th, 2004 at the Kenyatta National Hospital, Nairobi, Kenya; the largest teaching and referral hospital in the country.

Data management.

Collection.

The study was approved by the Kenyatta National Hospital Research and Ethics Committee (KNH-ERC) before data collection. A pre-tested questionnaire was administered to consecutive patients by the author, once a decision to amputate a lower limb was made. Data collected included date of admission, details of pre-operative preparation, operative date and procedures. Other data included general and wound care in regard to complications, date of discharge and progress in terms of stump condition and mobility on follow up in the outpatient clinic.

All patients who were amputated at the KNH during the study period were included in the study. Criteria for exclusion from the study were: all patients who were operated outside the KNH and required either a revision procedure or conversion to a higher level, those who were lost to follow up before the stump wounds healed, and those operated on while admitted in the hospital amenity wards as the author could not be able to follow them up post operatively. There were no patients who declined to participate in the study. During data collection, whenever a conversion from one level of amputation to another during the same hospitalisation, the most proximal level was chosen for classification.

The Burgess long posterior flap technique⁴⁸ was used for closed BKA amputation. The timing for wound assessment was arbitrarily fixed by the investigator to fit in the hospital's discharge and clinic attendance routines. Six weeks was chosen for assessment of mobility based on the rehabilitation experience of Burgess⁴⁹ and Hanspal⁵⁴.

Sample size.

Recruitment involved prospective consecutive enrolment of patients who fulfilled the set eligibility criteria.

The sample size (n), was derived by the formula: $n > z^2 pq/d^2$

Where p is the proportion of patients undergoing LLA in KNH, d the confidence limit, $q=(1-p)$ and z is the standard deviation of the 95th percentile (1.96).

A confidence limit of 0.1 was used.

The sample size targeted was seventy six patients; from $(1,96)^2 \times (0.27 \times 0.73) / (0.1)^2$

Data analysis.

After the data were collected, the information was re entered into a coded data sheet, and entered into data editor of the Statistical Package of Social Sciences (SPSS) for Windows, version 11. Chicago, Illinois, U.S.A. 2001. Comparison between variables was performed by cross tabulation and Pearson's Chi square test. Time to incision healing was determined with the Kaplan-Meier method. A *P value less than 0.05* was considered significant.

Hospital management protocol

At the KNH, any patient who is to undergo surgery must have a full blood count or at least a haemoglobin level in emergencies, and urea, electrolytes and creatinine. Patients on whom arteriography is performed must have had the following prior investigations performed: FBC, UEC, LFTs, Elisa for HbsAg and HIV and a coagulation screen. A lipid profile is performed at the discretion of the managing surgeons. A Chest radiograph is performed on all patients with lower limb tumours who eventually are amputated, and is a requirement for all patients above sixty years who are to undergo surgery. Post-operatively, after ruling out stump sepsis, and especially those patients whose pathology does not require specialized care for instance traumatic amputations in young fit patients, are discharged with an option of being followed up at the nearest residential hospital for removal of sutures, other than the KNH surgical clinics, at the discretion of the managing surgeons. Patients admitted to the Amenity wards are managed by personal surgeons and are followed up in their private clinics.

Ethical considerations

1. Approval to carry out the study was granted by the Kenyatta National Hospital Ethical and Research Committee(KNH-ERC/01/1866 of 25th June, 2003).
2. Patients consented to take part in the study freely and voluntarily.
3. The information collected about the patients was kept confidential, and can be made available to interested party/parties only with permission of the investigator.

Study limitations

1. Discharge of some patients through the nearest health facilities made follow-up of some patients impossible.
2. Poor handling of patients' laboratory investigations records between the laboratories and the wards made some records go missing.
3. The follow-up period was not long enough to identify further morbidity and survival.
4. The study was limited to the KNH, therefore its outcome can not entirely be representative of what happens in the whole country.

Study definitions

Minor amputations refers to amputations distal to the ankle joint while Major amputations refers to those proximal to the ankle joint to the hip joint.

Below knee refers to a trans-tibial and 'Above knee' to a trans-femoral amputation plane.

Hip disarticulation refers to amputation through the hip joint.

Stump sepsis was defined by a stump, which clinically was discharging pus and/or had a positive bacteriological culture.

RESULTS

This chapter presents the results of the study on assessment of the outcome of lower limb amputations that was carried out at the Kenyatta National Hospital between July 1st 2003 and June 30th 2004.

A total of 91 patients underwent 94 lower limb amputations during the study period.

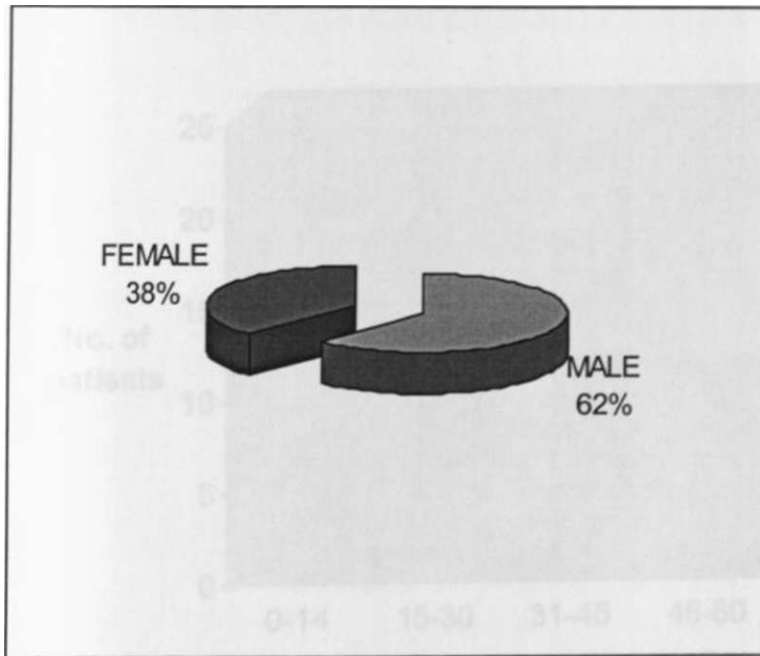
TABLE 1: EXCLUSION CRITERIA

PATIENTS EVALUATED		74
PATIENTS EXCLUDED FROM STUDY	Lost to follow up	8
	Private patients in Amenity wards	9
TOTAL NO. OF AMPUTEES OVER STUDY PERIOD		91

Seventeen patients were excluded from the study. Eight of these, were lost to follow up after discharge from the wards before stump wounds had healed, while nine were managed in the Amenity wards where they were under the care of private surgeons.

TABLE 2: SEX DISTRIBUTION OF THE PATIENTS

	FREQUENCY	PERCENTAGE
Male	46	62
Female	28	38
TOTAL	74	100

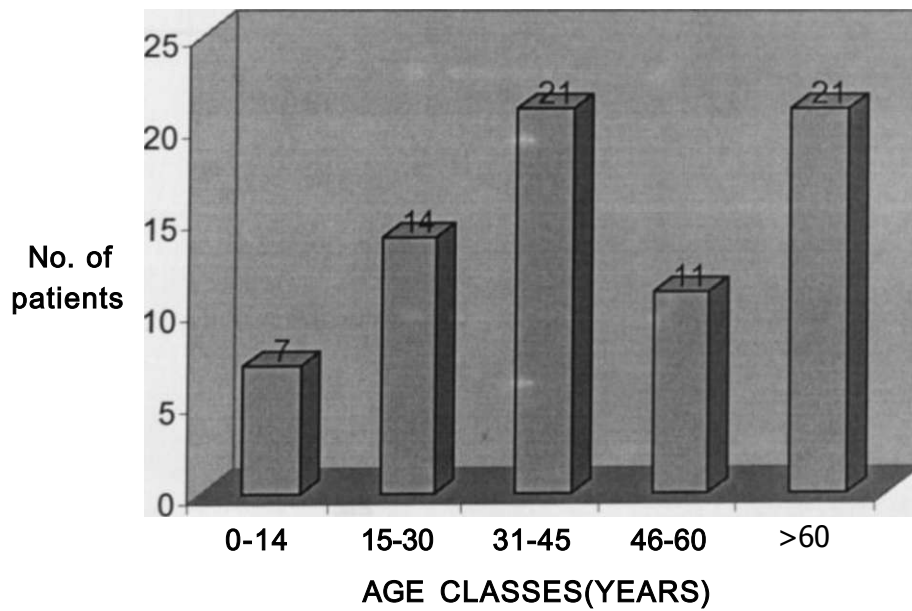
FIGURE 1: SEX DISTRIBUTION OF THE PATIENTS

Majority of the patients were male (62%), while females made 38% of the total study population.

TABLE 3: AGE DISTRIBUTION OF THE PATIENTS

AGE CLASS (YEARS)	0-14	15-30	31-45	46-60	>60
NO. OF PATIENTS (n=74)	7	14	21	11	21
PERCENT OF THE TOTAL	9	19	28.5	15	28.5

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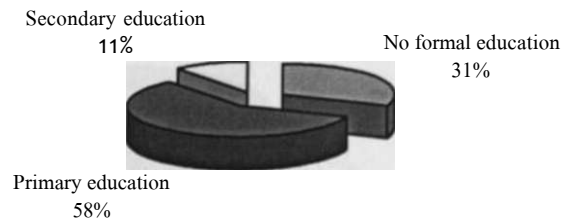
FIGURE 2: AGE DISTRIBUTION OF THE PATIENTS

The mean age of the patients was 44.4 years (range of 7 months to 96 years).

The distribution of patients was bimodal, with majority (28.5%) being in the 31-45 year and the 'over 60 years' age classes, followed by the 15-30 years age class.

TABLE 4: LEVEL OF EDUCATION OF THE PATIENTS

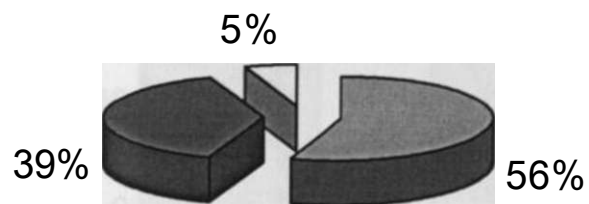
LEVEL OF EDUCATION	NO. OF PATIENTS
No formal education	23
Primary education	43
Secondary education	8
TOTAL	74

FIGURE 3: LEVEL OF EDUCATION OF THE PATIENTS

Most of the patients had primary education and below. Forty-three patients (58% n=74) had primary education while 23 (31%) had no formal education. The minority, 8 (11%) had secondary education and none with tertiary education.

TABLE 5: EMPLOYMENT STATUS OF THE PATIENTS

EMPLOYMENT STATUS	NO. OF PATIENTS
Unemployed	41
Self-employed	29
Formal employment	4
TOTAL	74

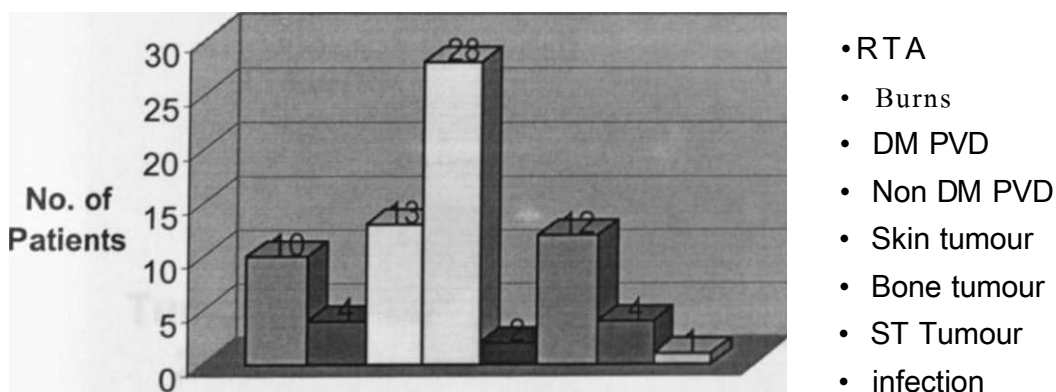
FIGURE 4: EMPLOYMENT STATUS OF THE PATIENTS

- Unemployed
- Self-employed
- Formal employment

Majority of the patients (56% n= 41) were unemployed. 39% were self employed in the informal sector and only 5% had formal employment.

TABLE 6: INDICATIONS FOR AMPUTATION

INDICATION	NO. OF PATIENTS	PERCENTAGE (n=74)
RTA	10	13.5
Burns	4	5.4
DM PVD	13	17.6
Non DM PVD	28	37.8
Skin tumour	2	2.7
Bone tumour	12	16.2
ST Tumour	4	5.4
Infection	1	1.4

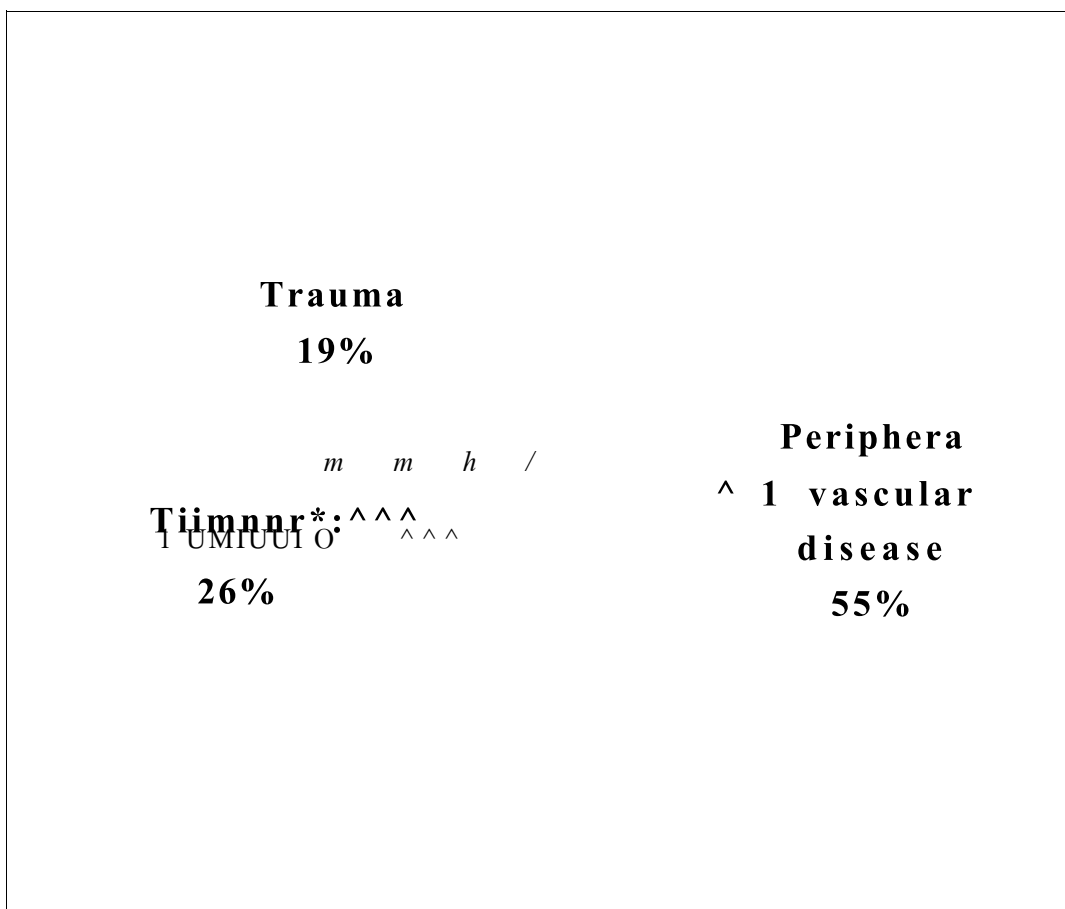
FIGURE 5: INDICATIONS FOR AMPUTATION.

KEY: 1 .RTA - Road traffic accident, 2. DM - Diabetes mellitus, 3. ST - Soft tissue.
4. PVD -Peripheral vascular disease.

Non diabetic peripheral vascular disease was the most common indication for amputation (37.8%) followed by diabetic peripheral vascular disease (17.6%) and closely by bone tumours, mainly osteosarcoma (16.2%). Traumatic amputations were mainly secondary to crush injuries from road traffic accidents (10%). Soft tissue tumours included Kaposi's sarcoma, rhabdomyosarcoma and liposarcoma. There was only one case of infection due to a necrotizing fasciitis of the leg that complicated to chronic osteomyelitis.

TABLE 7: AETIOLOGICAL CLASSIFICATION OF AMPUTATIONS

AETIOLOGY	NO. OF PATIENTS	PERCENTAGE (n=74)
Peripheral vascular disease	41	55
Tumours	19	26
Trauma	14	19

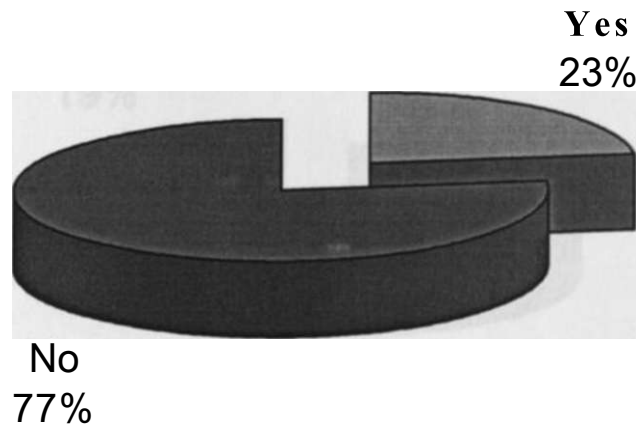
FIGURE 6: AETIOLOGICAL CLASSIFICATION OF AMPUTATIONS.

Forty one patients (55% n=74) were amputated due to peripheral vascular disease.

Twenty six percent of the amputations were due to tumours, while trauma contributed 19%.

TABLE 8: USE OF SURGICAL ANTIBIOTIC PROPHYLAXIS

SURGICAL PROPHYLAXIS	NO. OF PATIENTS	PERCENTAGE (n=74)
Yes	17	23
No	57	77

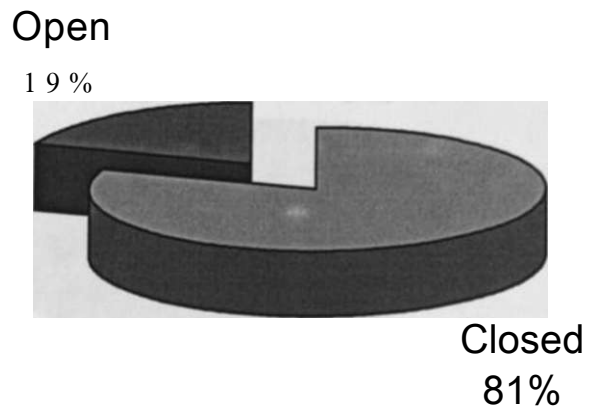
FIGURE 7: USE OF SURGICAL ANTIBIOTIC PROPHYLAXIS

No patient was administered with formal preoperative surgical antibiotic prophylaxis.

However, seventeen patients (23%) were on antibiotic treatment courses for either underlying sepsis or severe trauma before amputation surgery was performed.

TABLE 9: TYPE OF AMPUTATION

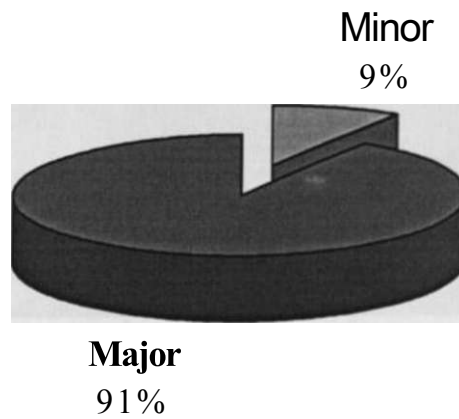
TYPE	NO. OF PATIENTS	PERCENTAGE (n=77)
Closed	62	81
Open	15	19

FIGURE 8: TYPE OF AMPUTATION

A total of 15 (19% n=77) open amputations were performed. Thirteen of these were for major amputations. Five open amputations were secondary to peripheral vascular disease, four due to tumours and the rest due to trauma and infection.

TABLE 10: CATEGORIES OF AMPUTATION LEVELS

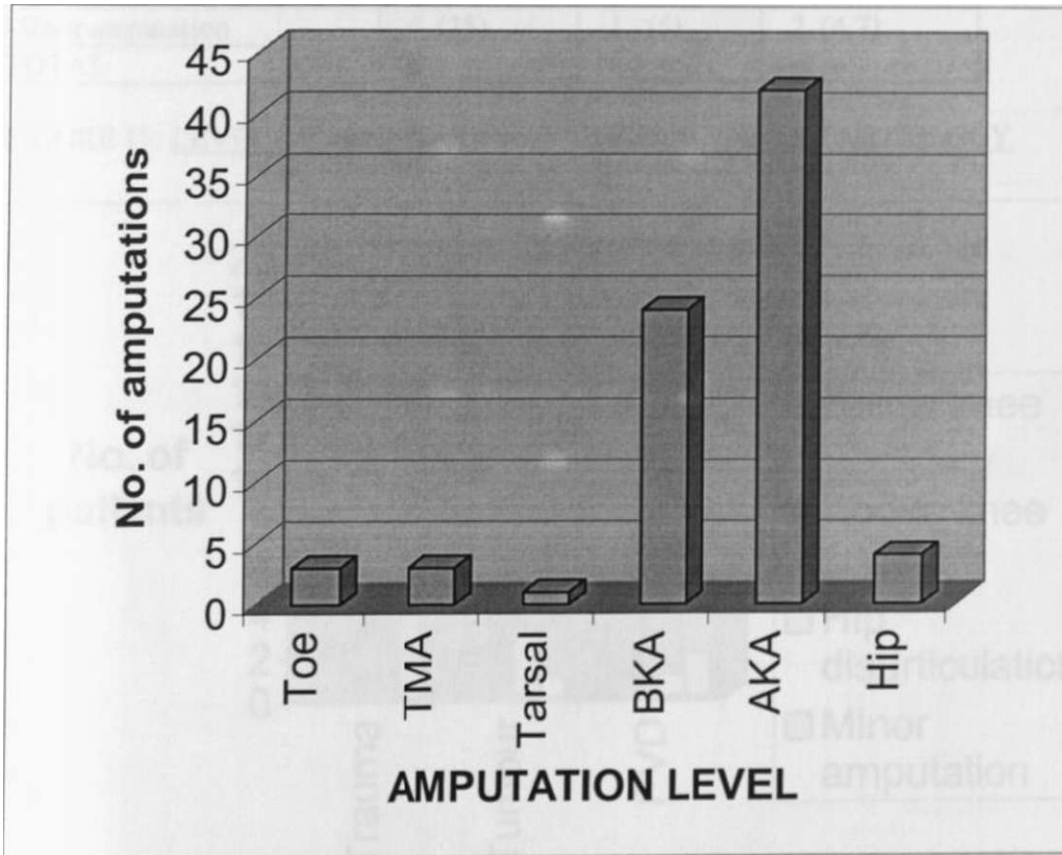
CATEGORY	NO. OF PATIENTS	PERCENTAGE (n=77)
Major amputation	70	91
Minor amputation	7	9

FIGURE 9: CATEGORIES OF AMPUTATION LEVELS

There were 70 (91% n=77) major amputations and 7 (9%) minor amputations. Three patients underwent bilateral major amputations.

TABLE 11: LEVELS OF AMPUTATION

LEVEL OF AMPUTATION	Toe	TMA	Tarsal	BKA	AKA	Hip	TOTAL
NO. OF AMPUTATIONS	3	3	1	24	42	4	77
PERCENTAGE	4	4	1	31	55	5	100

FIGURE 10: LEVELS OF AMPUTATION

Key: TMA- Transmetatarsal
 BKA- Below knee
 AKA- Above knee
 Hip— Hip disarticulation

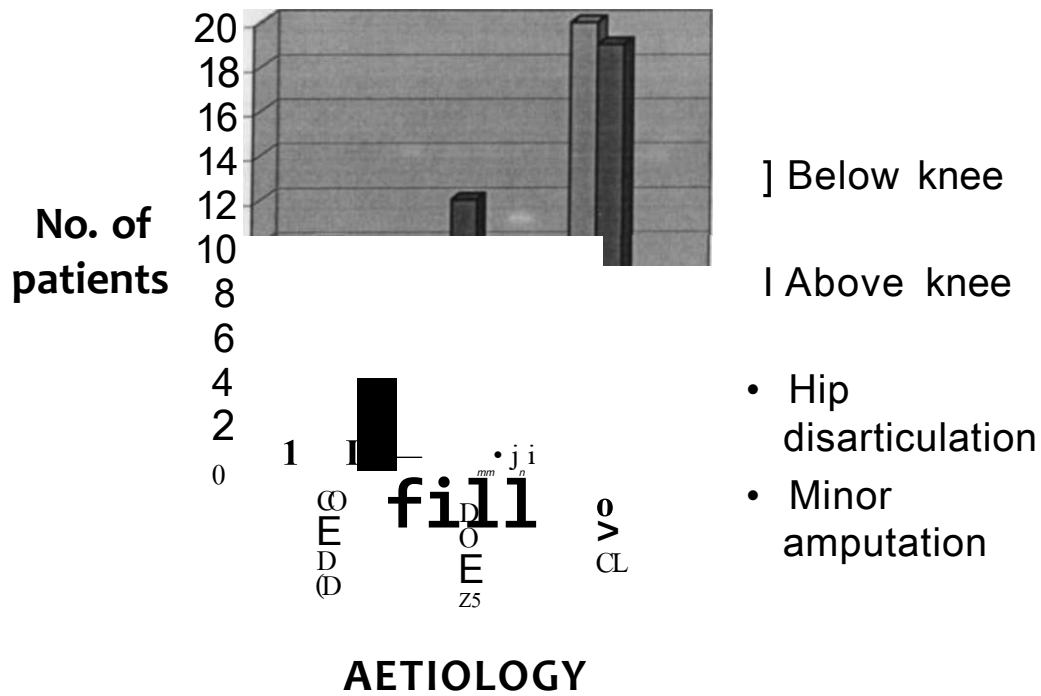
Forty-two patients (55%) underwent above knee amputation, 3 of which were bilateral.

Those who underwent below knee amputation were 31% and 5% had hip disarticulation.

The rest were minor amputations.

TABLE 12: LEVEL OF AMPUTATION ACCORDING TO THE AETIOLOGY

LEVEL OF AMPUTATION	AETIOLOGY/ NO. OF AMPUTATIONS (%)		
	Trauma	Tumour	PVD
Below knee	2(12.5)	2(11)	20 (47.6)
Above knee	10(62.5)	12(67)	19 (45.3)
Hip disarticulation	0	3(17)	1 (2.4)
Minor amputation	4 (25)	1 (5)	2 (4.7)
TOTAL	16	18	42

FIGURE 11: LEVEL OF AMPUTATION ACCORDING TO THE AETIOLOGY

Key: PVD- Peripheral vascular disease

Below knee and above knee amputations were performed almost equally in patients with peripheral vascular disease at 47.6% and 45.3% respectively. AKA was the main level for both trauma and tumour-related amputations (62.5% and 67% respectively).

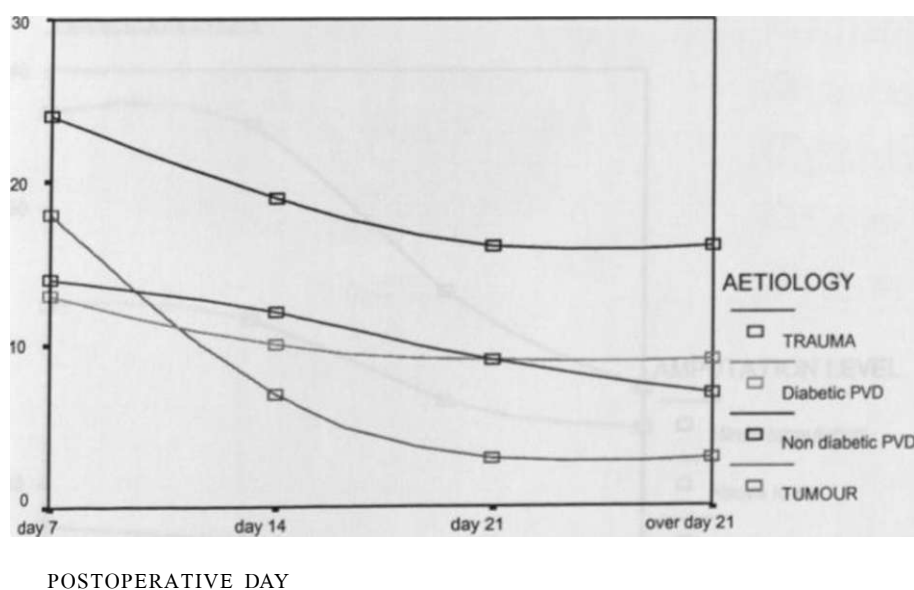
One patient underwent AKA due to infection.

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TABLE 13: DURATION OF WOUND HEALING ACCORDING TO THE AETIOLOGY

AETIOLOGY	Number of patients as per duration of postoperative wound healing (in days)				Total no. of patients. (n)	Percentage of the total of wounds not healed after 21 days($X \times 100/n$)
	7th day	14th day	21st day	More than 21st day (X).		
Trauma	2	3	2	7	14	50
Diabetic PVD	0	3	1	9	13	69
Non- diabetic PVD	0	5	3	16	24	67
Tumours	0	11	4	3	18	17

FIGURE 12: PATTERN OF WOUND HEALING ACCORDING TO THE AETIOLOGY



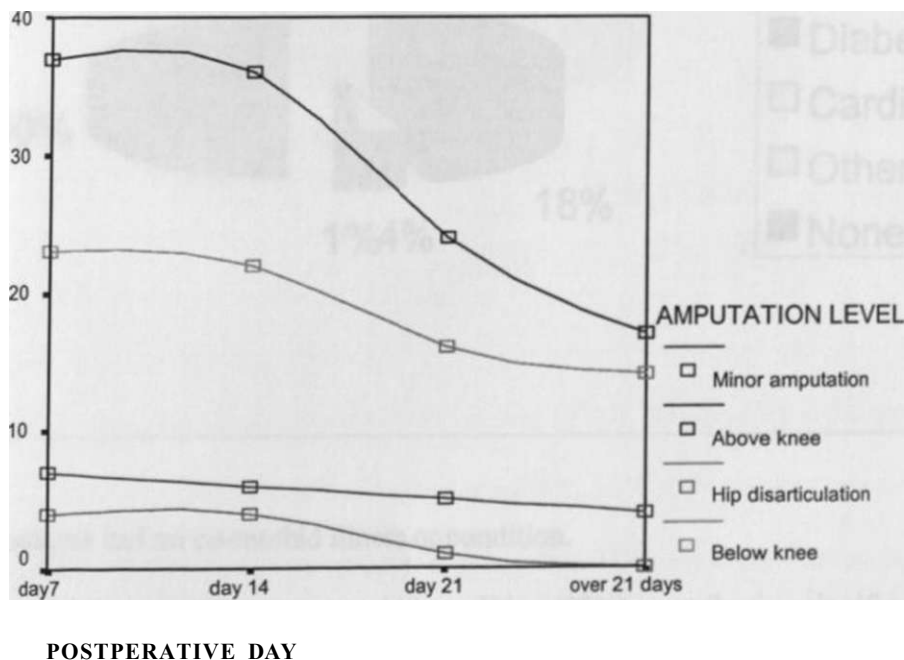
Key: PVD- Peripheral vascular disease

Majority (67-69%) of the wounds had not healed by the twenty-first postoperative day following amputation for peripheral vascular disease. Only 17% had not healed for neoplastic causes and 50% following traumatic amputations at the same point in time.

TABLE 14: DURATION OF WOUND HEALING AS ACCORDING TO THE AMPUTATION LEVEL

LEVEL	Number of patients as per duration of postoperative wound healing (in days)				Total no. of patients, (n)	Percentage of the total of wounds not healed after 21 days($X \times 100/n$)
	7th day	14th day	21st day	More than 21st day (X).		
Below knee	1	6	2	14	23	61
Above knee	0	12	6	18	36	50
Minor amputation	1	1	1	4	7	57
Hip disarticulation	0	3	1	0	4	0

FIGURE 13: PATTERN OF WOUND HEALING ACCORDING TO THE LEVEL OF AMPUTATION

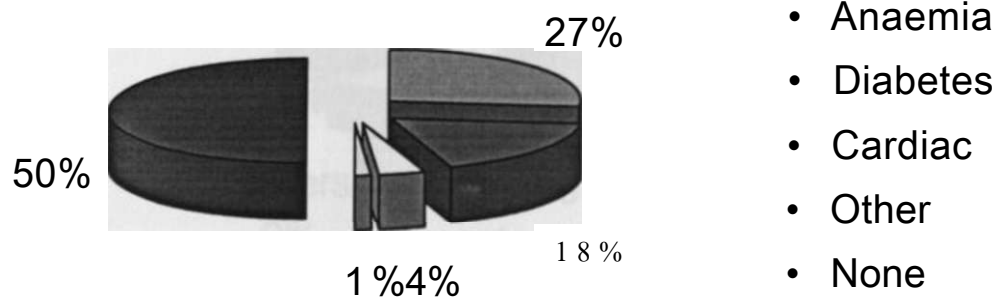


Below knee amputation stumps took the longest time to heal, as sixty one percent of the wounds had not healed by the twenty-first postoperative day. Half the number of stumps had healed following both above knee and minor amputations, 50% and 57% respectively by the same time. Seven amputation stumps were not assessed because the patients died before the wounds healed and before the twenty-first postoperative day.

TABLE 15: INCIDENCE OF CO-MORBID CONDITIONS IN PATIENTS UNDERGOING AMPUTATIONS

DISEASE/CONDITION	NO. OF PATIENTS	PERCENTAGE (n=74)
Anaemia	20	27
Diabetes	13	18
Cardiac	3	4
Other	1	1
None	37	50

FIGURE 14: INCIDENCE OF CO-MORBID CONDITIONS IN PATIENTS UNDERGOING AMPUTATION



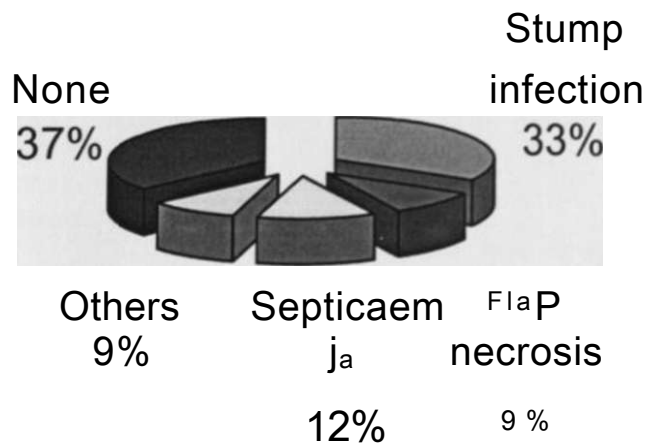
Half the patients had no co-morbid illness or condition.

Anaemia was the most common co-morbid condition (27%), contributing significantly towards the prolongation of the preoperative in-hospital stay ($p= 0.005$).

Thirteen patients (18%) had underlying diabetes, while cardiac conditions in 4%. None had ischaemic heart disease.

TABLE 16: INCIDENCE OF COMPLICATIONS.

COMPLICATION	NO. OF PATIENTS	PERCENTAGE (n=75)
Stump infection	25	34
Flap necrosis	7	9
Septicaemia	9	12
Others	7	9
None	27	36
Mortality	12	16 (n=74)

FIGURE 15: INCIDENCE OF COMPLICATIONS

Stump infection was the most common complication (33%), followed by septicaemia (12%). All the patients who developed septicaemia died; half of them had flap necrosis. Other complications included contractures, bone erosion of stump and phantom pain (9%). The overall mortality for the duration the patients were followed-up was 16%. Ten patients (13.5%) died within thirty postoperative days after BKA and AKA in equal proportions.

TABLE 17: CONVERSION TO A HIGHER LEVEL OF AMPUTATION

LEVEL CONVERSION	NO. OF STUMPS CONVERTED	STUMPS AMPUTATED AT PRECEDING LEVEL (n)	PERCENTAGE (%)
FOOT TO BKA	3	7	43
BKA TO AKA	5	24	21

All patients who required stump conversions had peripheral vascular disease. A total of 8 patients (12.9% n=62) had conversions. The rate of conversion was highest at foot level with 43% (n=7) being converted to BKA. Twenty-one percent were converted from BKA to AKA.

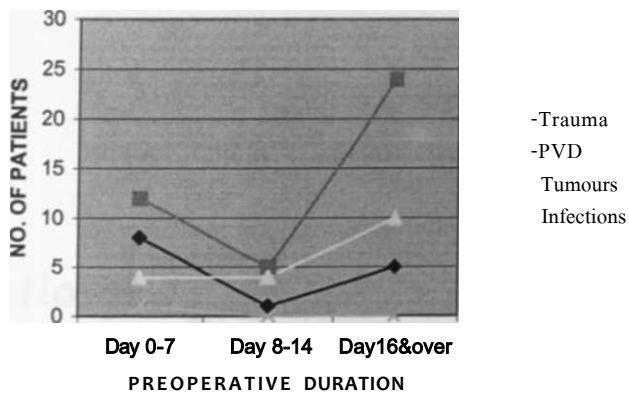
TABLE 18: REVISION SURGERY OF CLOSED MAJOR AMPUTATIONS

LEVEL OF AMPUTATION	NO. OF STUMPS (n=no. of closed amputations as per the level)	PERCENTAGE
BELOW KNEE	2 (n=18)	11
ABOVE KNEE	8 (n=35)	23
TOTAL	10	

A total of 59 closed amputations were done, 5 for minor amputations and 4 for hip disarticulation. Ten of the stumps that required revision were after a major amputation. Eleven percent of BKA required revision compared to 23% of AKA.

TABLE 19: PRE-OPERATIVE DURATION ACCORDING TO AETIOLOGY

AETIOLOGY	NO. OF PATIENTS AMPUTATED /days after admission		
	Day 0-7	Day 8-14	Day 16 & over
Trauma	8	1	5
PVD	12	5	24
Tumours	4	4	10
Infections	1	0	0

FIGURE 16: PRE-OPERATIVE DURATION ACCORDING TO AETIOLOGY

KEY: PVD. Peripheral vascular diseases.

Patients with PVD stayed the longest while awaiting amputation.

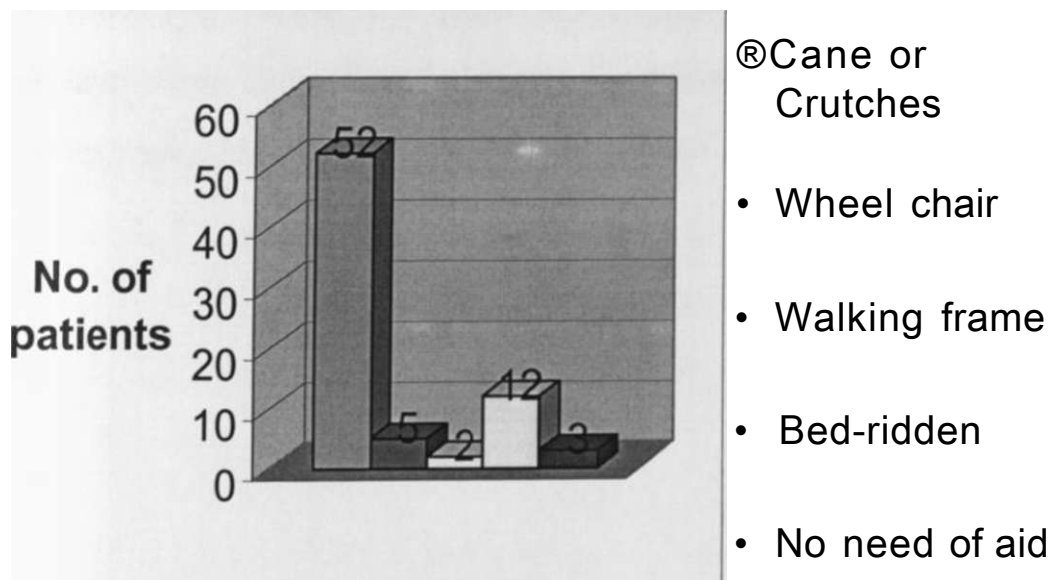
TABLE 20: NUMBER OF PHYSIOTHERAPY SESSIONS OFFERED TO PATIENTS IN A WEEK

NO. OF SESSIONS PER WEEK	NO. OF PATIENTS	PERCENTAGE (n=74)
None	11	15
Less than 7	62	84
Equal or more than 7	1	1

Most of the patients had in-patient physiotherapy sessions (85%) despite majority not getting the sessions on a daily basis. One patient among those who did not get the services died hours after surgery before physiotherapy could commence while 9 patients had undergone minor amputations.

TABLE 21: MOBILITY AIDS AS AT SIX WEEKS POST-OPERATIVE

WALKING AID	NO. OF PATIENTS	PERCENTAGE (n=74)
Cane or Crutches	52	70
Wheel chair	5	7
Walking frame	2	3
Bed-ridden	12	16
No need of aid	3	4

FIGURE 17: MOBILITY AID AS AT SIX WEEKS POST-OPERATIVE

Majority (70%) of the patients were ambulating using crutches by six weeks postoperative. Two patients were using a walking frame despite minor amputations as they were still on the wards and had not secured canes. Of the 12 patients that were bed-ridden, 6 had undergone AKA (two were bilateral). One patient who was wheel chair-bound had bilateral AKA.

TABLE 22: READINESS FOR PROSTHETIC USE AS AT SIX WEEKS POST-OPERATIVE

LEVEL OF AMPUTATION	RESPONSE		TOTAL NO. OF PATIENTS	PERCENTAGE OF READY PATIENTS FOR THE LEVEL
	YES	NO		
Below knee	10	17	27	37
Above knee	22	12	34	65
TOTAL	32	29	61	

Overall, fifty two percent (n=61) of the patients who underwent a major amputation were ready for prosthesis use by six weeks postoperative. While 65% of those undergoing AKA were ready, only 37% of those after BKA were ready.

DISCUSSION

A total of 74 patients were recruited into the study. There were 46 males and 28 females accounting for 62% and 38% respectively.

The study found the age distribution to be bimodal; one peak in the 31 -45 years and the other in the 'over 60 years' age classes. This distribution is more or less similar to that reported by Mbindyo⁵ in a local previous study who found a teenage peak due mainly to trauma and osteogenic sarcoma and '50 years and above' due to vascular disease. In this study however, PVD contributes significantly to the peak in 31 -45 years age class.

At a mean age of 44.4 years at operation, patients in this study are quite young compared to other series,^{5,8-59,60,62} because a significant proportion of amputations due to tumours and trauma are carried out on young patients.

Most of the patients had primary education and below and were either unemployed or self-employed in the informal sector. They therefore, could not afford to pay for the cost of investigations for amputation level assessment in PVD. This either prolonged the pre-operative duration while waiting for decision on amputation, or increased the number of patients amputated on clinical level assessment alone. The end result was a prolonged hospital stay (29.3 days in this study).

PVD whether diabetic or non-diabetic was the main indication for LLA as in the other series.^{58,59,60,61,62,69,70,71} This is however different from previous studies in the loco-regional setting,⁵¹⁰ where tumours were the main indication for LLA. This may be attributed to the rise in diabetic-related complications requiring amputations⁶ and probably an increase in the number of patients with PVD referred by lower level hospitals to the KNH Thoracic and Cardiovascular surgical unit for limb salvage surgery or for special radiological studies, but end up being amputated in the KNH.

This study found an overall AKA:BKA ratio of 1.75:1 unlike the reported 1:1 in the other major series/^{8'59'70,71} There was a relatively higher proportion of AKA than BKA performed due to trauma and tumours, which explains the difference. However, when you consider that most reports are based on vascular amputations alone, this study had a similar ratio as 47.5% and 45.3% of PVD amputations were BKA and AKA respectively.

Half the patients had no co-morbid conditions. Anaemia, followed by diabetes, was the most common co-morbid condition. Cardiac disease was rare unlike in other reports.^{58,59,61,70} maybe due to the relatively young age and the low socio-economic status of the patients in this study. The high prevalence of anaemia in the pre-operative period considering that far much fewer patients had traumatic amputations suggests other factors other than blood loss to be responsible. This study did not evaluate the aetiology or degree of anaemia. However, determining the causes of anaemia and how to prevent or treat them early will reduce the hospital stay, as anaemia significantly increased the pre-operative duration in this study (p=0.005).

The healing rate of BKA was significantly less than for AKA ($p=0.036$), with a 21% rate of eventual conversion of BKA to AKA, in accord with published series.^{6,43,58,62}

The study noted a relatively high proportion of patients with minor amputations (43%), who required conversion to BKA. All the patients who underwent minor amputations that required conversion in this study had PVD. It may therefore be that delays in performing arteriography for amputation level determination made surgeons carry out amputations on clinical assessment alone in situations where BKA would have been ideal..

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The most common complication was stump infection (33%), a rate much higher than in other series.^{6,58,62} In this study, majority of the patients were not administered with surgical antibiotic prophylaxis (77%). This and other un-investigated hospital-based factors such as delays in scheduling operations due to shortage of theatre space, congestion on general wards and irregular wound dressing habits could be the reason for this high rates of sepsis. This high rate of sepsis further explains the reason why the study found a higher proportion of revisions in AKA than BKA unlike other studies,^{58,61,62} as more AKA were performed compared to BKA.

The overall mortality for the duration the patients were followed up was 16%, with a thirty-day postoperative mortality rate of 13.5% which is similar to that in other studies.^{58,59,61,62} Unlike in these studies where death is usually related to acute cardiac events, majority of the patients died from septicaemia also in keeping with high sepsis rates.

Majority of the patients (70%), were ambulating using crutches at six weeks after surgery despite irregular physiotherapy sessions and poor rehabilitation protocol. The younger age at amputation could explain the higher rate of ambulation compared to other studies.^{58,70} None of the patients wore a prosthesis during the study period mainly due to the cost of securing prostheses. Majority of the patients are lost to follow-up therefore, long-term rehabilitation is not carried out or is there a laid-down program for the same.

CONCLUSIONS

1. Peripheral vascular disease is the main indication for lower limb amputations in the KNH.
2. One of the most affected age class (31 -45 years) comprises people in the economic prime age.
3. Majority of the patients undergoing LLA at the KNH have primary school education and below and are unemployed.
4. Diabetes mellitus and anaemia are the most common co-morbid conditions in patients undergoing LLA at the KNH.
5. The pre-operative in-hospital duration is long due to delays in pre-operative assessment for level of amputation in patients with PVD..
6. Stump infection is the most common postoperative complication.
7. Majority of the patients are able to ambulate outdoors despite lack of established rehabilitation programs and availability of prostheses.

RECOMMENDATIONS

LLA are costly to the nation and are associated with high morbidity and mortality.

In the Kenyatta National Hospital, the following recommendations will help in improving the outcome of patients undergoing LLA.

1. Health education to patients attending clinics and the Accident and Emergency department on the risk factors for amputation.
2. Expand the Thoracic and Cardiovascular unit of the hospital with full support of diabetologists, cardiologists and physiotherapists for better management and rehabilitation of patients with PVD.
3. Increase the number or utility of operating theatres to help reduce pre-operative waiting time.
4. Encouraging the use of Duplex ultrasonography in amputation level determination especially in patients already with gangrene, will reduce the waiting time and provide more space for arteriography to be used in evaluating especially patients requiring revascularisation procedures to save limbs from amputation.
5. Equip laboratories to facilitate constant availability of tests that identify and help manage known risks such diabetes, cardiac, renal and liver disease.

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APPENDIX 1.

QUESTIONNAIRE

Patient's name: Age ()

series

IP No

Date of admission:

Date of discharge:

Date of operation:



1. Age group (in years)

a) <15

b) 15-30

c) 31-45

d) 46-60

e) >60

W

2. Sex

a) Male

b) Female

3. Education level

a) Illiterate

b) Primary

c) Secondary

d) Tertiary_

O

4. Employment status

a) Not employed

b) Self employed

c) Employed by other

d) Retired

O

5. Co-morbid medical illness

a) Cardiac

b) Respiratory

c) Neuropsychiatry

d) Diabetes

e) Anaemia

f) None

Blood tests

- a) White cell count (TLC)
- b) Liver function tests (albumin levels)
- c) Urea & Electrolytes
- d) Random blood sugar
- e) P24 Elisa
- 0 Lipid profile
- g) None

Radiological tests

- a). Doppler ultrasonography of the limb
- b). Chest X-ray
- c). Arteriography

Indication of amputation

- a) Trauma
 - (i). RTA
 - (ii). Industrial accident .
 - (iii). Bums
 - (iv). Assault
 - (v). Other
 - b) Peripheral vascular disease
 - (i). Diabetic
 - (ii). Non diabetic
 - c) Neoplastic
 - (i) Skin
 - (ii) Bone
 - (iii) Other
 - d) Infection
 - (i) Soft tissue
 - (ii) Bone
 - e) Congenital
- Category

Surgical prophylaxis

- a) Yes
- b) No

Level of amputation	
(i). Toe	
(ii). Transmetatarsal	
(iii). Transtarsal	
(iv). BKA	O
(v). AKA	w
(vi). Hip disarticulation	
Technique of amputation	
a) Open	^
b) Closed	(J)
Pre-operative physiotherapy	
a) Yes	
b) No	
Duration taken for wound to heal	0
a) By day 7	
b) 7 to 14 days	
c) 14 to 21 days	
d) >21 days	0
Day post-operative physiotherapy was started	
a) Day 2	
b) After day 2, but before day 7	
c) After day 7 post-operative	0
Number of physiotherapy sessions in a week	
a) None	
b) <7	
c) 7	
d) >7	O

16. Complications

a) None

b) Systemic

- i). Cardiac
- ii). Pulmonary
- iii). Neuropsychiatry Category
- iv). Anaemia
- v). Septicaemia

c) Local

- i). Phantom pain
- ii). Stump infection
- iii). Flap necrosis
- iv). Significant contracture Category
- v). Bone erosion/stump ulcer
- vi). Adherent scar
- vii). Stump neuroma
- viii). Stump bulbosity/ 'dog ears'

d) Death

17. Method of mobility

- a). Wheel chair
- b). Walking frame
- c). Crutches/ Cane
- d). Bedridden
- e). Not applicable

18. Is the patient ready to use a prosthesis by six weeks?

- a). Yes
- b). No

19. Revision surgery

- a). None
- b). Foot o BKA
- c). BKA to AKA



20. Conversion

- a). None
- b). Refashioning
- c). Skin graft or flap

APPENDIX 2

**CONSENT BY THE PARTICIPATING PATIENT
(English)***

I have understood the explanation by Dr. Awori K.O, who is carrying out a study on lower limb amputations, and hereby give consent to participate in the study.

I agree to participate in the study on my own free will and also to do the following:

- > Be interviewed concerning my illness and subsequent amputation and the answers to be recorded by Dr. Awori.
- > To be examined physically.

I have understood that my participation is completely voluntary, and that I can withdraw my consent at any point of the study, and that such act will not affect my treatment in any way.

That the information I give will be treated with utmost confidence and that my name will not be included in the results

PARTICIPANT'S NAME
(OR GUARDIAN/PARENT/CONSULTANT)

Signature/thumb print

WITNESS

Signature/thumb print

INVESTIGATOR
DR. KIRSTEEN ONDIKO A WORU

Signature

* There was a Kiswahili version for patient who did not understand English

APPENDIX 3



KENYATTA NATIONAL HOSPITAL

Hospital Road along Ngong Rd
P.O. Box 20723, Nairobi*

Telephone: 726300-9

Fax: 725272

Telegrams: MEDSUP- Nairobi

Website: www.knh.ac.ke

Rcf: KNH-ERC/01/1866

Date: 25 June 2003

Dr K Ondiko Awoti
Dept of Surgery
Faculty of Medicine

Dear Dr. Ondiko,

RESEARCH PROPOSAL "ASSESSMENT OF THE OUTCOME OF LOWER LIMB
AMPUTATIONS AS SEEN IN KENYATTA NATIONAL HOSPITAL" (P53/5/2Q03)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and approved your above cited research proposal.

On behalf of the Committee I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of a database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF. A. N. G. DANTAI
SKCHH I ARV. KNH-ERC

Cc Prof KM Hatt. Chairperson, KNH-CRC
The Deputy Director (C/S), KNH
The Dean, Faculty of Medicine, UON
The Chairman, Dept of Surgery, UON
CMRO
Supervisor Prof J. F. O. Ating'a. Dept. of Orthopaedic Surgery, UON